

Lavender

Contents: A demonstration of the steam distillation of lavender with reading, questions, data analysis and an outline of the history of a commercial enterprise.

Time: 1 double period and homework.

Intended use: GCSE Chemistry, Biology and Science courses. Links with work on distillation, emulsions, industrial processes, molecular structure and plant breeding.

Aims:

- To revise and complement work on distillation and separation techniques
- To describe an application of selective plant breeding and plant propagation
- To develop an awareness of the scale of industrial processes compared to laboratory operations
- To develop an awareness of the timescale involved in setting up a new business
- To provide opportunities to practise skills of reading, comprehension, and the interpretation of data and chemical symbols.

Requirements: Students' worksheets No.1004 including copies of the diagram sheet which may be cut up. The requirements for the teacher demonstration are given below. It may also be useful to have a set of molecular models available.

Author: Malcolm Walker

Suggested use

This is an interdisciplinary unit which can be adapted for use with the whole GCSE ability range. Pages 1 and 2 have more links with chemistry. Page 3 relates to the study of plant reproduction in biology while page 4 describes the historical background to the development of the commercial enterprise. The diagram sheet is for use with the teacher demonstration and with questions 6 to 10.

Teacher demonstration of the steam distillation of lavender

Requirements

steam generator with safety tube and delivery tube
250 cm³ round-bottomed flask, fitted with bung and delivery tubes
condenser with bung and delivery tube
2 short lengths of connecting tubing
measuring cylinder, 25 cm³
burner, tripod and mat
3 stands with bosses and clamps
microscope and slide
scissors
lavender (see step A)
access to a sink

Procedure

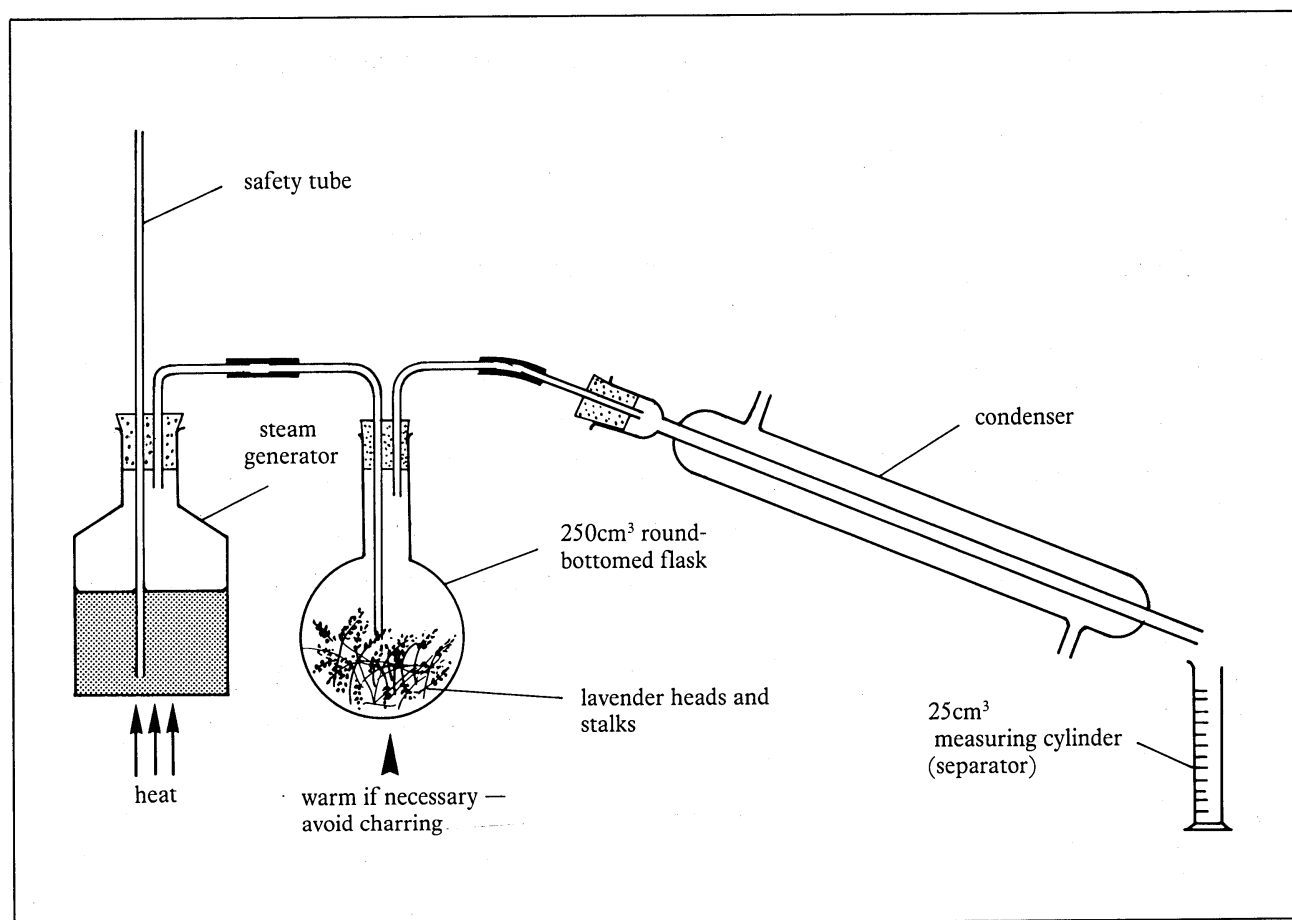


Figure 1 Apparatus for steam distillation

Step A Harvest the blooms and stalks of lavender in July. Immediately hang the bunches to dry for 2 to 3 days (for example, in the prep. room). The dry blooms will keep well. In industry the lavender is **not** dried before steam distillation.

Step B Chop 5 to 10 of the heads into a 250 cm³ round-bottomed flask.

Step C Set up the apparatus shown in Figure 1. Steam distil. It may be necessary to warm the flask containing the blooms if too much water begins to condense. This has to be done carefully to avoid charring. Discuss this with the students to help them with question 1.

Distillation will produce a cloudy distillate in the measuring cylinder which acts as the separator. The watery emulsion has a very distinctive odour. There will not be enough oil to form a separate layer. The commercial process uses 0.25 tonnes of blooms at a time.

Step D Examine a drop of the distillate with a microscope. Droplets of lavender oil will be visible. Allow time for the students to smell the oil and examine it.

Notes on some of the questions

Q.1 The steam carries the perfume molecules with it. Distillation on its own would cause charring and decomposition of the perfume molecules.

Q.2 This is a safety tube. It prevents a build-up of pressure if the apparatus becomes blocked.

Q.3 Newquay

Q.4 Norwich and Sheffield

Q.5 The Norwich area is the best of those in the table with high average hours of sunshine, low rainfall, and high average temperatures. The soil is alkaline. Lavender will also grow elsewhere.

Q.6–10 These questions are for students studying the theory of chemistry to a relatively high level. The questions show that the rules for bonding in more complex carbon compounds are similar to those in simpler substances. It may help to show students molecular models of the compounds.

Q.6 Carbon, hydrogen and oxygen

Q.7 Linalool, $C_8H_{14}O$; linalyl acetate, $C_{12}H_{20}O_2$

Q.8 C — 4 bonds, H — 1 bond, O — 2 bonds in both the perfume molecules and the simple molecules.

Q.10 The orange colour disappears as bromine adds to the double bond.

The compounds in lavender oil can be compared with some of the compounds which give rose oil its odour (see Figure 2).

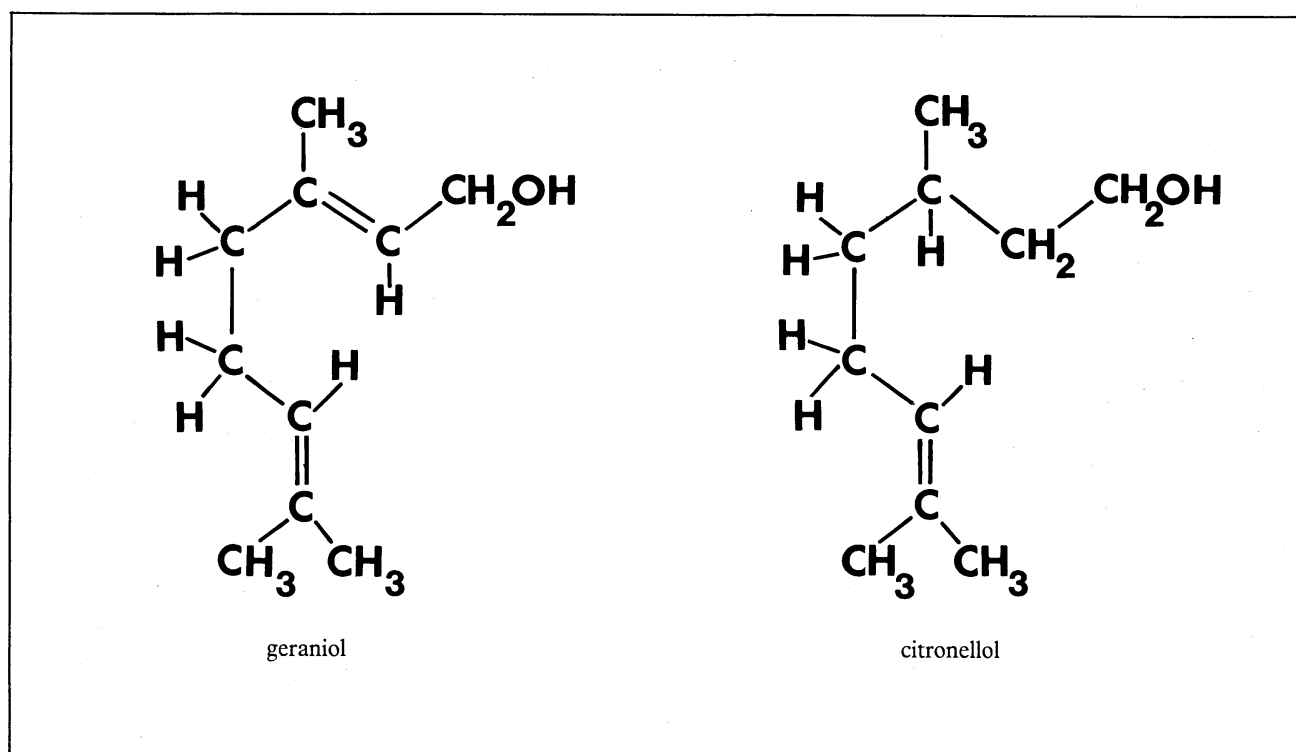


Figure 2 Molecules in rose oil

Q.11 Sexual reproduction allows variation and the production of hybrids. Vegetative reproduction produces identical plants.

Q.12 Five thousand bushes are needed to plant an acre of lavender. The information in the unit suggests that it might take as little as ten years to get a new oil to market once a suitable bush has been identified. In fact it would be unusual to get a large field full-bearing in less than twenty years.

Q.13 In France there were people with experience of distilling perfumes. Other French people had expertise in the use of copper stills for making brandy.

Q.14 Cross-channel trade was cut off during the Second World War. English perfumers continued to export to the USA.

Q.15 Twenty-one years

Norfolk Lavender supply their oil exclusively to Yardley.

Possible extension work

- 1 The use of steam distillation to extract perfumes from plant materials makes an excellent open-ended investigation. Possible ideas:
 - Try other plant materials such as lemon peel, orange peel and apples.
 - Carry out 'market research' on student/staff preference for perfumes.
 - Study the stability of the perfumes with time. (**Care!** Watch for bacterial growth.)
- 2 Study topics based on library reading including subjects such as the development of synthetic perfumes (see the article in *Chemistry in Britain* listed under Further Resources).
- 3 A short play to enact the setting up of the lavender business. This might take the form of an argument between Linn Chilvers, 'Ginger' Dugate and two other local farmers as they discuss the merits of using farm land to grow lavender commercially. This can be based on page 4 of the unit.

Further resources

Norfolk Lavender Ltd, Caley Mill, Heacham, King's Lynn, Norfolk, PE31 7JE will provide further information about the lavender industry.

Ingasetter Ltd, Fragrance of Scotland, Royal Deeside, Banchory, Scotland, AB3 3YR. This company will loan a 10-minute film of the process.

Andrews, B. 'The chemistry and art of perfumery', *Chemistry in Britain*, Dec.1982, page 864.

Festing, Sally. *The Story of Lavender*, London Borough of Sutton Libraries and Arts Services, 1982.

LAVENDER

Our noses are insensitive compared to the noses of other animals such as dogs. Yet we can distinguish as many as 10 000 different odours. One of the most memorable is the smell of lavender.

Lavender grows well on the coast of the Mediterranean and was chosen by the Romans to scent their baths. Today, lavender is used in perfumes, soaps, talcs, bath cubes, bubble baths, hand lotions, after-shaves and midge repellants.

In this unit you will be shown how to get the perfume from the flowers and stalks of lavender. You will also read about the growth of the only successful lavender business in England.

How is a perfume extracted from lavender flowers?

You may be shown a demonstration of the method used to extract the perfume from the flowers. The technique used is called **steam distillation**. The diagram sheet shows the pieces of apparatus used for the distillation.

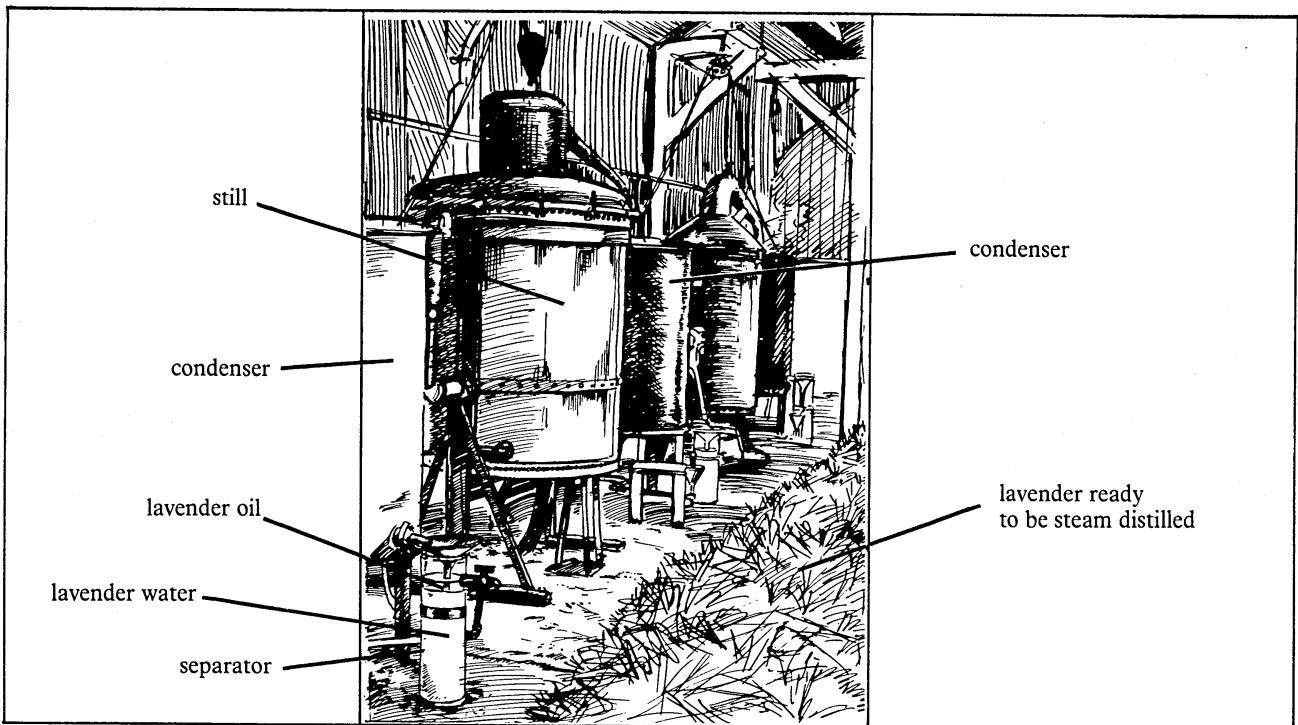


Figure 1 Commercial equipment for steam distillation

Produce a diagram of the steam distillation apparatus.

You can do this by cutting up the diagram sheet and sticking the parts together as in the demonstration. Or you can use the diagram sheet to help you prepare your own diagram.

Label your diagram using the captions on the diagram sheet. You can cut out the captions and stick them in place, or you can copy them.

You may be shown what the lavender water looks like when seen through a microscope. If so draw a diagram of what you see.

Now answer questions 1 and 2.

Where will lavender grow well?

Lavender grows well in sunny positions on light, well drained soils which are alkaline.

Look at the table below, then answer questions 3 to 5.

Town	Average daily sunshine/hours	Annual rainfall/inches	Average monthly temperature/°C	Soil type
Blackpool	4.1	35	9.6	wet, pH 6
Durham	3.6	26	8.7	dry, pH 7 - 7.5
Newquay	4.5	34	10.7	wet, pH 5.5
Norwich	4.3	26	9.9	dry, pH 8
Sheffield	3.4	32	9.6	wet, pH 7.5 - 8

Which molecules give the perfume its smell?

The diagram sheet shows you the structures of two of the chemicals which give lavender its smell. **Cut out the diagrams and stick them in your notes.** Then answer questions 6 to 10.

Questions

(Your observations during the steam distillation may help you with your answers)

- 1 Why is steam distillation used to extract the perfume from lavender? What would happen if the lavender was simply distilled on its own?
- 2 What is the purpose of the straight glass tube in the bung of the steam generator?

Questions

- 3 Which town has the most sunshine on average?
- 4 Which town has the most alkaline soil?
- 5 Which town seems to have the best conditions for growing lavender?

Questions

- 6 Which three chemical elements are combined in linalool and linalyl acetate?
- 7 Write the molecular formulas of the two compounds in the form $C_xH_yO_z$. Replace the x , y and z by the correct numbers.
- 8 (a) How many bonds are formed by a carbon atom, a hydrogen atom and an oxygen atom in the molecules?
(b) How do your answers to part (a) compare with the numbers of bonds formed by the same atoms in simpler molecules such as water and methane?
- 9 Draw one diagram to show the parts of the linalool and linalyl acetate molecules which are the same in both molecules.
- 10 What would you expect to see happen if you shook some linalool with a solution of bromine?

How is a good variety of lavender found?

There are two main types of lavender. Cross-breeding can produce many hybrids. The cultivated varieties are hybrids of *Lavendula angustifolia*. *Lavendula angustifolia* is resistant to diseases. It grows wild in France.

Once a suitable variety has been developed it can still take a long time before it can be used to produce perfumes on a large scale. These are the stages:

- 1 Select a bush for tests.
- 2 Steam distil the flowers from that bush alone.
- 3 Measure the amount of oil produced, analyse it and test the quality of the perfume.
- 4 If the test results are favourable, take *cuttings* from the plant in October. Plant out the cuttings to produce new bushes.
- 5 Five years later, if the bushes have grown to a suitable size, take samples of flowers from the bushes. Distil the samples and test the perfume.
- 6 If the results are still good, take a large number of cuttings from the bushes and plant a field.
- 7 Five years later the field may be full-bearing.

Answer questions 11 and 12.

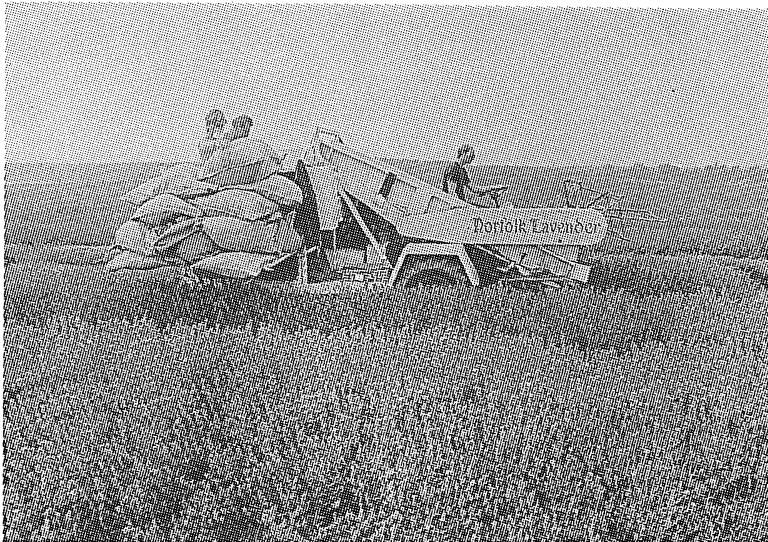


Figure 2 Harvesting the lavender

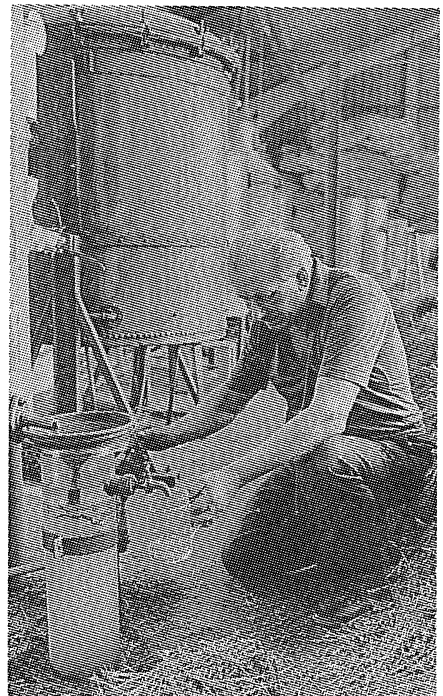


Figure 3 Drawing off the distilled lavender oil

Questions

11 Plant breeders use two different methods to produce lavender bushes.

(a) Hybrid plants are developed by using the pollen from one type of lavender to fertilize a different variety.

(b) Bushes of a chosen hybrid are reproduced by taking cuttings.

Why are two methods of producing new plants used?

12 How long does it take to get to large-scale production once a good new hybrid has been found?

How did a lavender business start in England?

1932

On April 26th, 'Francis Edwin Dugate of Fring Hall near Docking in the County of Norfolk, Esquire, and Linnaeus Chilvers of Hunstanton in the same county, Nurseryman' agreed to form a partnership. They decided to produce lavender oil for commercial purposes. 'Ginger' Dugate provided 6 acres of land and Linn Chilvers provided 33 000 rooted lavender cuttings at £10 per 1000.

At that time Linn Chilvers owned a small market garden nursery. He had started to grow lavender successfully and realised its great commercial possibilities. He needed a large acreage to make a business out of growing lavender. Some local farmers were reluctant to grow lavender. They believed (wrongly) that lavender reduces the fertility of the soil. However, Linn Chilvers was able to persuade 'Ginger' Dugate, a local sportsman and landowner, to join him.

1936

The directors of a famous perfume company gave encouragement to the new business. Traditional copper stills were bought from France, to distil the lavender oil.

Mr Horace Avery, a Leicester chemist, was visiting the Norfolk coast. He bought a bunch of lavender and then took an interest in the business. He knew about perfumery and was able to give Linn Chilvers a secret, eighteenth-century formula for lavender perfume.

1939 - 1945

The production of lavender oil increased to supply an English perfumer whose supplies from France were cut off.

1941

The partnership was named 'Norfolk Lavender Ltd'.

1953

Linn Chilvers died followed shortly by 'Ginger' Dugate. The company was continued by the Head family.

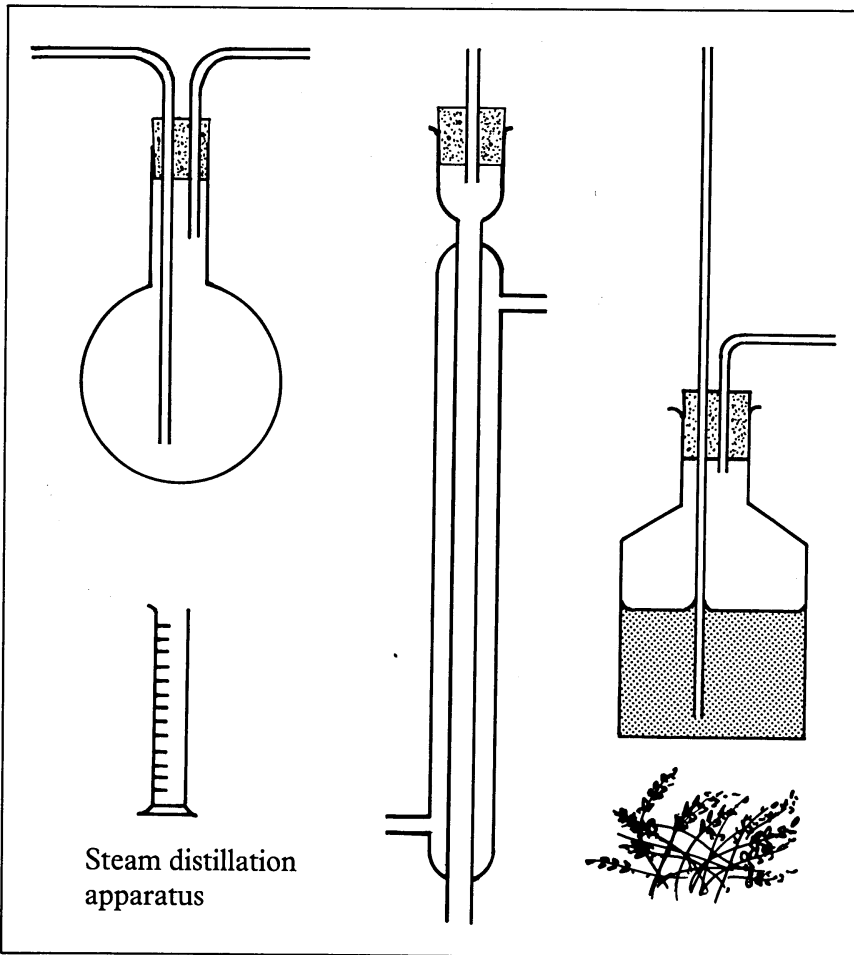
1984

Henry Head, the company's Managing Director, told *The King's Lynn Trader*: 'We hope to expand the market for the product especially to the United States.'

Answer questions 13 to 15.

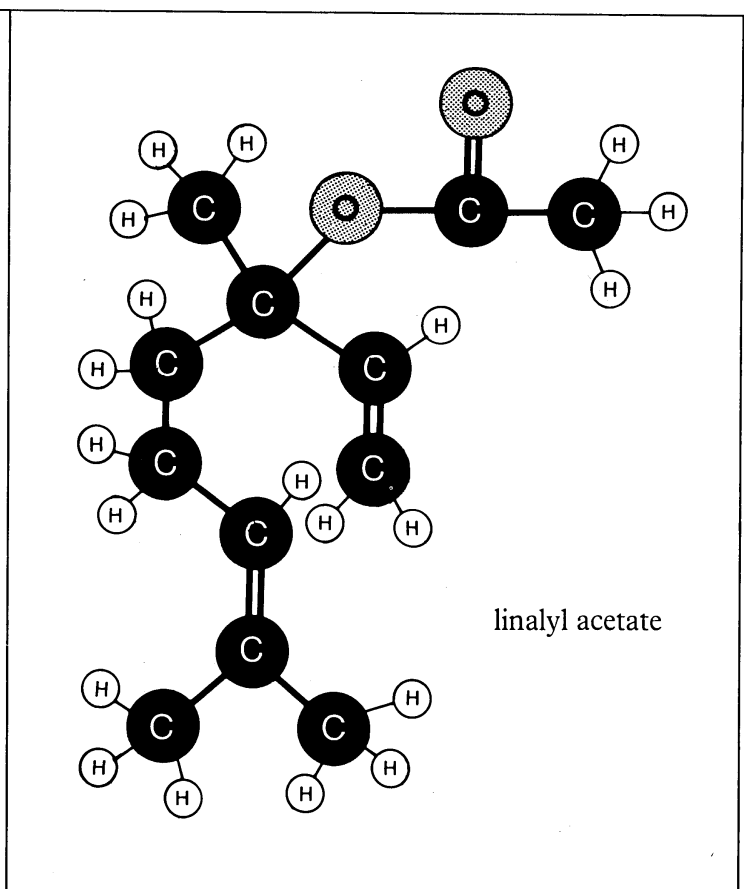
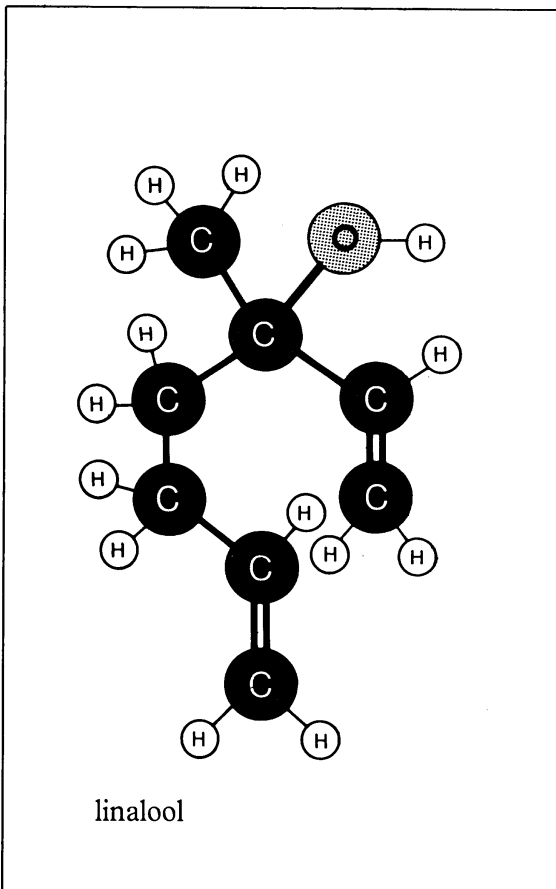
Questions

- 13 *Why do you think that the copper stills were imported from France?*
- 14 *Why were English perfumers cut off from French supplies in the years 1939-45?*
- 15 *For how long did the partnership between Linn Chilvers and 'Ginger' Dugate last?*



Labels for diagram

- still
- condenser
- heat
- steam generator
- water to make steam
- lavender heads
- water in
- water out
- lavender water
- collector and separator



Mental Illness

Contents: Reading, questions and discussion on the nature and treatment of mental illness and people's attitudes to it.

Time: 1 to 2 periods depending on the amount of discussion.

Intended use: GCSE Biology, Human Biology and Science courses. Links with work on the brain and mental health.

Aims:

- To complement course work about the brain and mental disorders
- To give students an awareness of the two main types of mental health problem
- To bring into the open for discussion some of the prejudice which may exist in the minds of the students
- To give students some awareness of the ways in which mental illness can be treated
- To develop awareness of some of the social problems involved in the care of the mentally ill
- To provide an opportunity for discussion of a topic which requires emotional feelings to be balanced against medical and economic issues.

Requirements: Students' worksheets No.1005.

Authors: Ann Fullick and Joan Solomon

This unit is about mental illness **not** mental handicap. Many people confuse the two. The distinction is not explained in the introduction to the unit because experience suggests that to put the two together in print can add to the confusion. However, teachers may choose to discuss the difference with their students, along the following lines.

Mental illness can be compared to other illnesses. We all get ill at one time or another. Some illnesses affect our minds. We generally get better either naturally or because we have been given medical treatment. Some medical treatments are intended to cure; others just make the symptoms more bearable. Some illnesses are incurable.

Mental handicap is brain damage. A person is either born with a mental handicap, or becomes handicapped as a result of a serious accident or illness. Someone who is mentally handicapped can be educated within the limits of the handicap but they can never get better.

Some children may have direct experience of mental illness or mental handicap in their families and so the discussion and questions need sensitive handling.

A suggested approach

Trials have shown that a good way to start this unit is to have a 'brainstorm' session based on the words: 'mental illness' and 'normal' (see the SATIS *General Guide for Teachers*, page 61). This can be followed by reading and discussion. The discussion of the questions is better tackled in small groups.

Most mental illness is an extreme form of what we have all experienced. Most of us know what it is like to feel so depressed that we look for a refuge from noise and responsibilities where we can recover our peace of mind. It is valuable to remember that the meaning of 'asylum' is just that — a refuge for the distressed (see discussion question 8).

Unfortunately many people have a grotesque idea of what a mental hospital or asylum is like, which may be due to having seen old prints of half naked lunatics in strait-jackets. Most modern hospitals have psychiatric wards which are quite pleasant places, where patients wear their normal clothes and move around, go to group or occupational therapy sessions, and watch television.

Older students may find themselves asked by a doctor if they are willing to visit a close friend or relative in such a ward since such visits help the patients to recover. Discussion of the ideas in this unit may help them to approach such a visit with less prejudice and more understanding.

Another common misconception is that a mild loss of memory for recent events in the old is senile dementia or Alzheimer's disease. It is neither. All of us have experienced moments when we cannot recall a name or word, and as we get older this may get worse. Ask students to compare the accurate and often vivid memories the old have of the events in their youth and they will see that it is the process by which new information is committed to memory — rather than memory recall — which has been slowed down by ageing.

ECT (electro-convulsive therapy commonly called 'shock treatment') is not mentioned in the text. It is rarely used now, and then only for severe psychotic illness which has not responded to drug treatment.

The policy of the NHS in recent years has been to close down the large mental hospitals and to have patients live in special houses in the community. This is a controversial policy among psychiatrists as well as among members of the public. It may make a good subject for discussion.

Further resources

The SATIS unit No. 806, *Stress*, provides an alternative and simpler approach to some of the problems discussed in this unit.

Leaflets and booklets from MIND, the National Association for Mental Health, 22 Harley Street, London W1N 2ED

Acknowledgements Text: extracts are reproduced by permission from John Payne, *All in the Mind* (Oxford University Press in association with Chameleon/Ikon) (Extract 1a); MIND Factsheet 7, *Depression* (MIND) (Extract 1b, c); David Brandon, *Voices of Experience* (MIND) (Extract 2). Illustrations: Figure 1 based on a photograph by Tony Othen; Figure 2 supplied by the Mansell Collection.

MENTAL ILLNESS

What is mental illness?

It is easy to misunderstand what is meant by mental illness because many of us know very little about it. Anything which is different from our own idea of what is *normal* is likely to cause fear and worry. But what do we mean by *normal*?

Is it normal to be frightened of spiders?

Is it normal to talk to yourself?

Is it normal to be sad when things go wrong?

Is it normal to want to be by yourself when you feel upset?

Imagine the ups and downs of everyday life — passing exams and failing them, falling in love and being sneered at, getting a job and losing it, the death of a dearly loved friend or relative. It is natural to feel upset when something bad happens. It often spoils our concentration so that we cannot think of anything else until we 'get over it'.

Some people need help to get over their troubles. Do you ever feel nervous before an important test or exam? If so, you have some idea of what mild stress is like. People may need help when stress gets painfully acute.

Now discuss questions 1 to 3.

Who is affected?

It is estimated that at any one time 250 out of every 1000 people are experiencing some sort of mental distress. Most of these people will go and see their doctor and out of the 250 perhaps six will be admitted to hospital. This may not seem a large number but over the whole population this adds up to about 200 000 hospital admissions each year.

Read the extract about James, Jackie and John. Discuss question 4.

Extract 1

(a) James was a student in his last year at university. He was twenty-one years old. He was intelligent, but not brilliant. So he had to work hard to keep up with his Modern Languages course. He was not bad looking, quiet, enjoyed playing football, and was also interested in politics and films. Three months before his final exams, his girl-friend dropped him. His revision suffered immediately. A week later he heard that his father had to go into hospital for an operation to find out whether or not a growth was cancer.

His work stopped completely for a week. He went home, but his parents encouraged him to go back to University to get ready for his exams. He tried but was unable to concentrate. He got some pills from the medical centre but by now he was well into a state of anxiety and depression. He was beginning to think about suicide.

(b) Jackie says:

'When I walk down the street with my friend I feel there's a glass wall

Questions for discussion

- 1 The number of people attending psychiatric clinics is much greater today than it was fifty years ago. Why is this? Is it because people are less ashamed of admitting to mental health problems? Is it because we are now able to help more people than before? Is it because it is easier to reach a psychiatric clinic? Is it because there are more hardships and problems in modern living?
- 2 What are you afraid of? What upsets you? What makes you tense? Discuss this in your group and draw up a list of fears and causes of stress.
- 3 The word 'acute' is used in this unit. What is the medical meaning of the word?

Question for discussion

- 4 Have you ever felt a bit like the students James, Jackie and John? What is it about the cases of these students which most convinces you that they are mentally ill and need help?

between us. I feel I'm alone. I want to scream and shout out. I try to break the glass but it's like plastic. It bends but it does not break.'

(c) John says:

'When I am depressed I feel I'm in a dark place. I'm trying to stay in a corner, because the floor slopes away and it gets darker and darker. I'm there on my own, and at the same time it's as if I'm cut off from myself and I'm watching myself. It's a horrible feeling.'

What are the main types of mental illness?

There are two main types of mental health problems — **neurosis** and **psychosis**.

Neurosis

This is the mildest sort of mental illness. Neurotic people have similar feelings to the rest of us, so they are not hard to understand. Their feelings are exaggerated and so central to their lives that they cannot think about much else. They do not lose touch with reality and so they often feel useless and even guilty about their illness. This type of illness is sometimes called a 'nervous breakdown' but the term has no special meaning.

There are four main types of neurosis:

Depression

This usually comes on slowly and makes patients physically inactive. They are often anxious at the same time. (Very severe depression is classed as psychosis.)

Anxiety

This is the result of intense stress or suppressed anger. It may produce feelings of panic and shaking, among other symptoms.

Obsession

Sufferers feel compelled to carry out regular patterns of behaviour. A person with an obsession about not walking on the lines between paving stones may have feelings of panic if they make a mistake. *Anorexia nervosa* is an illness in which the patient does not eat enough. Sometimes a boy or girl starts dieting to slim and then cannot stop. They may become dangerously weak unless helped.

Hysteria

Extreme stress can cause loss of memory or even temporary paralysis. An example is the 'shell shock' which may affect soldiers in wartime. The symptoms of hysteria are often indirect appeals for help.

Psychosis

When someone is suffering from a psychotic illness they lose touch with reality and live in their own fantasy world. Even when someone has a neurotic illness they withdraw a little from their friends and family, but in a psychosis the withdrawal is much more complete.



Figure 1

The two main types of psychosis are:

Schizophrenia

Patients have hallucinations, hear 'voices', giggle, or talk to an invisible presence. You may have seen a schizophrenic shouting in the street. Although they sound violent and frightening, they rarely harm anyone. The illness is not well understood but it can be treated with drugs. Some patients recover completely. Others may need to take drugs continuously to keep their hallucinations under control.

Manic-depression

This produces very severe changes of mood. Sometimes patients feel deeply unhappy, guilty and unable to think clearly. At other times they may be violent, irresponsible, noisy, and apparently cheerful. Such extremes of mood can often be successfully controlled and cured by new drugs. Some creative people have been manic-depressives including Schumann, Goethe and Sylvia Plath.

What causes mental illness?

We still cannot answer that question, even though big advances in the treatment of mental illness have been made in the last twenty years.

Mental illness certainly is not catching! It seems that a tendency to develop manic-depression or schizophrenia can sometimes be inherited. It is also true that circumstances such as bereavement, divorce, unemployment and poverty can affect the mental health of members of a family.

We also know that mothers sometimes suffer mental illness after the birth of a baby. This may be due to sudden changes in the body hormones. The condition is called *post-natal depression*.

When people get very old their bodily health is likely to suffer as may their memory. This is probably due to the loss of active brain cells. Talking to elderly people you will find that it is their memory for recent events which suffers most. They can often remember events from their youth very clearly. This makes them interesting to talk to, and talking about the past is good for them too. They are not mentally ill.

Sometimes the elderly become so forgetful that they cannot look after themselves. We say that they have *senile dementia*. They may then have to go into the geriatric ward of a hospital because they need continual nursing care.

Alzheimer's disease is one form of senile dementia. It is caused by a special kind of deterioration in the structure of the brain. It may occur at an earlier age.

In or out of hospital?

People with mental illness may be treated by their family doctor at home, or may attend the out-patients department of a local hospital. They may discuss their problems with a psychiatrist — singly or in groups.

Some ill people are scared of going into a mental hospital in case it is like a 'lunatic asylum'. They fear that they may be thought mad and locked away. It is offensive to use words like 'mad' — it suggests that the patient will not recover. Remember that half of those who go into mental hospital come out cured within a month.

Quotations from hospital patients

'When I entered the ward on my first day I was faced with people in a similar position to my own. They call it "nervous breakdown", "schizophrenia", "mental disorder", and a label which I had never heard before "anorexia nervosa". We recognised one another. You are frightened... I am frightened...'

'I went in very overweight, depressed, suicidal, lost, distraught, embarrassed at where I had ended up. But, after two days I already felt better for being surrounded by people in far worse positions than myself. For the first time in two years I could talk to both staff and patients who understood me.'

'The worst part of being in hospital was the boredom. The days were routine and you lost interest in life and the outside world. Long empty days, the best feature of which was visiting time. The reassurance that people outside were still interested in you.'

'I have improved a lot since I've been here. For the first time I managed to see what kind of person I was to my wife and others. I was really frightened when I first came here because I thought I was a lunatic... mad... you know what I mean? And that I was going to be kept in here for months. But it is not like that. By talking to people and patients here I have sorted out a lot of my problems.'

'I think that the richness of my pre-injection days, even with brief outbursts of madness, is preferable to the numbed cabbage I have become.'

'One of the worst periods in hospital is when you're well and you can't convince anyone you're well. Somehow you have got to sell your sanity to the nurses and the doctor and it is very easy to fluff it.'

'Another danger which exists with hospitalisation, especially if it is prolonged, is that one becomes increasingly reluctant to tear oneself away from the security of the hospital...'

'Of course the great thing about hospital is getting out of it again.'

Extract 2



Figure 2 Wonford House, Exeter, a 'retreat for the insane' opened in 1869

The Victorians built huge mental asylums in the country far away from the patients' homes. Patients suffered because they got too little personal care and very few visits from their friends and relations. This made it less likely that they would recover. A few of these Victorian hospitals are still in use and they are a problem.

The question is what to do for those who are ill for a long time. Many of them can be given drugs or injections which control their condition so that they are not a danger to themselves or to others. It does not do them any good if they are kept in a large hospital far away from where they are known.

Mental hospitals are expensive to run, but some must remain to care for those who are acutely, or dangerously ill. In recent years many hospitals have been closed and long-stay patients have been moved out into *group homes*. Small numbers of people share houses in the local community.

This has caused much argument.

Those for group homes argue that the patients get 'in a rut' from hospital routine. In a group home they can learn to care for themselves with the help of regular visits from a nurse. This is good for them. Running group homes is cheaper for the NHS than maintaining large mental hospitals. The community should learn to help the mentally ill and not shut them up and forget about them.

Those against group homes do not like to see the mentally ill around their neighbourhood. The patients may look odd because they are ill. They may be under drugs, or have brain damage. The patients may need more care than they get in a small home so that they look shabby, untidy and unhappy. A group home may bring down the price of houses near it.

What do the patients think?

This is more difficult. They may feel frightened if they are used to life in hospital and their new neighbours are hostile, at least to begin with. In the long run the new situation and responsibilities may help them to enjoy more normal living.

What do you think?

Discuss question 5 and then go on to some of the questions 6 to 9 if you have time.

Questions for discussion

- 5 (a) *Is there a group home near you? Could you, would you, help the people living in a group home?*
(b) *What would you and your family say if there was a plan to open a new group home near to where you live?*
- 6 *Some people with mental problems talk to themselves much of the time. Should they be allowed to go to places where others like to be quiet such as places of worship or libraries?*
- 7 *Many people are ashamed of mental illness. They are embarrassed and find it very hard to come to terms with the idea of mental health problems. Suggest as many reasons as you can for this. Can these prejudices be overcome?*
- 8 *What does the word 'asylum' mean? Do you think that people who are mentally ill need 'asylum'? Why do you think that the word asylum has become unfashionable for those who have mental health problems while it is still used for political refugees?*
- 9 *What can young people do for those who have mental health problems? How do volunteers in your local community help in hospitals, residential homes and day centres?*

As Safe as Houses

Contents: A survey of the structure of a building, followed by data analysis, information and questions.

Time: 2 to 4 periods. The time required will depend on whether Parts 1 and 4 are done in school or for homework.

Intended use: GCSE Science courses. Links with the study of materials in physics and chemistry. Links with technology.

Aims:

- To complement work on the properties and uses of materials
- To create interest in the basic methods of house construction and how these are related to local resources and traditions
- To provide opportunities for making observations and interpreting data.

Requirements: Students' worksheets No.1006.

Author: Anabel Curry

This unit is in four parts. It is differentiated and teachers can select those parts which are appropriate for their students.

Part 1 Survey of a building

This has been written so that it can either be done at home or as a school-based activity. Students are encouraged to use diagrams to illustrate their notes.

Part 2 A closer look at materials for building

Part 3 Materials for window frames

These two parts are more challenging and require students to interpret numerical data.

Part 4 Houses around the world

This part includes reading and questions to set the topic of building homes in a wider context.

Part 1 Survey of a building

The advantages of loft insulation and double glazing are well documented. However, 15 per cent of heat is lost through the ground floors by conduction. Most British homes do not have floor insulation.

Students may introduce the subject of condensation, which tends to occur in rooms where the humidity is high or on poorly insulated surfaces where ventilation is inadequate.

A damp-proof course (DPC) prevents rising damp from the ground. A DPC must be included wherever the cavity is bridged, for example, around windows and doors.

Students may be interested in an explanation of damp penetration. Moisture will penetrate brickwork by capillary action. Solid walls are prone to damp and the outsides are often rendered to make them waterproof. The cavity in modern wall construction not only improves thermal insulation but also stops damp penetrating to the inner wall. Cavity fill insulation occasionally introduces problems of damp because it bridges the cavity.

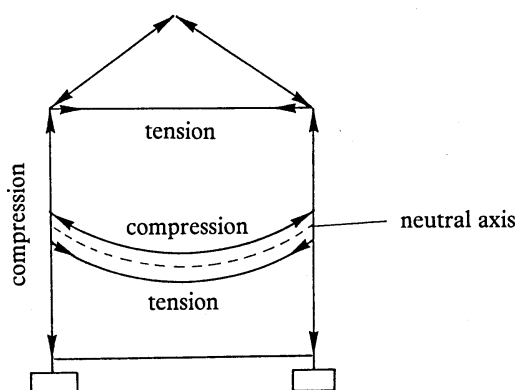
Flashing, usually made of lead, prevents damp penetration where a roof adjoins a wall or other vertical surface.

The Building Regulations are very specific about structural fire precautions in the construction of hearths and fireplaces and the installation of boilers and flues to reduce fire hazards. Terraced houses and flats must have a fireproof wall between them. A door from a house to a garage must be fire-resisting and self-closing. Local bye-laws may have extra requirements.

The designs for staircases must conform to Building Regulations and there must be a handrail. Balustrades must be of a safe height. There have been bad accidents through people crashing into patio doors, few of which are fitted with safety glass (though this is becoming more common).

Part 2 A closer look at materials for building

The directions of the *internal* forces in the structure are shown in the diagram.



Part 3 Materials for window frames

More energy escapes through aluminium and steel frames than from timber or UPVC. Some makes of aluminium frames now have a thermal barrier. UPVC has a much higher expansivity than the other materials and initially there were problems with windows sticking.

Part 4 Houses around the world

The unit is designed to provide a simple background in building methods by comparing British homes with those in other developed countries.

On the continent of Europe there are many firms who supply factory-made homes for a client's site and a few in England (for example, Guildway) who do so. In Britain, many small builders tend to use traditional wet construction and some of the larger firms, such as Barratts, use timber-frame above the level of the DPC. The economics of large-scale production favour timber frame, where much of the work is standardized and can be carried out independent of weather conditions. There is also the advantage that timber-frame houses are immediately dry whereas traditional buildings take weeks or months to dry out.

Timber-frame construction is used in many countries — USA, Canada, Sweden, etc. British builders and homeowners have experienced some problems, largely due to inexperience. Timber-frame houses are normally very well insulated. They have low thermal inertia, and so require less energy to heat them and warm up quickly once the heating has been switched on.

Timber-frame construction is not new to Britain. It was introduced by the Saxons who employed boat-building techniques to construct strong frames which were filled in with wattle and daub or brick. Modern timber-frame buildings have an internal timber frame, the external face is merely a cladding (for example, brick, timber, aluminium panels, etc.). The inside is dry-lined with plasterboard.

Further resources

Everett, Alan, *Materials*. Mitchell's Building Series. Batsford, rev. edn, 1986.

Thomas, Jill, *Home Insulation*. Aura Books for Texas Homecare, 1985. Available from Texas Homecare stores. This is simply written and well illustrated.

Acknowledgements Figures 3, 5, 6, 7, 8 and 9 supplied by Anabel Curry.

AS SAFE AS HOUSES

Part 1 Survey of a building

Find out as much as possible about the structure of a building you live or work in. You may find it easier to report on your findings with the help of a number of labelled diagrams.

Points to look for

- 1 Is the building detached or linked to other buildings? Does it have one storey, or several storeys? Is it a permanent or a temporary structure?
- 2 When was it built?
- 3 What are the outside walls made of (for example, brick, stone, timber, etc.)?
- 4 Is there a cavity in the walls or are they solid? If there is a cavity, does it contain extra insulation?
- 5 Is the roof/loft of the building insulated? If so, what is the thickness (in millimetres) of the insulation?
- 6 What are the window frames made of?
- 7 Does the building have double glazing? If so, is it useful? Give reasons for your answer.
- 8 What are the floors at ground level made of (for example, wood, concrete)?
- 9 Are the ground floors insulated to stop energy loss downwards?
- 10 Are the floors strong enough to support a heavy load such as a piano or a heavy piece of equipment?
- 11 Does the building have a damp-proof course? What is its purpose?
- 12 Does the building have flashings where a small roof (for example, of a porch or bay window) joins the walls or where a chimney stack joins the roof? What is the purpose of flashings?
- 13 Fire can be a fatal hazard. Large buildings have fire doors which must be kept closed. Some have smoke detectors and sprinkler systems.
 - (a) What safety features are designed into the building to prevent fire, or stop it spreading?
 - (b) What precautions can be taken against fire by the people who use the building?
 - (c) How can fire be prevented from spreading from one building to another?
- 14 Many accidents happen in buildings.
 - (a) What accidents have there been recently in the building you are surveying?
 - (b) Are there any special risks for young children or elderly people in your building?
 - (c) Would your building be suitable for a person in a wheelchair?
- 15 How might your building be changed to make it safer and more convenient for the people who live or work in it?

Part 2 A closer look at materials for building

The choice of building material depends in part on whether it needs to be 'strong'. In fact, there are several ways of looking at the strength of a material.

In buildings, the walls are being squashed by the weight of the roof. They are *in compression*.

The roof ties are *in tension* to hold the roof together.

Putting furniture on the floors makes them bend. We say that the floor joists are subject to a *bending moment*.

Materials like brick and concrete are strong in compression but weak in tension. Timber is more versatile because it is strong in tension *and* in compression.

Table 1 on page 3 shows the strengths of typical building materials. Remember that there are many types of brick, concrete and timber. The figures given are for materials in common use.

The table also shows the density of the materials. The denser the material, the heavier will be a beam or a wall made of it.

Thermal conductivity shows how fast energy can be conducted through the material if it is colder on one side than on the other.

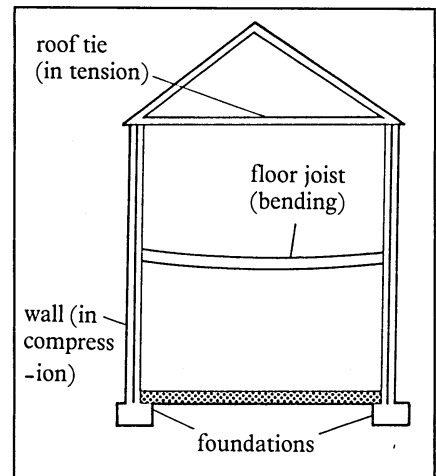


Figure 1

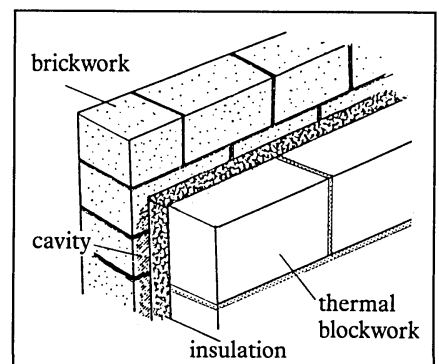


Figure 2 A modern brick cavity wall



Figure 3 These stone houses are built with a timber frame. The outer walls are made of simulated stone

Table 1

<i>Material</i>	<i>Strength in compression (MN/m²)</i>	<i>Strength in tension and bending (MN/m²)</i>	<i>Density (kg/m³)</i>	<i>Thermal conductivity (W/m²°C)</i>
Bricks (for loadbearing walls)	7-70	depends on the joints	1800	1.0
Low density concrete blocks (for inner walls)	4-8	depends on the joints	500-1000	0.4
Plain concrete	20-35	cracks unless reinforced	2400	1.5
Softwood (spruce, parallel to the grain)	5	7	400	0.12
Hardwood (oak, parallel to the grain)	15	21	720	0.16
Mild steel	250	2501	7700	60

Look at the information in the table and then answer questions 1 to 7. You are only asked to compare one material with another so you do not need to worry about the units.

Questions

- 1 *Why are walls usually made of bricks or concrete blocks?*
- 2 *Why does the tensile strength of brick walls depend on the joints?*
- 3 *Why are floor joists and roof trusses in houses made of timber?*
- 4 *Why is steel used as the framework for many big buildings?*
- 5 *How can plain concrete be made stronger in tension?*
- 6 *Is timber suitable or unsuitable for walls?*
- 7 *Explain how building houses with timber instead of with brick and concrete might help to conserve fossil fuels.*

Part 3 Materials for window frames

Table 2 shows figures for the thermal conductivity of materials used to make window frames. The values compare how much energy can escape through different materials when it is cold outside.

The rate of loss of energy is bigger if there is a big temperature difference between the inside and the outside. The rate is slower if the material is thicker.

Glass and brickwork are included for comparison.

Use this information and anything else you may know about these materials to answer the questions 8 to 12.

Table 2

<i>Material</i>	<i>Thermal conductivity (W/m °C)</i>	<i>Comment</i>
Aluminium	200	Strong, does not need painting
Steel	60	Very strong, but needs painting to stop it rusting
Timber (hardwood)	0.16	Strong, needs a little varnish
Timber (softwood)	0.12	Needs paint or preservative
UPVC (plastic)	0.15	White, needs no painting, does not rot.
Glass	1.0	
Brickwork	1.0	

Questions

- 8 Which material would allow least energy to escape through the frame?
- 9 Some buildings have window frames made of steel. Steel window frames tend to suffer from condensation in winter. Why?
- 10 New houses in Britain often have aluminium window frames and patio doors. What do you think might be the advantages and disadvantages of aluminium window frames?
- 11 UPVC is a stiff white plastic. It has been used to make window frames in Germany for the past thirty years. It has only recently been used in Britain. What advantages does it seem to have over the other materials? Can you think of any disadvantages?
- 12 Many houses, both old and new, have wooden window frames.
 - (a) Explain why wood is a particularly suitable material.
 - (b) What are the disadvantages of wood compared with aluminium and UPVC?

Part 4 Houses around the world

Polar bears live in cold climates, hippopotamuses in hot. Yet by building houses, humans have extended their habitat from the tropics to the tundra.

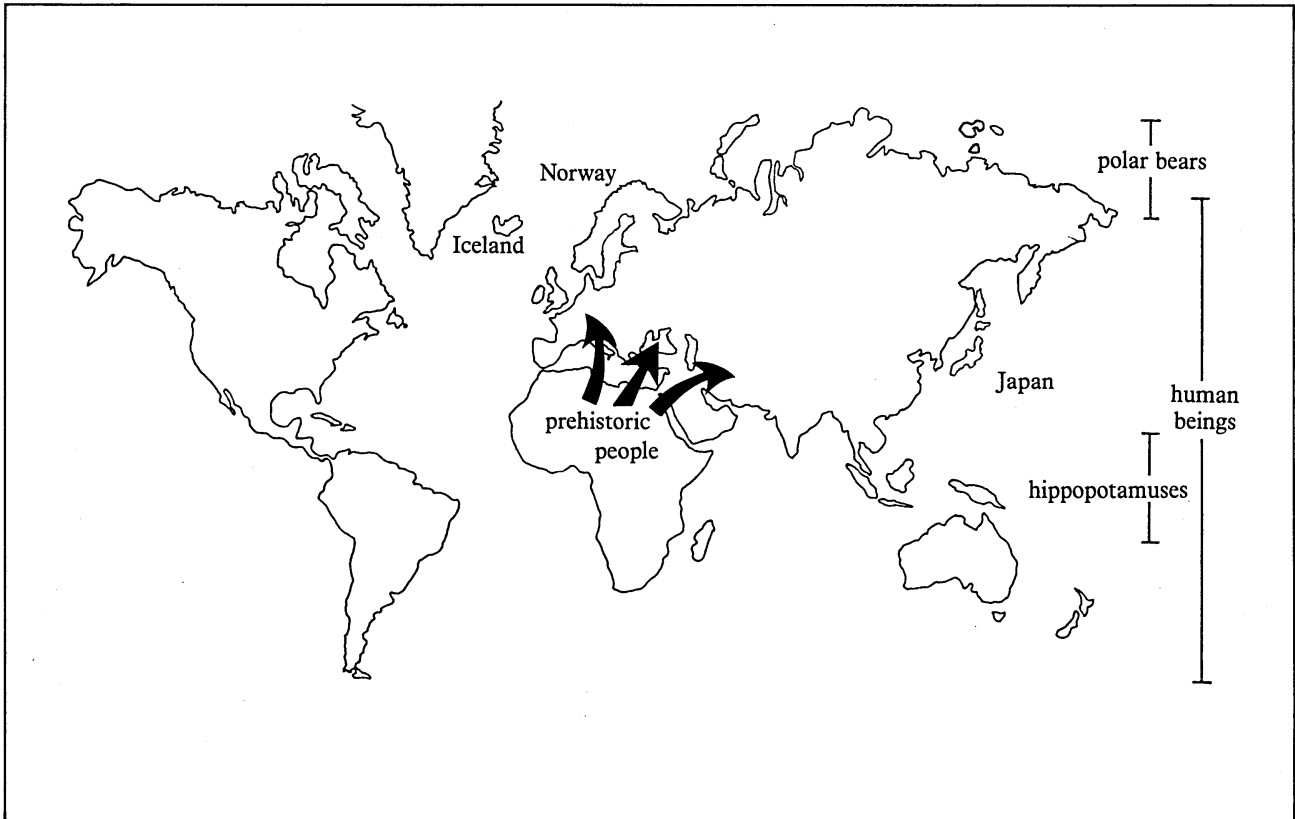


Figure 4

The last ice age finished about 10 000 years ago and the glaciers retreated. Archaeologists believe that the prehistoric people then moved out of Africa into the cooler climates of Europe, North America and Asia.

Human beings were ill-adapted to their new environment with their bare skin. They had to find food and firewood to survive. They also had to build shelters to protect themselves from the wild animals and chilly weather.

The wild animals may have disappeared but the need for warmth and shelter remains. People throughout the world today are highly skilled at building homes to suit their needs.

Now answer question 13.

Question

13 Why do human beings need warmth and shelter in a cold habitat, but polar bears do not?

Japanese houses

Japanese homes are timber-frame structures which have to withstand frequent earth tremors. They have high ceilings to allow air to circulate during the hot and humid summers. Many Japanese houses have no form of heating.

Answer question 14.

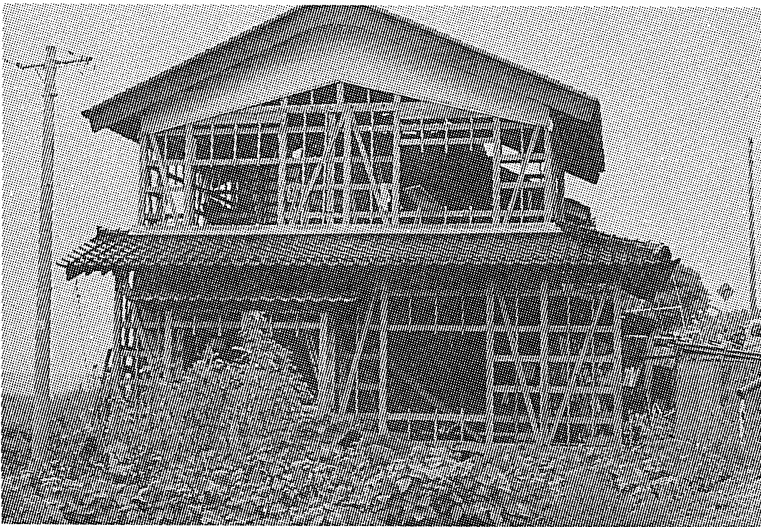


Figure 5 A Japanese house being built

Icelandic houses

All timber has to be imported into Iceland and so Icelanders build with as little timber as possible.

This suburban house in the capital city of Reykjavik is made of concrete (Figure 6). The roof is made from sheets of corrugated iron. The roof is light so it needs little timber to support it. The iron is painted red to make it look better.

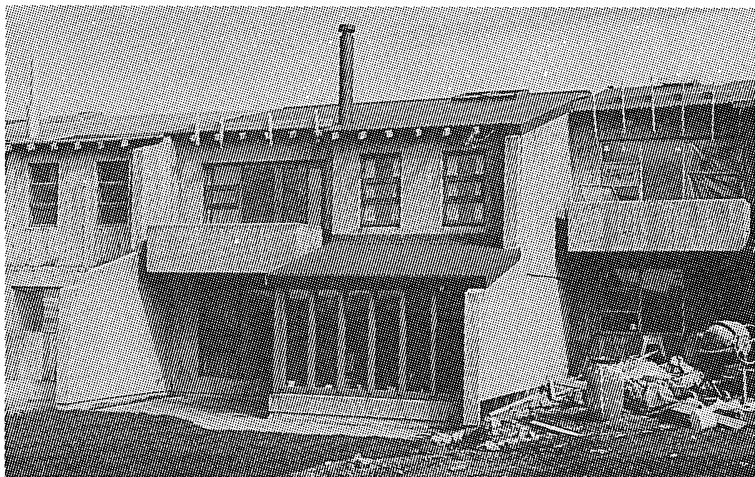


Figure 6 An Icelandic house

Houses in Reykjavik have no boilers or fireplaces. They have central heating supplied with hot water piped from geothermal wells or springs.

Answer questions 15 and 16.

Question

14 Why do you think that a timber-frame house might be better at surviving earth tremors than other types of building?

Questions

15 (a) What are the advantages of making roofs out of corrugated iron in Iceland?

(b) What do you think the disadvantages might be?

16 What is a geothermal well?

Norwegian houses

Norway is a cold country but it has many large forests. People use timber-frame construction on top of concrete basements. The outside walls are made of timber. The wood is painted with a coloured preservative.

Norwegian homes are very well insulated (large windows have triple glazing). Electricity is quite cheap because there is plenty of hydroelectric power. Most Norwegians have a fireplace for burning logs in the living room but otherwise they heat their homes with electric radiators.

Timber is an excellent building material. It is light and strong as well as being a good insulator.

Answer question 17.

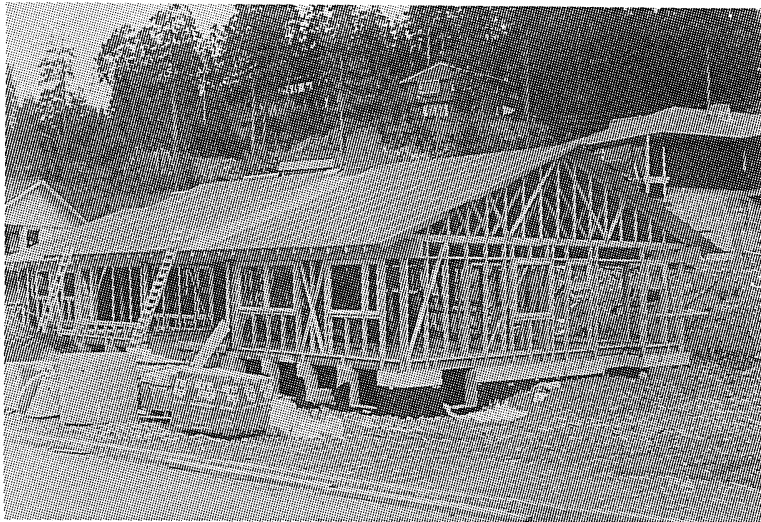


Figure 7 A Norwegian house under construction

British houses

Most houses in Britain are built of brick or from local stone.

Older houses have solid walls and were originally heated by a fireplace in every room. Cavity walls were introduced in the late 1920s.

Today, many homes are built with central heating and older houses have been modernized by removing fireplaces and installing radiators or electric storage heaters.

Energy for heating is expensive. If a house is well insulated, it saves money on fuel bills and helps to prevent condensation on walls and windows. Yet many older homes are still not insulated at all because people cannot afford the cost or do not appreciate the benefits.

Answer question 18.

Question

17 Why do you think that Norwegians insulate their houses to a higher standard than we do in Britain?

Question

18 People who cannot afford the cost of insulation have to spend more money on heating their homes. Wasting heat is wasting a non-renewable fossil fuel. Does it matter? Who should be responsible for insulating houses — individual families or the community at large?

When the oil crisis of the 1970s caused the cost of fuels to rise rapidly, it had two effects on British house design:

- The Government introduced stricter building regulations to save energy. New houses now have to have much higher standards of insulation.
- The price of traditional building materials, such as bricks and cement, rose with the increasing cost of fuel. Wages rose too. Brick laying and plastering are skilled jobs and building brick houses required much expensive labour. Timber-frame construction became an economic alternative. Parts could be factory-made and houses speedily erected on a prepared site.

The houses being built today may look very similar to those of the past, but their structure is different and their standard of insulation much higher. New 'brick' houses have only the outer wall of brick and the inner one of insulating blockwork. 'Timber-frame' houses may be brick on the outside too, but an internal timber frame carries the load of the building.

Answer questions 19 and 20.

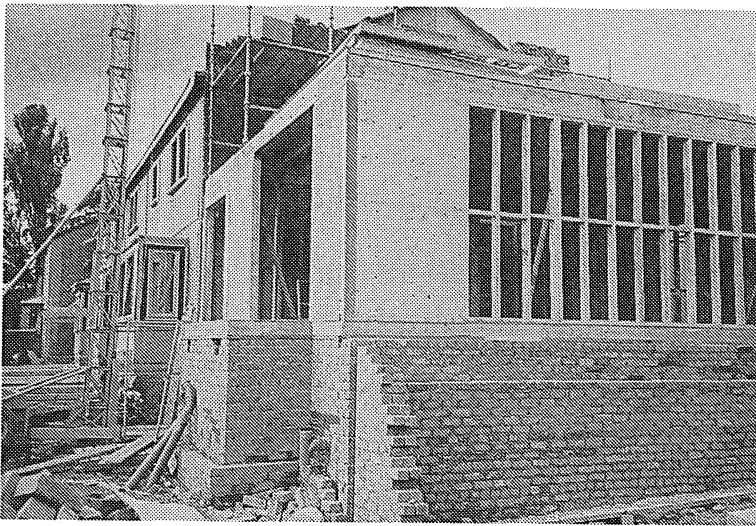


Figure 8 Modern timber-frame construction



Figure 9 Traditional timber-frame construction

As safe as houses?

When someone builds a house, there are many checks to ensure that its structure is safe. The local authority must see that the plans conform to the Building Regulations. A building inspector must visit the site at each stage of construction to check that the work has been done properly.

Sometimes people want to alter the structure of a house, perhaps by removing a wall or adding a window. This cannot be done before it has been approved by the local authority. The local authority checks the plans and makes sure that they do not break any bye-laws. The officers of the authority will give advice if necessary. This is the way that the community ensures that our homes are structurally safe.

Answer question 21.

Questions

- 19 What are the advantages of factory-made houses?
- 20 Timber-frame construction was first introduced to Britain by the Saxons. How does the traditional method of construction differ from the modern one?

Question

- 21 Find the notice of planning applications in your local paper.
 - (a) What sort of planning applications do people in your neighbourhood make? Give several examples.
 - (b) Why does the Chief Planning Officer publish a list of planning applications?