

## Spectacles and Contact Lenses

*Contents:* Reading, questions, practical work and survey concerning spectacles and contact lenses.

*Time:* 2 periods or more, depending on number of parts used.

*Intended use:* GCSE Physics, Biology and Integrated Science. Links with work on the eye, defects of vision and lenses.

*Aims:*

- To complement and revise prior work on the eye, defects of vision and lenses
- To show some of the background to the development of spectacles and contact lenses
- To develop awareness of the scale and pattern of visual defects in the community
- To provide opportunities to practise certain skills, including observation and interpretation, and to develop the ability to carry out and interpret a survey.

*Requirements:* Students' worksheets No. 209. For Part 2, a variety of old spectacles of different types will be needed.

This unit comprises reading and activities designed to complement standard work on the eye and defects of vision. There are three parts, and these can be used separately or in conjunction with one another.

- Part 1 Gives background information on spectacles and contact lenses. It is a short piece of reading with questions.
- Part 2 A short exercise involving the examination of spectacles. It will be necessary to provide a range of spectacles: students could be asked to bring old ones from home. It would be a good idea to go through them before the exercise to check they are a representative selection.
- Part 3 A survey, followed by questions. The survey could be carried out in the school, in the street or from home. The main problem is likely to be getting an adequate spread across the age ranges. It might be helpful to pool results.

### Notes on some of the questions

*Q.2* British people enjoy a high quality of eye care, but this is not the case in many developing countries. Students may be interested to hear of the systems that operate elsewhere. In many countries spectacles are bought at an ordinary shop, without any specialist help with fitting. (This is possible in Britain too, though because of free eye-testing the majority of people get prescription lenses.) Schemes exist for collecting old spectacles in Britain and other developed countries and distributing them in developing countries.

*Q.6* Most laboratory lenses are biconcave or biconvex, or possibly plano-concave or plano-convex. Spectacle lenses are generally concave on the side nearer the eye, to give clearance between lens and eye and to correspond to the curvature of the retina, thus minimizing distortion. The other side is generally convex, its curvature deciding the overall nature of the lens.

Q.9 a needs 2; b needs 4; c needs 3; d needs 1.

Qs 15, 16 Students should be aware of the problem of drawing conclusions from a survey based on small numbers or on an uneven sample. Even with a large sample spread across the age-range, distortions may occur — for example, people may be reluctant to admit their true age or sight condition.

### Other resources

- 1 *The Eye*. A computer software package published by Longman.
- 2 Two booklets published by the Optical Information Council (Temple Chambers, Temple Avenue, London EC4Y 0DT): *Insight — a look at Human Vision* and *The Sense of Sight*.

*Acknowledgements* Figures 1 and 4 supplied by the Optical Information Council.

## SPECTACLES AND CONTACT LENSES

There are 55 million women, men and children in Britain. 24 million of them need spectacles or contact lenses to help them see clearly.

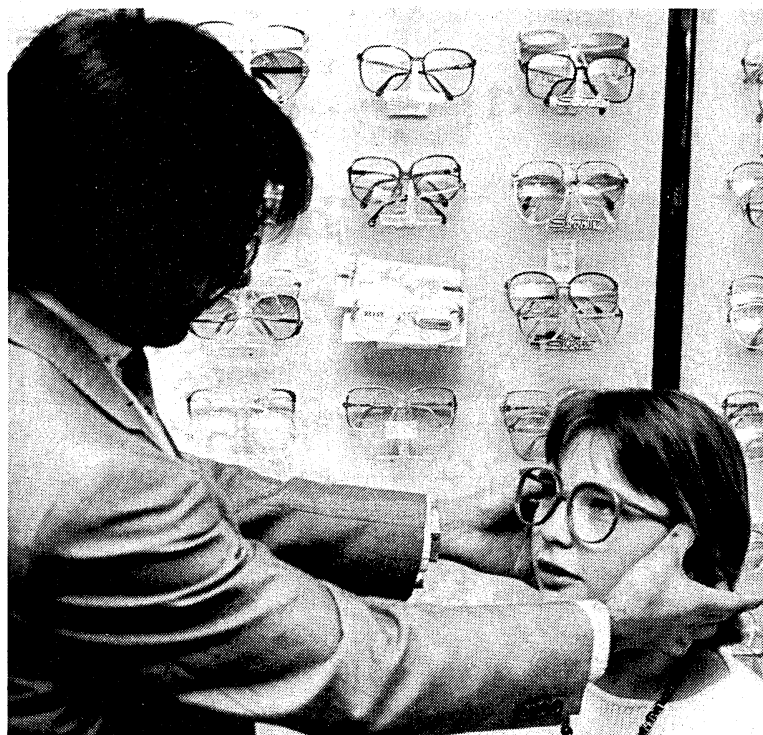


Figure 1 Fitting new spectacles

In your science lessons you will probably have learned about the eye and why it sometimes does not work properly. Table 1 is a brief summary of the main defects of vision.

Table 1 The main defects of vision

Name of defect	Nature of defect	Why it happens	How it is corrected
Short sight	Cannot see distant objects clearly	Eyeball too long, or lens too strong	With concave lenses
Long sight	Cannot see close objects clearly	Eyeball too short, or lens too weak	With convex lenses
Poor accommodation	Difficult to focus on things close up, and far away	Lens hardens, making it difficult to change its shape. Usually starts to happen in middle age	With bifocal spectacles, containing two lenses, one for close up, one for far away
Astigmatism	Cannot see as well in one plane as in others	Lens or cornea is slightly barrel-shaped instead of spherical	With lenses which are slightly barrel-shaped to compensate

This unit is in three parts:

- Part 1 Background to spectacles and contact lenses
- Part 2 Looking at spectacles
- Part 3 A sight survey.

## Part 1 Background to spectacles and contact lenses

### Who invented spectacles?

The Romans and ancient Chinese knew that a piece of glass of a particular shape would magnify objects seen through it. We do not know who first invented spectacles but by the fourteenth century they were quite common in Europe. Figure 2 shows a monk wearing spectacles, and dates from 1352.

In England in the early thirteenth century Bishop Robert Grosseteste suggested that specially shaped pieces of glass could be used to magnify small objects. He called these pieces of glass lenses, because they were shaped like lentils. This idea was used by his pupil, Roger Bacon, who made some of the earliest spectacles. At first only convex lenses were produced, to help long-sighted people. After the invention of printing many more people needed spectacles and by the fifteenth century they were used quite a lot.

It is now possible to have spectacles that help long sight, short sight, or both (bifocal lenses).

In Britain today, everyone can have their eyes tested free under the National Health Service. If the tests show they need spectacles, young people under 19 or in full-time education get them free under the NHS. So do some people on low incomes. Other people have to pay for their spectacles.

### What about contact lenses?

Contact lenses float on the front of the eye, actually touching it. Leonardo da Vinci first suggested the idea, in the fifteenth century. But it was not until 1887 that the first glass contact lenses were fitted. Glass lenses could only be worn for a short time because oxygen could not get through the glass and reach the eye.

By 1935 the growth of the plastics industry meant that contact lenses could be made from plastic. The lenses float over the cornea and are shaped to fit the wearer exactly (Figure 3 on next page).



Figure 2 A monk wearing spectacles  
— date 1352

#### Questions

- 1 Why did more people need spectacles after the invention of printing?
- 2 In Britain, practically everyone can get spectacles if they need them. How would people manage in a developing country where there are few opticians?

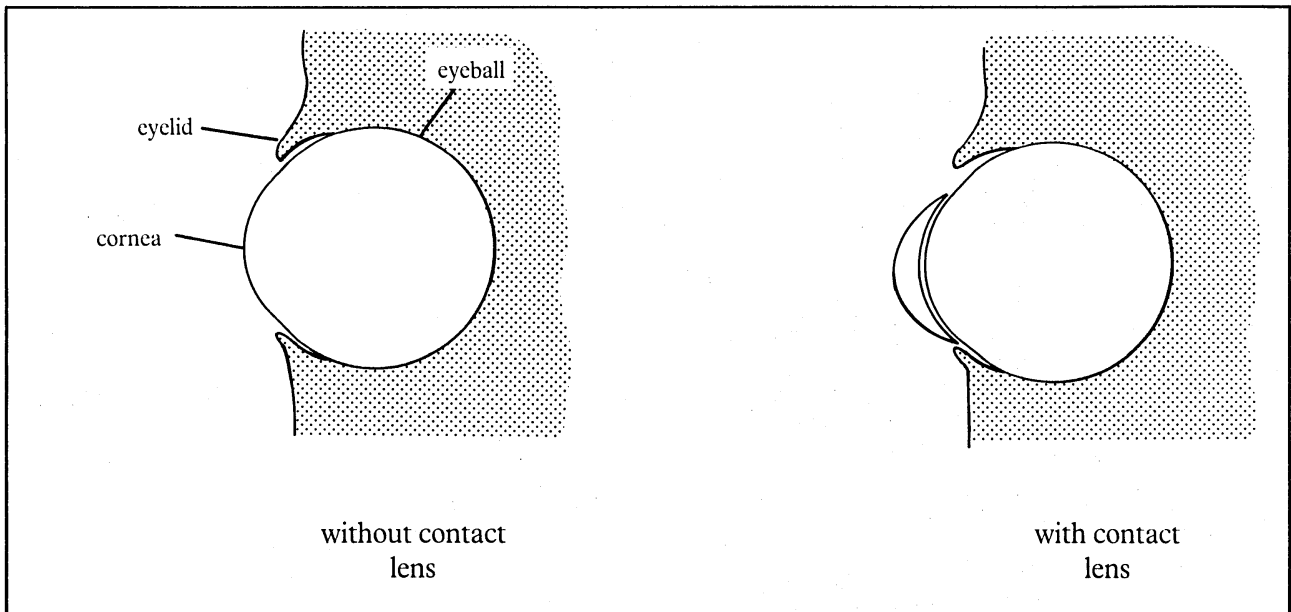


Figure 3 How a contact lens is worn

Modern contact lenses are classified as hard, soft and gas-permeable.

**Hard lenses** are very small (approximately 9 mm across) and are made from rigid plastic material. They float on the surface of the eye, and are small enough to allow oxygen to reach the eye.

**Soft or hydrophilic lenses** were developed in the 1970s and can be worn for long periods without discomfort. They are made from a plastic that is hard when dry, so that shaping and polishing can be carried out. But the plastic absorbs up to 80 per cent of its own weight of water. This gives a soft, permeable, jelly-like material which is comfortable to the eye.

**Gas-permeable lenses** are made from recently developed plastics. They are thin and flexible with similar properties to hard lenses, but they allow more oxygen to pass through to the eye.

#### Questions

- 3 Why did the development of the plastics industry lead to many more people wearing contact lenses?
- 4 What are the advantages of (a) hydrophilic lenses, and (b) gas-permeable lenses, over hard contact lenses?
- 5 What do you think are the advantages of wearing contact lenses rather than spectacles? What are the disadvantages?

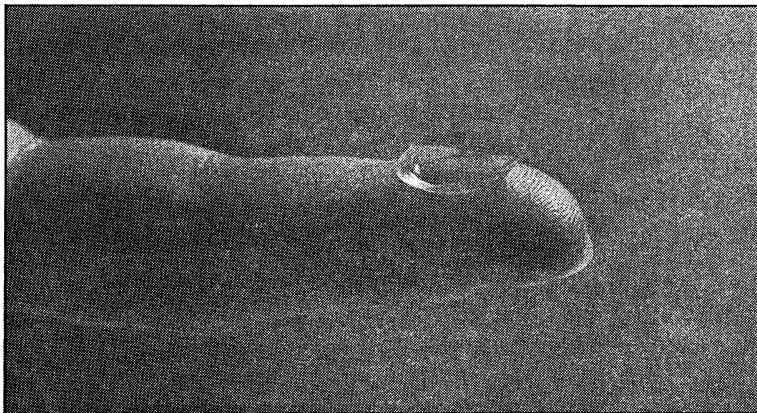


Figure 4 The size of a contact lens

## Part 2 Looking at spectacles

For this part of the unit, you will need a collection of spectacles to examine. Use the following method to decide what defect of vision each pair of spectacles is for:

- A** Look closely at the spectacles. Are there two (or three) different parts to the lens? If so, they are bifocals (or trifocals), for poor accommodation.
- B** If they are not bifocals or trifocals, hold the spectacles at arm's length. Do they make things look smaller? If so, they have convex lenses for long sight.
- C** Hold the spectacles at arm's length. Look through one lens at an object, then rotate the lens, still looking through it. Does the shape of the object change as the lens rotates? If so, the lens is designed for astigmatism.

### Questions

- 6 In what way do spectacle lenses differ from the lenses you use in the laboratory? Why do you think this is?
- 7 Examine a pair of bifocal lenses. Which part is for looking at close objects, and which is for looking at distant objects?
- 8 Why are bifocals usually worn by middle-aged and old people, but hardly ever by young people?
- 9 Bifocal lenses can be made in different arrangements to suit people with different needs. Figure 5 shows four different bifocal lenses.

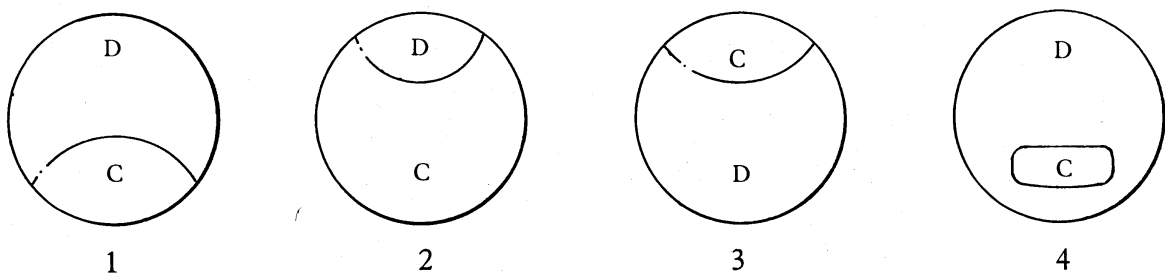


Figure 5 Different bifocal lenses. The part marked C is for close work, the part marked D is for distance.

Which bifocal lens would be most suitable for each of the following?

- a A musician who needs to be able to look at wide sheets of music, and occasionally look at the conductor.
  - b A painter and decorator who needs to be able to look at the walls being painted, to go up and down ladders and occasionally do close reading.
  - c An airline pilot, who needs to read overhead instruments in the cockpit, and also look ahead out of the cockpit window.
  - d A shop assistant, who needs to keep looking up at the customer and down at the till.
- 10 Are both lenses of a pair of spectacles always the same? If not, why not?
  - 11 What is a monacle? What sort of sight defects are monacles worn for? Why are they hardly ever worn nowadays?

### Part 3 A sight survey

In this survey you are going to try and find out if there is a pattern to the type of sight defects from which people suffer.

To help you spot any patterns you must include as many people as possible in your survey. They should be spread as much as possible across the age ranges.

Perhaps you could pool your results with other members of the class to increase the sample. (Make sure you have not asked the same people!)

Copy Table 2 and complete it by putting a tick in each of the boxes which apply to the person you are interviewing. Include people who only wear glasses some of the time.

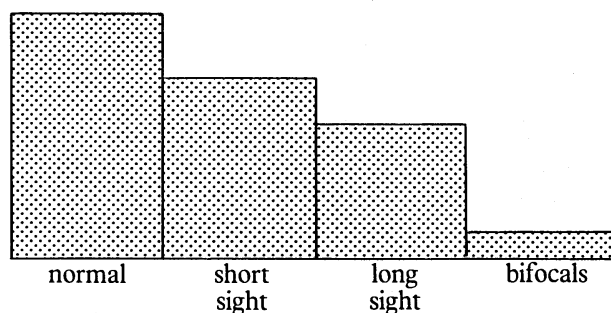
Table 2 A sight survey

<i>Normal-sighted</i>	<i>Wear glasses or contact lenses for short sight</i>	<i>Wear glasses or contact lenses for long sight</i>	<i>Wear bifocals</i>
Male			
Female			
Age 11—21			
Age 21—40			
Age 40—70			
Age over 70			

#### Questions and activities

12 For each of the four age groups, draw bar charts to compare the numbers of people with different sight conditions. For example, your bar chart for the 21—40 age group might look like Figure 6.

Figure 6  
Example of bar chart  
for age group 21—40



- 13 Is there a noticeable relationship between age and type of sight condition? If so, what is it?
- 14 Is there a noticeable relationship between sex and type of sight condition? If so, what is it?
- 15 Are there enough people in your survey to make your conclusions reliable? How could you improve your survey?
- 16 Even if your survey did include large numbers of people, the results might still be unreliable. Suggest some reasons why.

## The Pesticide Problem

*Contents:* A decision-making and data-analysis exercise concerning the testing and use of pesticides.

*Time:* 2 periods.

*Intended use:* GCSE Chemistry, Biology and Integrated Science. Links with work on the use of chemicals as pesticides, and the ecology of pest control.

*Aims:*

- To complement work on pesticides and pest control
- To show some of the benefits and disadvantages of the use of pesticides
- To develop awareness of some of the methods used in commercial decision-making
- To provide opportunities to practise skills in the evaluation of evidence and the use of information and data in making decisions.

*Requirements:* Students' worksheets No. 210. It would be useful to have samples of pest-damaged plants and examples of commercial pesticides available for showing the class.

### Suggested use of the unit

In school trials it was found valuable to precede the use of the unit with some discussion of pesticides and their advantages and disadvantages, rather than going into the unit 'cold'. For example, students could be asked to write a quick list of the properties needed in a good pesticide. After a brief discussion they could then tackle the unit.

The idea of Official Registration may prove difficult, and may need some explanation.

The exercise is best conducted in small groups of four or five, with an appointed or elected group recorder. At the end of the exercise a plenary session could be held to compare results. Alternatively, groups could be asked to design posters advertising one of the pesticides, incorporating information from the unit.

### Notes on some of the questions

*Q.8* The difference between rows is only 2 plants in about 50, and therefore not significant.

*Q.10* The trial plots should be more widely spaced, with 'guard rows' in between to avoid the pesticide on one plot affecting the results on a neighbouring plot.

*Q.11* Further trials would be necessary to verify results, thus increasing validity.

*Q.12* Trials should be carried out on other crops that are prone to slug damage, for example, potatoes, strawberries, celery, carrots.

*Acknowledgements* Figures 1 and 3 are Shell photographs



# THE PESTICIDE PROBLEM

## Pests and pesticides

Pests are animals which steal or damage the food grown by humans.

The most common pests are insects. But mammals such as rats and mice, and molluscs such as slugs and snails can also be pests.

Pesticides are chemicals which kill or control pests. You are using a pesticide every time you use a fly-spray. Gardeners often use pesticides, and farmers spray them on their crops.



*Figure 1 Crop spraying*

Pesticides have to be very carefully designed. They must kill the pest, but not damage the food crop. They must not be harmful to the humans who will eat the food. They should not harm animals other than pests.

The chemical companies which manufacture pesticides have a tricky problem getting this balance right. Sometimes it is not possible. For example, DDT is a very effective insecticide which has been used to help control diseases, such as malaria, as well as protecting crops. But many countries, including Britain, have now banned the use of DDT. This is because it is suspected of killing birds, fish and harmless insects as well as pests.

There are strict Government regulations about testing pesticides for safety. Chemical companies spend millions of pounds on testing. Even so, many people say that pesticides are still unsafe, and that we use them too much. Others say that without pesticides we could never grow enough food to feed the world's huge, and growing population.

In this unit you will be looking at the testing of pesticides. You will be trying to make the kind of decisions a Government department or a pesticide manufacturer might have to make.

The unit is in two parts: Part 1, Which registration?; Part 2, Trials on pesticides.

## Part 1 Which registration?

Before pesticides can be sold in Britain they have to go through tests for safety and efficiency. Manufacturers test their products to check they meet five conditions:

- 1 The pesticide is safe for people to use and does not harm them
- 2 Treated crops are safe to eat
- 3 Wildlife and the environment are not harmed
- 4 Treated crops are not damaged by the pesticide
- 5 The pesticide works in the way it is supposed to.

Once the test results have been collected, the company applies to the Ministry of Agriculture, Fisheries and Food for Official Registration. The Ministry has to decide whether the pesticide can be sold for use. There are three different types of registration that can be given. Without one of the different types of registration, the pesticide must not be used at all.

- *Trials Registration* This is granted if conditions 1, 2 and 3 only are met. The pesticide can then be used for 'field trials' by farmers. If these trials are successful it may be considered for Full Registration.
- *Provisional Registration* All five conditions have to be met. The pesticide can be sold, but there might be limits on:
  - (a) the area it is used on
  - (b) the time it is available for sale
  - (c) the quantity that can be sold.
- *Full Registration* Again, all five conditions have to be met, but now the pesticide can be sold, provided it is properly labelled.

### Three pesticides for controlling slugs

Slugs are a common garden pest (Figure 2). Slugs cause damage to food crops, including potatoes, celery, lettuce, carrots and strawberries. They can attack wheat grains in the soil, and young wheat plants. There are many species of slugs but only some of them are pests.

You work in the Official Registration Department at the Ministry of Agriculture. You have been asked by the Ministry to decide which type of registration (if any) to give to each of three pesticides which kill slugs. The pesticides are called **Sluggo**, **Sluggoff** and **GoSlug**. All three are made in pellet form.

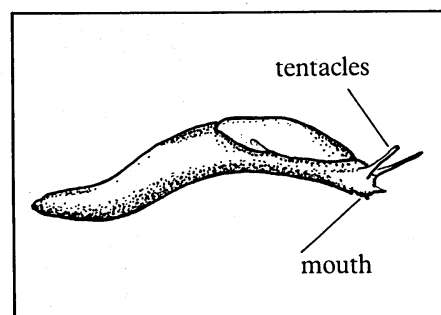


Figure 2 The garden slug — a common pest. It eats plants using a hard file-like tongue which tears at plant tissue.

**Outline information about the three pesticides**

**Slugger** (Chemical formula:  $\text{Cu}(\text{O}_2\text{C CH}_3)_2\text{AsO}_3$ )

The pesticide contains arsenic and is poisonous to humans and animals. A small amount of it is taken up by plants. It is very efficient, killing 90 per cent of slugs in the area where it is used.

**Slugoff** (Chemical formula:  $\text{C}_{11}\text{H}_{15}\text{O}_2\text{NS}$ )

This chemical is not poisonous to humans. The recommended time between using the product on a crop and harvesting the crop is 7 days. About 5 per cent of the earthworms in the treated area may be killed by it. Birds do not eat the blue pellets or the dead slugs. Plants are unaffected, and it kills 95 per cent of slugs in the treated area.

**GoSlug** (Chemical formula:  $\text{C}_8\text{H}_{16}\text{O}_4$ )

The chemical is harmful to animals. The product does not affect the crop or nearby plants. 50 per cent of slugs may recover in damp weather, because the pesticide works by drying out the slug.

*Which registration will you give each pesticide?* It is best to work in groups for this activity.

Draw up a table like Table 1. Then answer questions 1 to 7.

Table 1

	<i>Refuse a Registration</i>	<i>Trials Registration</i>	<i>Provisional Registration</i>	<i>Full Registration</i>
Slugger				
Slugoff				
GoSlug				

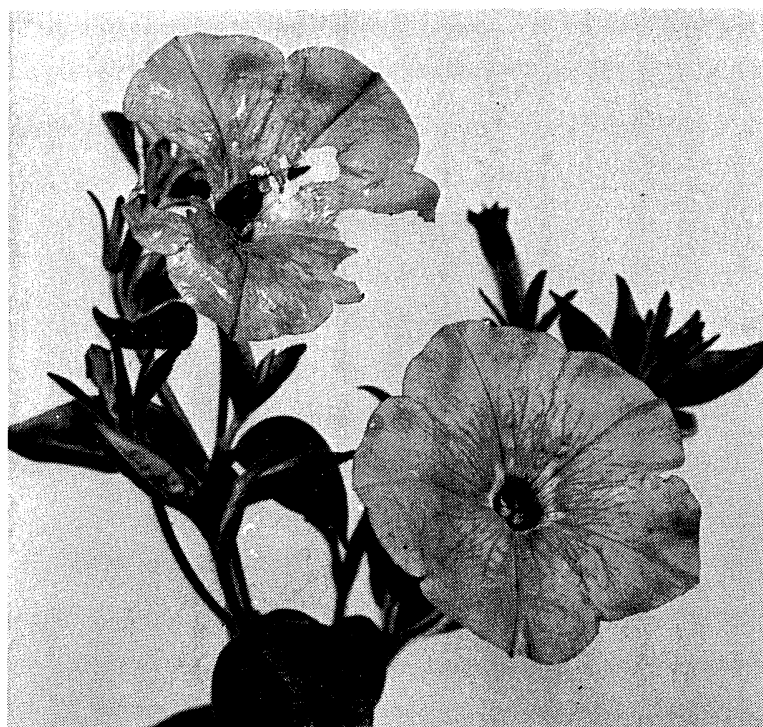


Figure 3 Slugs eat flowers as well as leaves. This petunia flower shows slug damage

*Questions*

- 1 *What registration will you give each product? Enter your decisions in Table 1. In each case give a brief reason.*
- 2 *For the product or products (if any) that you have given Trials Registration, what sort of evidence will you be looking for in the trials?*
- 3 *For the product or products (if any) that you have given Provisional Registration, what extra information would you need before granting Full Registration? In the meantime, what limits would you put on the use of the pesticide?*
- 4 *For the product or products (if any) that you have given Full Registration, what sort of information should be put on the label?*
- 5 *For the product or products (if any) that you have rejected, what will you tell the manufacturer?*
- 6 *The decision about registration is based on the five conditions given earlier. Do you think any other conditions should be added? If so which?*

## Part 2 Trials on pesticides

Table 2 gives information about 'field trials' that were carried out by farmers. The idea of these trials was to test the effectiveness of Slugoff and GoSlug. Figure 4 shows how the trials were carried out.

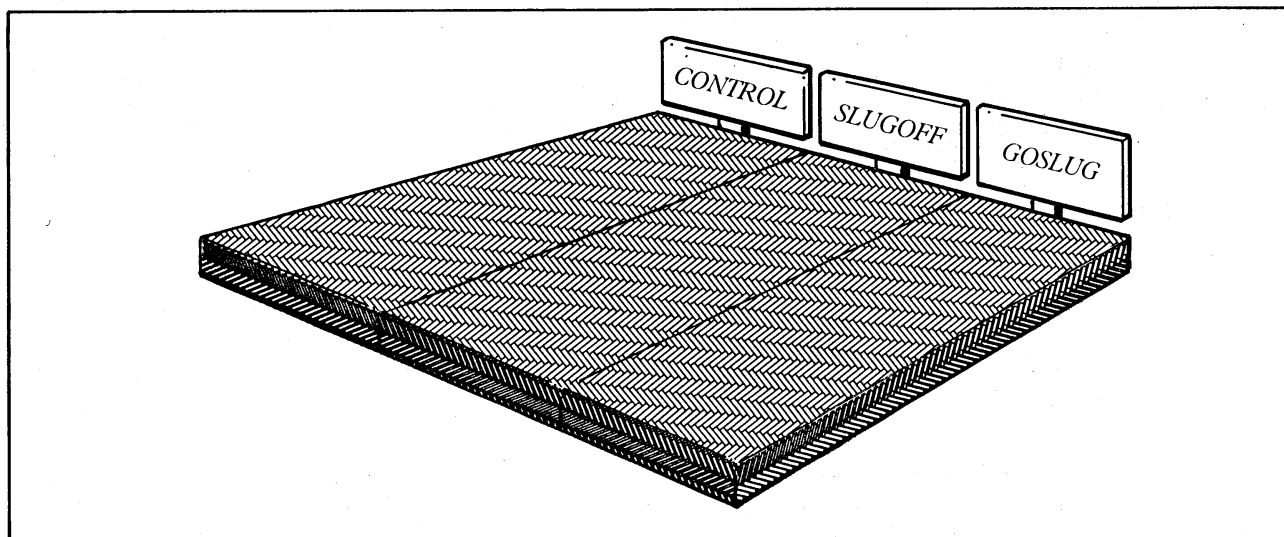


Figure 4 Field trials of pesticides.  
Crop: winter wheat

Table 2 Results of trials

	Control	GoSlug	Slugoff
Amount applied/kg per hectare	Untreated	31	6
Dead slugs per square metre	0.0	6.5	10.3
Wheat plants per metre of row	52.1	54.2	54.9
Slug damaged wheat plants per metre of row	21.0	9.3	4.1
% damaged wheat plants	40.3	17.2	7.4

### Questions

- 7 Why was there a 0.0 count of dead slugs in the control area?
- 8 The number of plants per metre of row is not exactly the same in each case. Do you think this is an important factor in the trial? Give a reason for your answer.
- 9 Assuming Slugoff and GoSlug cost the same per kg, which product would seem better in terms of value for money?
- 10 Look again at Figure 4. What improvements could you make to the way the trial plots are arranged?
- 11 This trial was not the only one carried out. Explain why further trials would be necessary.
- 12 On what other crops, apart from wheat, would you recommend trials to be carried out?



## **SATIS 2**

List of units in this book

### **201 ENERGY FROM BIOMASS**

Reading and problem-solving exercises, including optional practical work, on the production of biomass energy.

### **202 ELECTRIC VEHICLES**

Reading and questions concerning the advantages and limitations of electric vehicles.

### **203 DRINKING ALCOHOL**

Practical work, reading and questions on alcohol and its effects on the body.

### **204 USING RADIOACTIVITY**

Reading and problems concerning the medical and industrial applications of radioisotopes.

### **205 LOOKING AT MOTOR OIL**

Information and questions on the function of motor oil in an engine, and the problems involved in formulating an efficient oil. Optional practical work investigating the change of oil viscosity with temperature.

### **206 TEST-TUBE BABIES**

Information and discussion questions on the problem of infertility and the technique of *in vitro* fertilization.

### **207 THE STORY OF FRITZ HABER**

Reading and discussion questions relating to the life and work of the inventor of the Haber Process.

### **208 THE PRICE OF FOOD**

Survey, analysis and discussion concerning the factors affecting the price of food items.

### **209 SPECTACLES AND CONTACT LENSES**

Reading, questions, practical work and a survey concerning spectacles and contact lenses.

### **210 THE PESTICIDE PROBLEM**

A decision-making and data-analysis exercise concerning the testing and use of pesticides.

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