SCIENCE AT WORK

Plant Science

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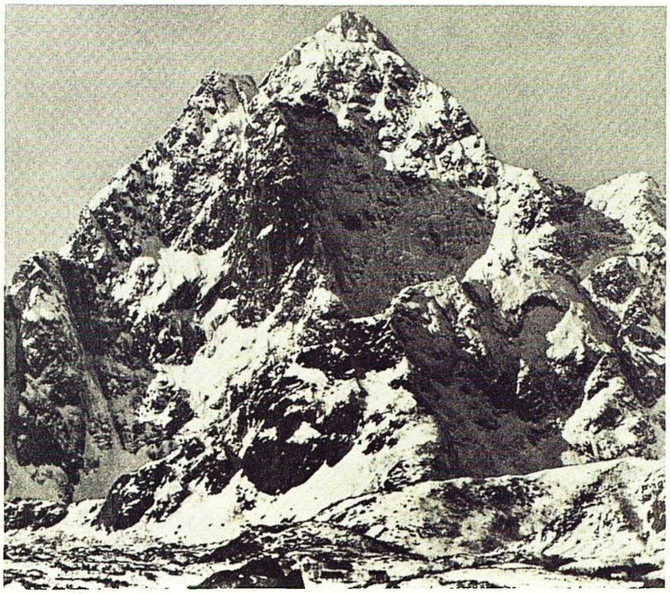
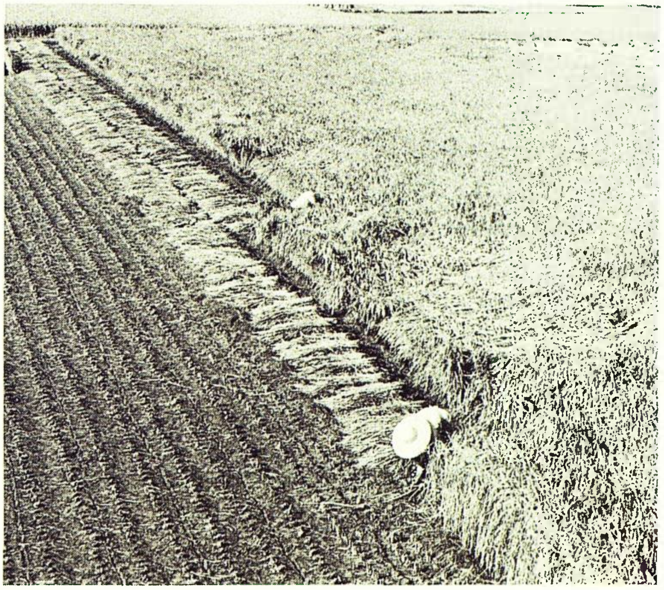
1 Soil

Information: What is soil?



These mountains in Norway are covered in snow for much of the year.

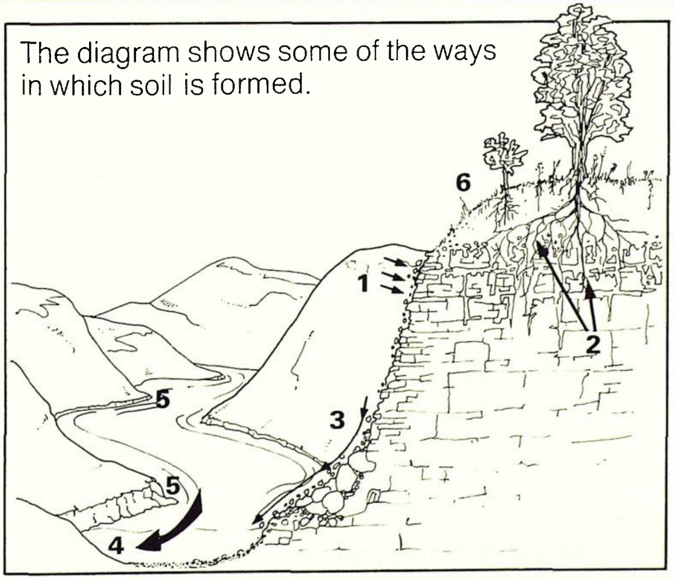


Rice being harvested in Japan.

Two-thirds of the earth's surface is covered by sea. The rest is land. Some of the land is the bare rock of **mountains.** Other parts are sandy or stoney **desert** where very little rain falls.

The rest of the land is covered with **soil.** Plants are found in the upper 15-25 cm of soil. All plants need some of the substances in the soil for their growth. Different crops grow in different soils. One of the most important **cereal** crops, rice, grows in very wet soil. Other cereals cannot grow in such places.

The diagram shows some of the ways in which soil is formed.



Soils are formed from the break-up of rocks by wind and water. The rotting remains of dead animals and plants, called **humus,** mix with the small rock particles to form soils. Living bacteria in the soil change the complex chemical substances of the dead organisms into simple substances that growing plants can use.

1 Water freezes in cracks. The cracks widen. Rock pieces break off.

2 Plant and tree roots grow along cracks in rock. The cracks get wider.

3 Rocks fall down towards the river.

4 River water carries rock pieces. The pieces wear down.

5 Small particles and rock pieces settle out from the river.

6 Rotting animals and plants are mixed with the rock particles.

Q1 How much of the earth's surface is land?

Q2 Why is soil important?

Q3 What is humus?

Q4 Why are soil bacteria important?

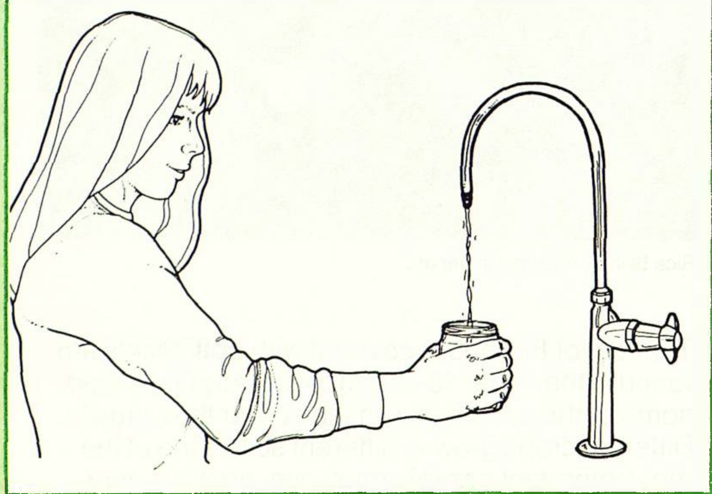
Particles in soil

Apparatus

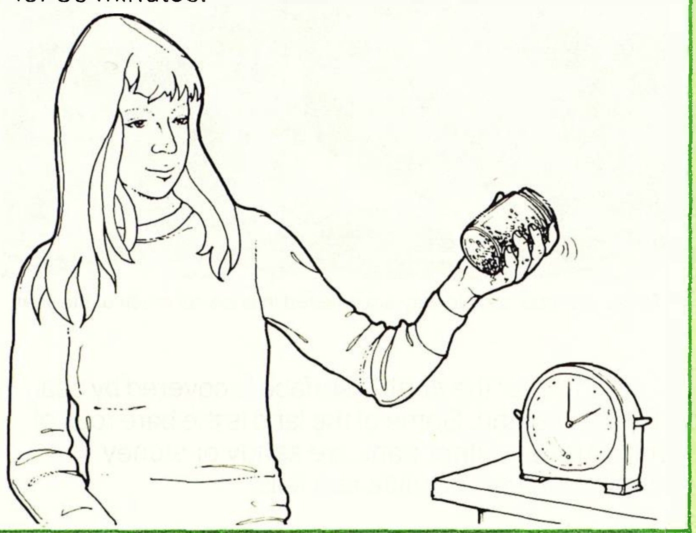
★ screw-top jar ★ fresh soil ★ dry soil ★ dry clay ★ dry sand ★ scoop
★ 3 slides ★ microscope ★ stop clock

You are going to find out about the different particles in soil.

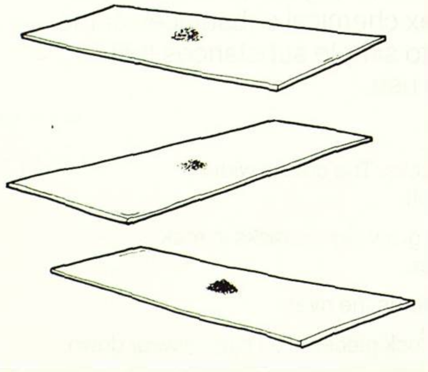
A Put one scoop of fresh soil into a screw-top jar. Add water and put on the lid.



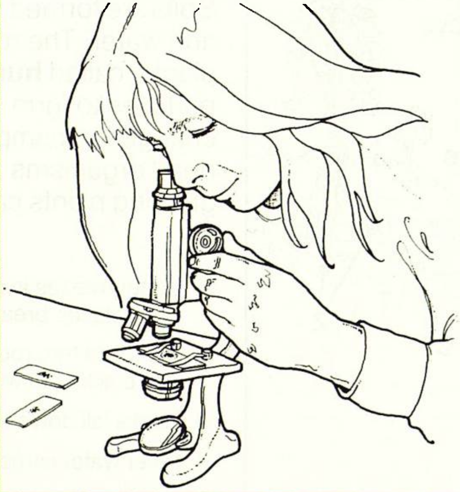
B Shake the jar for one minute. Leave it to settle for 30 minutes.



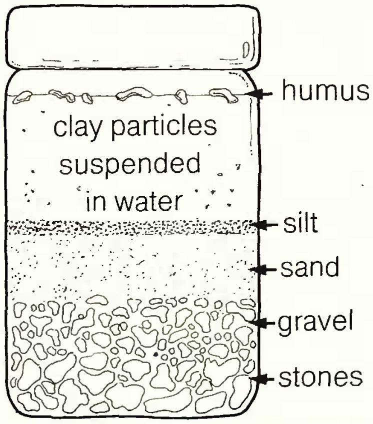
C Meanwhile put a little dry clay onto a slide. Examine it under a microscope. Use low magnification. Draw the appearance of the particles.



D Repeat step C for the dry sand and dry soil.



E Look at the layers in the jar. They may include the layers shown here.



Q5 Draw a diagram to show the layers in your jar. Label the layers. (Use step E to help you.)

Q6 Why do some particles float and some sink?

Q7 What differences did you see between the sand and clay particles under the microscope?

Q8 Are all the soil particles the same size?

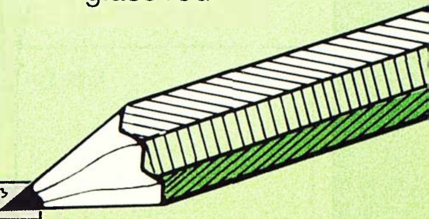
Air in soil

Apparatus

★ stick ★ spade ★ newspaper ★ two 500 cm^3 measuring cylinders labelled A and B
★ 2 small cans, one labelled X, one labelled Y with a small hole in the bottom ★ glass rod

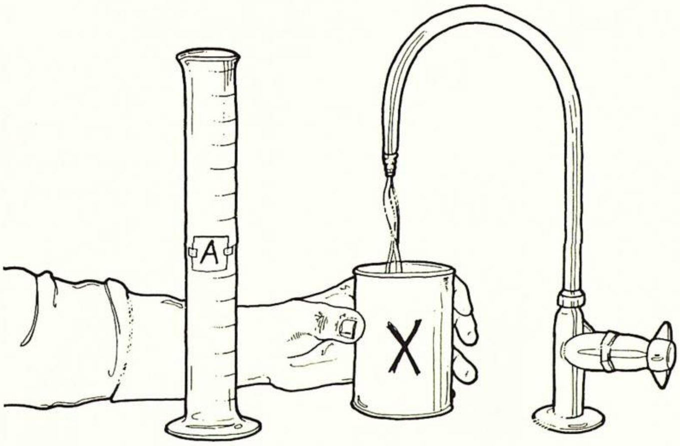
You are going to find out how much air there is in one soil sample.

Q9 Copy this table.



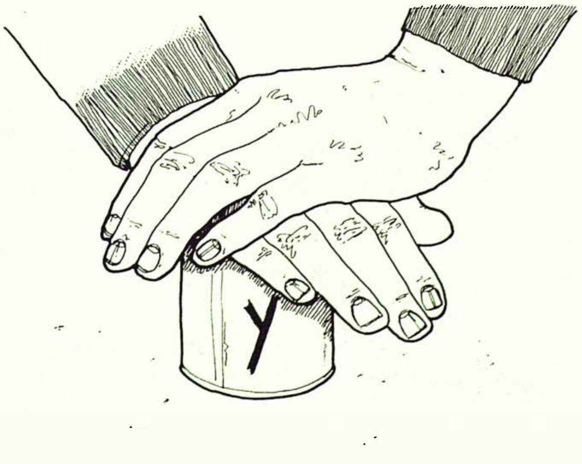
1 Volume of water in can X	cm^3
2 Volume of soil in can Y	cm^3
3 Expected total volume of 1 and 2	cm^3
4 Actual volume of water and soil mixed	cm^3
5 Difference between 3 and 4	cm^3

A Fill can **X** with water. Empty the can of water into measuring cylinder **A.** Measure the volume of water and record it in your table.

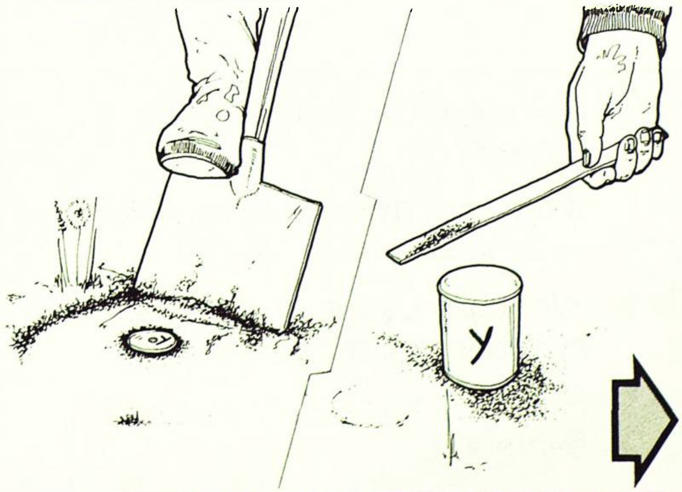


B Level off the surface of some soil with a stick.

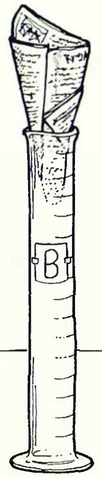
C Press can **Y** down into the soil, twisting it slightly.



D Dig out the can with a spade. Level off the top of the soil with a stick.

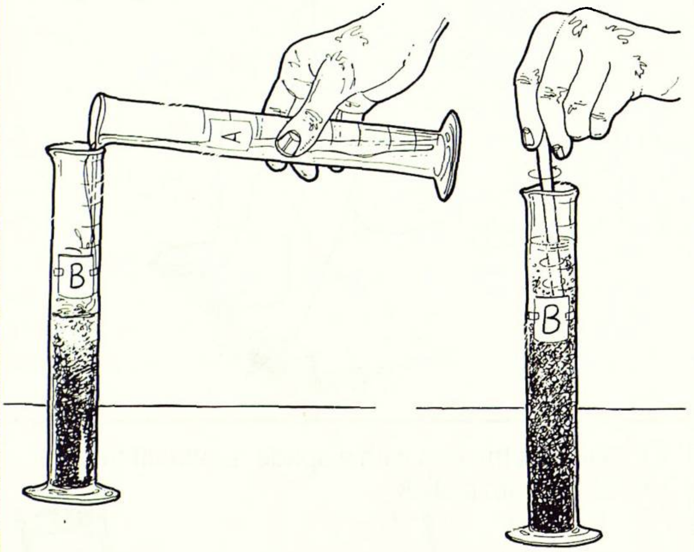


E Make a funnel from newspaper. Hold it in the top of measuring cylinder **B.**

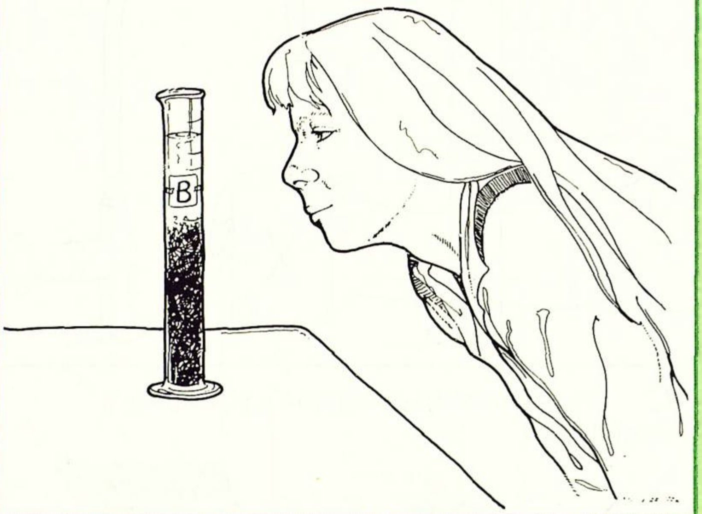


F Empty the can of soil into measuring cylinder **B.** Measure the volume of soil. Fill in rows (2) and (3) of your table.

G Pour the water from cylinder **A** onto the soil. Stir gently until bubbles stop coming from the soil.



H Measure the volume of the soil and water mixture. Fill in rows (4) and (5) of your table.



Q10 Are volumes (3) and (4) the same?

Q11 If they are **not** the same, which volume is smaller?

Q12 What has caused the difference between volumes (3) and (4)?

Q13 How much air was in your soil sample?

Q14 Work out the percentage of air in your soil sample.

$$\%\text{ of air in sample} = \frac{\text{volume }(5) \times 100}{\text{volume }(2)}$$

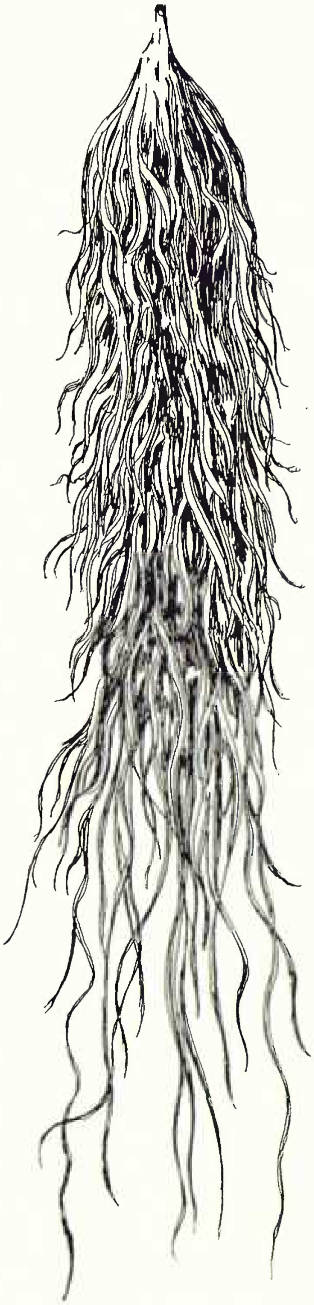
Q15 Why is it useful to work out a percentage?

Q16 Why is the soil collected in a can with a hole in the bottom?

Soil air contains oxygen, nitrogen and carbon dioxide. The roots of plants need oxygen. Unless the roots get enough oxygen they will not grow properly. Animals loosen the soil by moving about and burrowing through it. This **aerates** the soil and gives the plant roots oxygen.

Roots growing in badly aerated soil.

Roots growing in well aerated soil.



Lawns are rolled and walked on. The soil particles become very closely packed, and the amount of air round the grass roots is reduced. A machine like the one below **spikes** the lawn so that air can get in between the particles. This **aeration** helps the grass to grow.

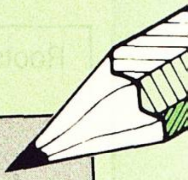
Q17 Which gases are found in soil air? **Q18** Why must lawns be aerated?

Soil drainage

Apparatus

- ★ filter funnel
- ★ 3 soil samples, X, Y and Z
- ★ scoop
- ★ clampstand with boss head
- ★ small gauze square
- ★ two 10 cm³ measuring cylinders
- ★ stop clock

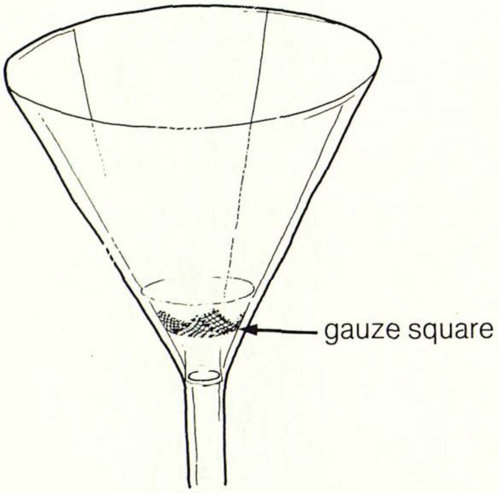
You are going to find out about the drainage of different soils.



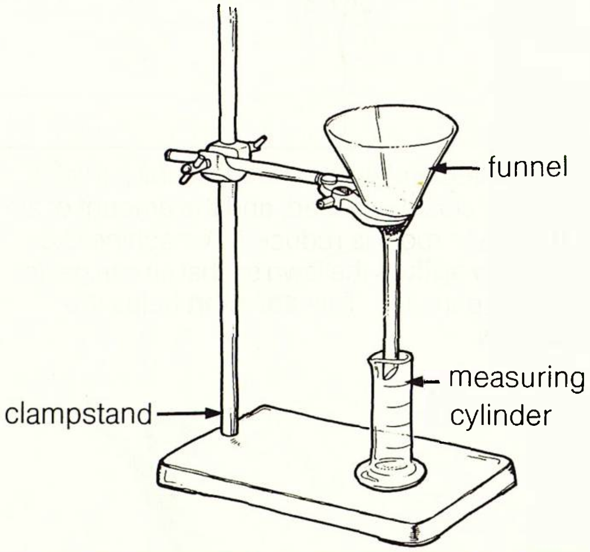
Q19 Copy this table.

Soil sample	Amount of water poured into funnel (P)	Amount of water passed through in 5 minutes (Q)	Amount of water left in funnel (P−Q)

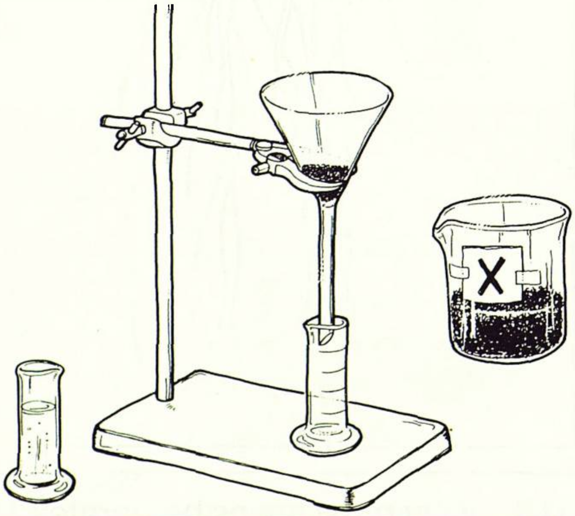
A Put a gauze square into a funnel.



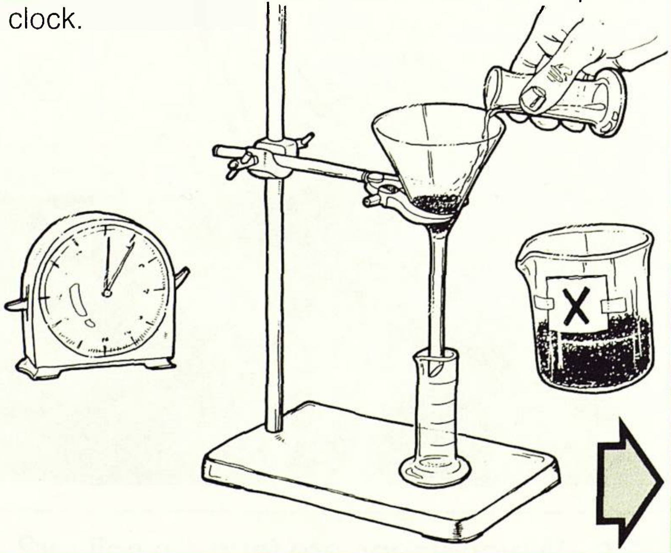
B Set up the apparatus as shown.



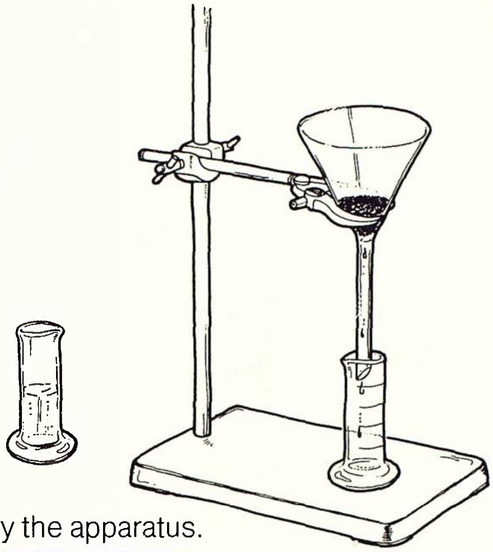
C Put one level scoopful of soil sample **X** into the funnel. Fill the other cylinder with 10 cm³ of water.



D Pour the water onto the soil. Start the stop clock.

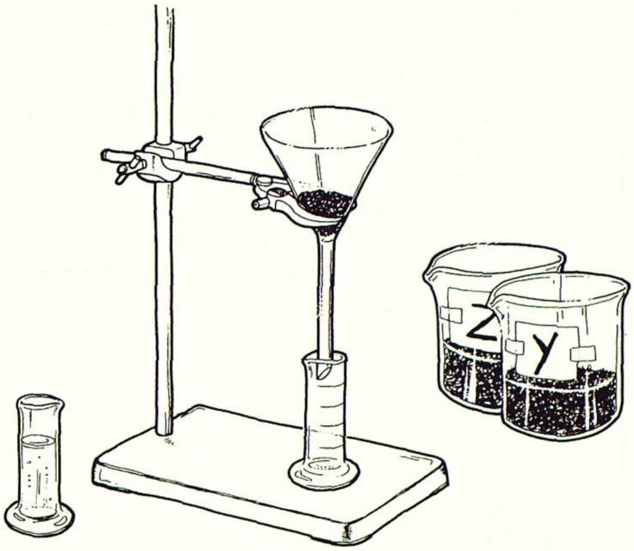


E After 5 minutes, record how much water has dripped or **drained** through the soil. Fill in the last 2 columns of your table.



Empty the apparatus.

F Repeat steps A to E for soil samples **Y** and **Z.**



Q20 Through which soil did most water drain?

Q21 Water was **retained** (kept in) by some soils. Which soil retained most water?

Q22 A soil is **waterlogged** when the air spaces are filled with water. Which of the soil samples could get waterlogged?

Q23 Would plants grow well in a waterlogged soil? Explain your answer.

Information: Loam

The size of the particles is one way of telling what sort of soil you have. A clay soil is made up of very small particles which are packed tightly together. Water cannot drain through easily. The particles in sandy soil are bigger and coarser. They do not fit tightly together, so water drains through quickly and the soil may dry out.

A **loam** soil is a mixture of clay, sand, silt and humus. This *mixture of different sized particles* stops the soil from becoming waterlogged or drying out too quickly. It retains the right amount of water for good plant growth. Loam is a good soil for growing crops. It is very **fertile.**

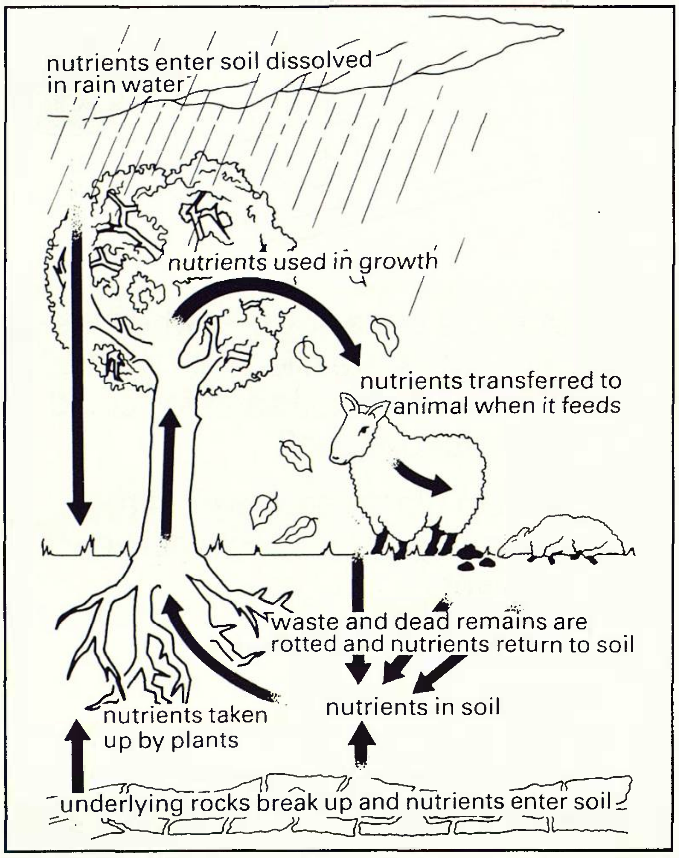
Q24 What is a loam?

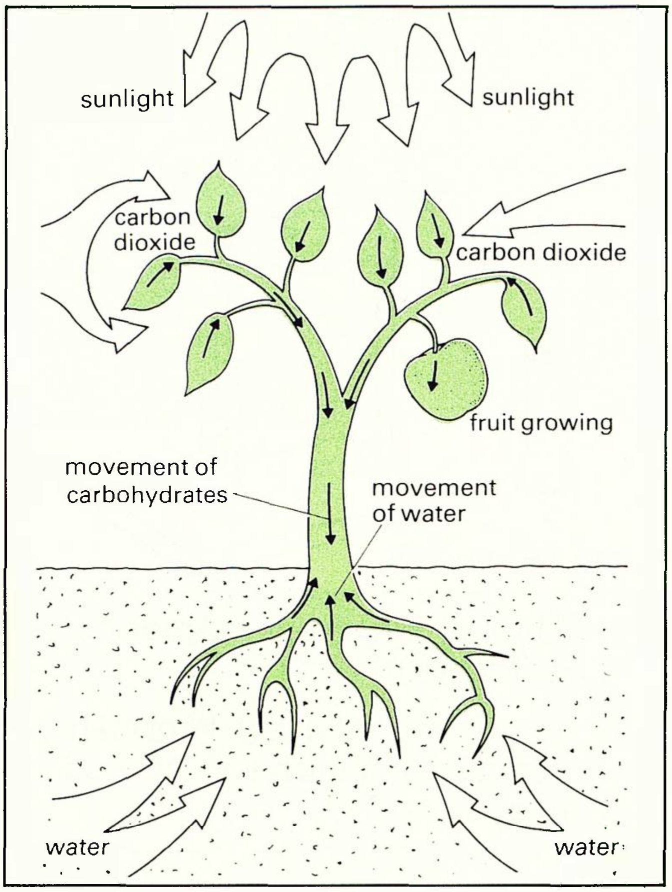
Q25 Why is a loam soil good for growing crops?

2 Soil nutrients

Information: Fertile soil

Green plants are the only living things that can make their own food. All animals depend on plants for food. In sunlight, green plants take in carbon dioxide from the air. The gas gets into the plants through tiny holes in the leaves. To make food the plants also need water and **nutrients.** These get into the plant from the soil through the roots. The nutrients are minerals. The 3 main nutrients all plants need are **nitrogen, phosphate** and **potash.**





In nature the nutrients in the soil are replaced when plants and animals die and rot. When a crop is grown, nutrients are taken up from the soil. When the crop is harvested, the nutrients it contains are taken away and not put back into the soil. If this goes on for some time the soil becomes very poor in nutrients. Crops will not grow properly. The soil is **infertile.**

Lowest soil pH in which crop will grow

4·2	potatoes
4·6	oats
4·8	beans
5·0	turnips
5·1	wheat / peas
5·3	carrots
5·4	barley

increasing acidity

Where there is a lot of rainfall, the water washes away the nutrients from the soil. The soil becomes acid. Soil acidity is shown by its **pH value.** Most crops grow best where the soil pH is 6·5. Some will grow in soils with a low pH (acid soils).

A farmer can add **lime** to his soil to make it less acid.

A farmer can do several things to make a soil fertile again. In the past, he would leave a field **fallow** (without crops growing) for a year or two to give the soil time to replace its nutrients. Today he can add **manure** or **fertilizer** to the soil.

Manure is the bulky waste of farm animals like cows and horses. Manure is put on the soil in large amounts usually once a year. This is called **muck spreading.** Manure improves the texture of the soil and gives the soil a very small amount of nitrogen.

⇦ This machine is used for muck spreading.

Some fertilizers come from animals and plants. Others are chemicals made in factories. Fertilizers can be powders, pellets, granules or liquids. Granules and pellets break down steadily and so give the plants a continuous supply of nutrients. Many fertilizers contain nitrogen.

Granules of a fertilizer containing ammonium nitrate being added to grassland by a "spinning disc" machine. ⇨

Q1 What do green plants need to make food?

Q2 How are nutrients in the soil replaced in nature?

Q3 Why is lime added to soil?

Q4 Why does a soil become infertile?

Q5 What is the difference between manure and a factory-made fertilizer?

Q6 Why do farmers put manure and fertilizers on their land?

Q7 What is the advantage of using fertilizers in pellet form?

Testing soils for nitrogen

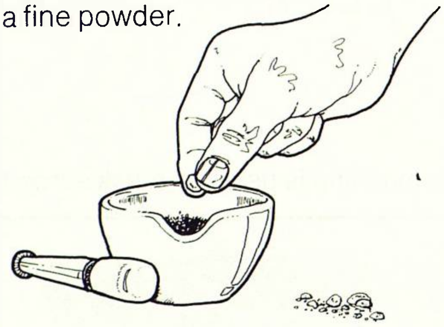
Apparatus

★ white-corked test tube ★ bottle of nitrogen test solution ★ spoon ★ small beaker
★ 2 samples of dry soil, X and Y ★ stop clock ★ pestle and mortar ★ spatula
★ colour chart (nitrogen) ★ safety goggles

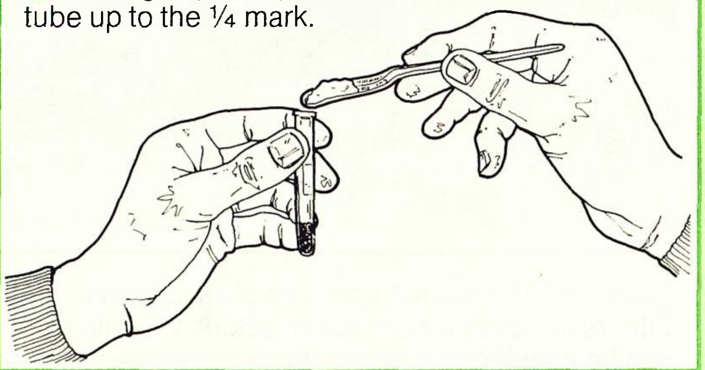
You are going to find out if soils are lacking in nitrogen.

Wear safety goggles.

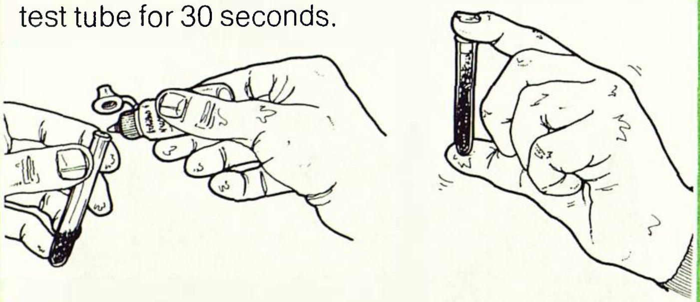
A Put 2 spoonfuls of soil **X** in a mortar. Take out any small stones, bits of chalk and fibres. Grind the sample to a fine powder.



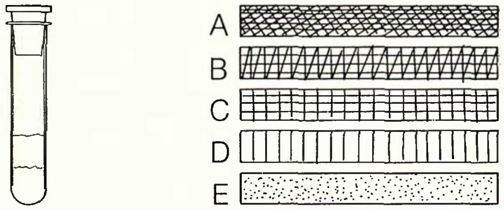
B Using a spatula put soil **X** into the white-corked tube up to the ¼ mark.



C Add the nitrogen test solution until the level reaches the ½ mark. Replace the cork. Shake the test tube for 30 seconds.



D Leave the test tube for 10 minutes. Match the colour of the test tube contents to your colour chart for nitrogen.



E Repeat steps A to D for soil sample **Y.**

Q8 What was the percentage figure next to the colour on the chart for:
a soil sample **X**? **b** soil sample **Y**?

The percentage number next to the colour tells you how much nitrogen fertilizer needs to be added to the soil to make it fertile.

Q9 Look at the table. How much nitrogen fertilizer needs to be added to 10 square metres of:
a soil **X**? **b** soil **Y**?

Percentage of nitrogen needed by soil	Colour code	Amount of fertilizer to be spread over 10 m² (Horn and hoof 12% N)
2%	A	275 g
3%	B	400 g
4%	C	550 g
6%	D	825 g
8%	E	1100 g

Testing soils for potash

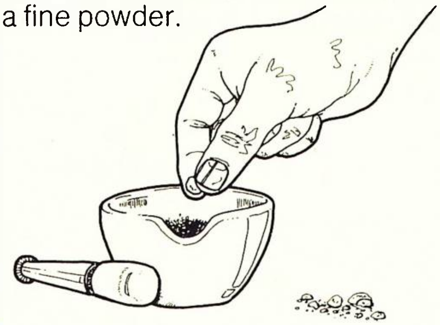
Apparatus

- ★ yellow-corked test tube
- ★ bottle of potash test solution
- ★ 2 samples of dry soil X and Y
- ★ spoon
- ★ small beaker
- ★ stop clock
- ★ pestle and mortar
- ★ spatula
- ★ colour chart (potash)
- ★ safety goggles

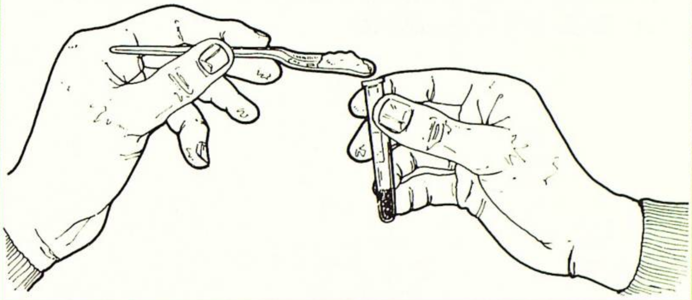
You are going to find out if soils are lacking in potash.

Wear safety goggles.

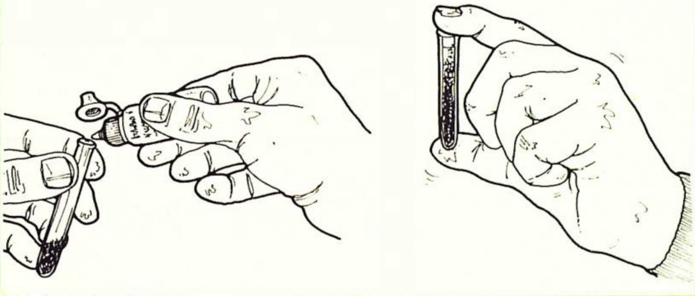
A Put 2 spoonfuls of soil **X** in a mortar. Take out any small stones, bits of chalk and fibres. Grind the sample to a fine powder.



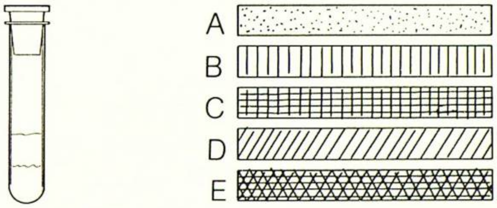
B Using a spatula put soil **X** into the yellow-corked tube up to the ¼ mark.



C Add the potash test solution very slowly until the level reaches the ½ mark. Replace the cork. Shake the test tube for 30 seconds.



D Leave the test tube for 10 minutes. Match the colour of the test tube contents to your colour chart for potash.



E Repeat steps A to D for soil sample **Y**.

Q10 What was the percentage figure next to the colour on the chart for:
a soil **X**?
b soil **Y**?

Q11 Look at the table. How much potash fertilizer must you give to 10 square metres of:
a soil **X**?
b soil **Y**?

Percentage of potash needed by soil	Colour code	Amount of fertilizer to be spread over 10 m² (Sulphate of Potash 50% K)
2%	A	60 g
4%	B	120 g
8%	C	250 g
12%	D	375 g
16%	E	500 g

Testing soils for phosphorus

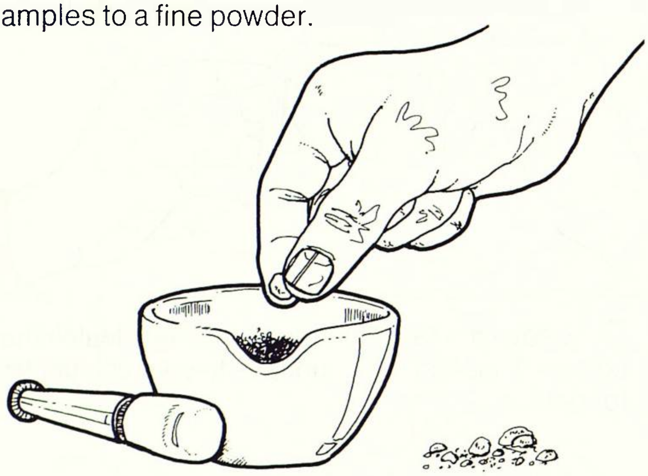
Apparatus

- ★ blue-corked test tube
- ★ bottle of phosphorus test solution
- ★ spoon
- ★ 2 samples of dry soil, X and Y
- ★ small beaker
- ★ pestle and mortar
- ★ tin rod
- ★ piece of sandpaper
- ★ colour chart (phosphorus)
- ★ spatula

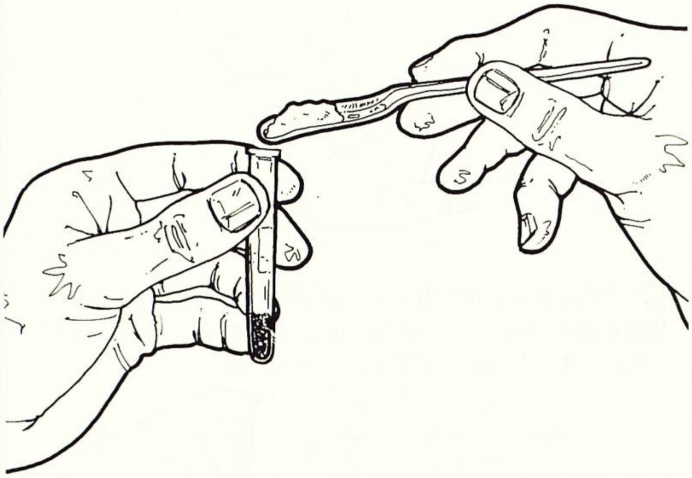
You are going to find out if soils are lacking in phosphorus.

Wear safety goggles.

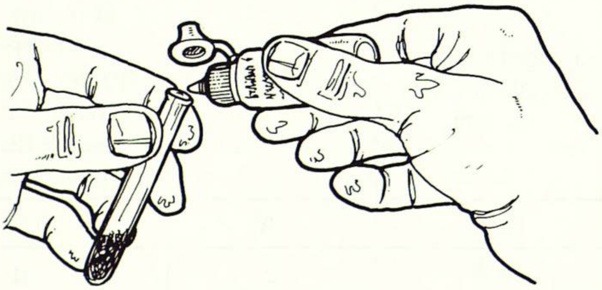
A Put 2 spoonfuls of soil **X** in a mortar. Take out any small stones, bits of chalk and fibres. Grind the samples to a fine powder.



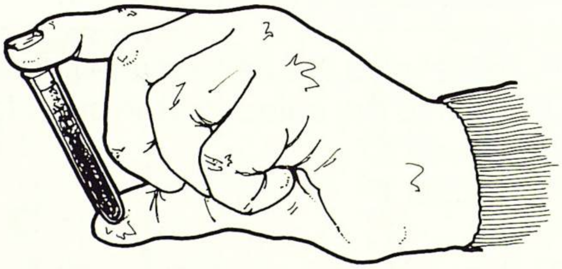
B Using a spatula put soil **X** into the blue-corked test tube up to the ¼ mark.



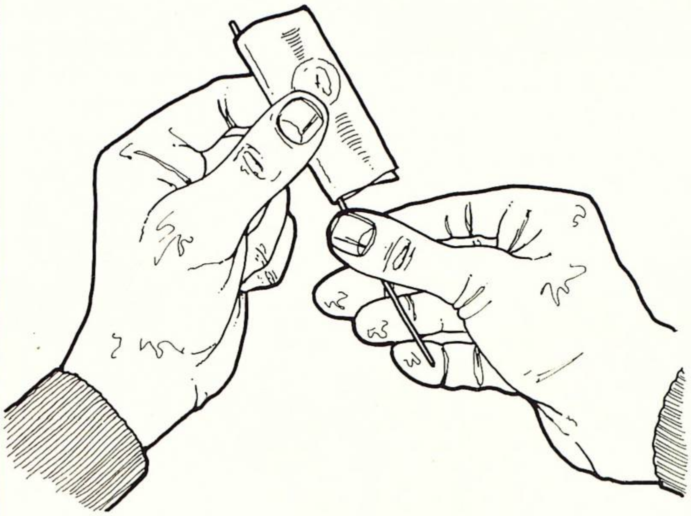
C Add the phosphorus test solution **very slowly** until the level reaches the ½ mark.



D Replace the cork. **Gently** tip the test tube from side to side for 30 seconds. Leave the test tube for at least 15 minutes.

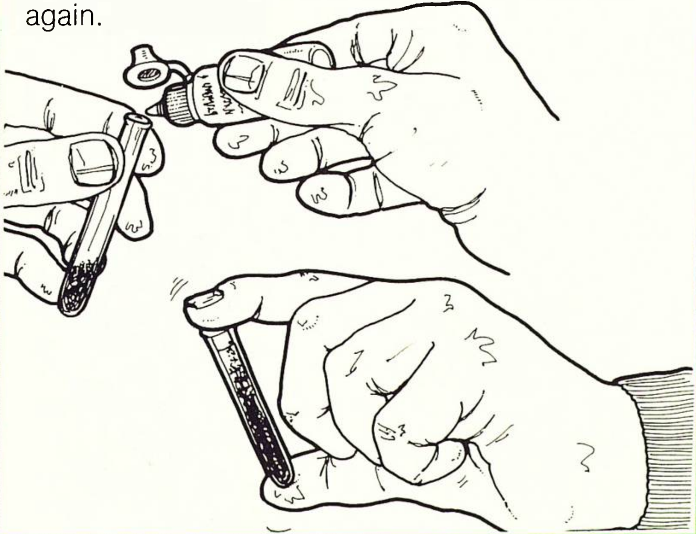


E Meanwhile, clean the tin rod with sandpaper. Bend one end of the rod into a small loop.

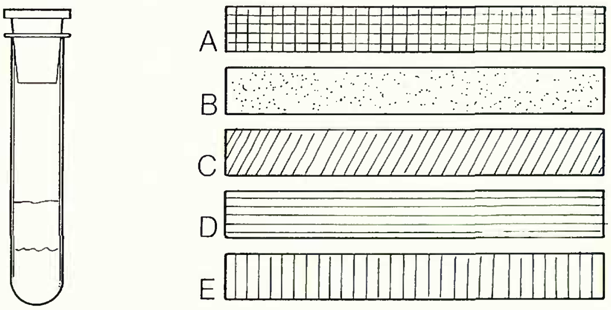


F Stir the solution above the soil with a tin rod for 30 seconds. Do not stir the soil.

G If there is no blue colour, add one more drop of phosphorus test solution. Clean the rod and stir again.



H Match the colour of your test tube contents with the colour chart for phosphorus.



I Repeat steps A to H for soil sample **Y.**

Q12 What was the percentage figure next to the colour on the chart for:
- **a** soil **X**?
- **b** soil **Y**?

Q13 Look at the table. How much phosphorus fertilizer must you add to 10 square metres of:
- **a** soil **X**?
- **b** soil **Y**?

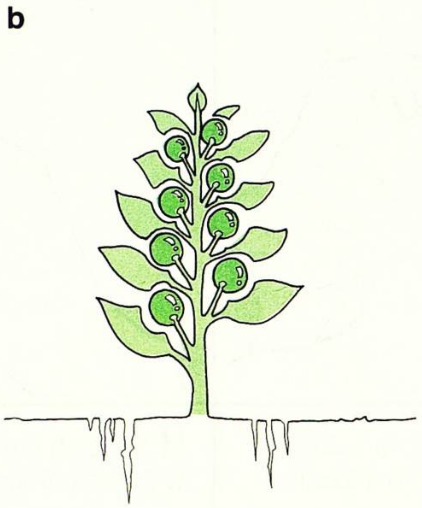
Percentage of phosphorus needed by soil	Colour code	Amount of fertilizer to be spread over 10 m² (Steamed Bone Meal 25% P)
2%	A	125 g
4%	B	250 g
6%	C	375 g
8%	D	500 g
10%	E	625 g

Plant nutrients

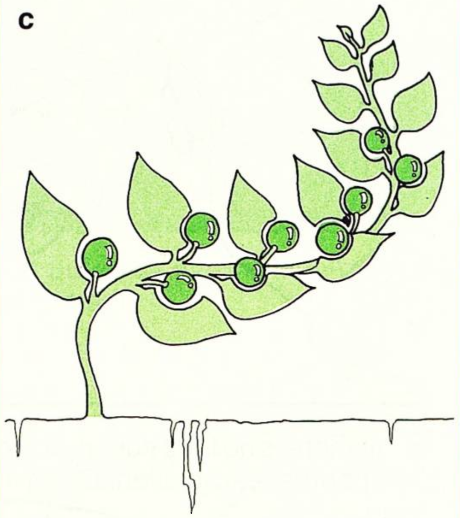
You are going to look at these drawings to see the effects of nutrients on plant growth.

NITROGEN

This plant is growing in a soil that contains the right amount of nitrogen.



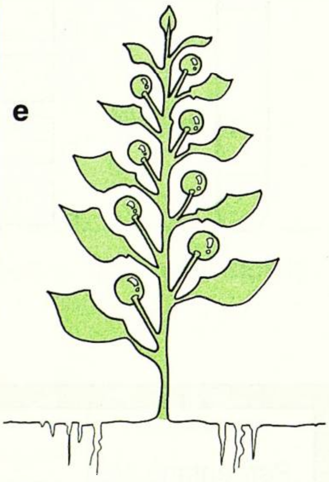
This plant is growing in a soil that does not contain enough nitrogen.



This plant is growing in a soil that contains too much nitrogen.

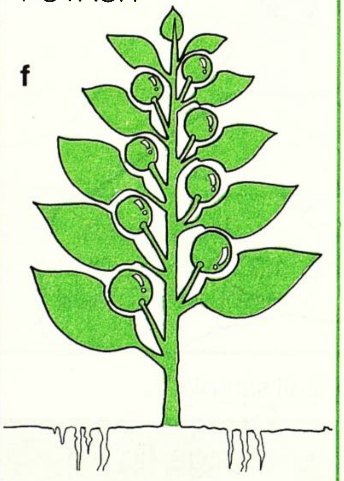
PHOSPHORUS
(phosphate)

This plant is growing in a soil that contains a lot of phosphorus.

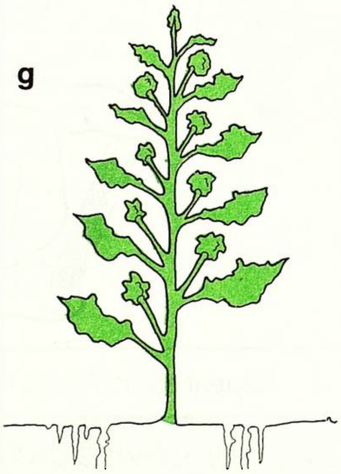


This plant is growing in a soil that does not contain enough phosphorus.

POTASH



This plant is growing in a soil that contains the right amount of potash.



This plant is growing in a soil that does not contain enough potash.

Q14 What happens to plants if they do not get:

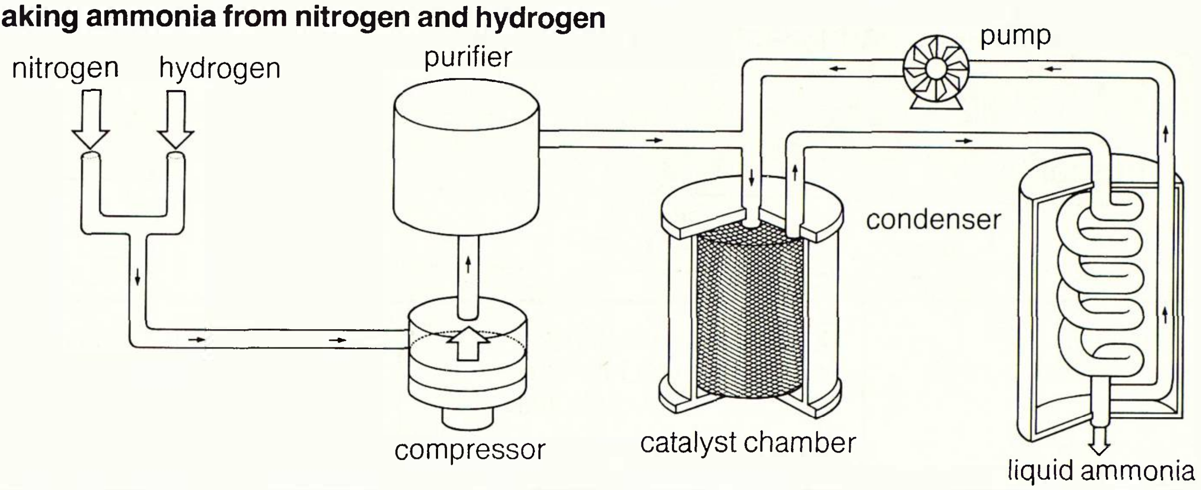
a enough nitrogen?
b enough potash?
c enough phosphate (phosphorus)?

Q15 How would you find out if green plants need iron for growth?

Information: Types of fertilizers

Fertilizers that contain nitrogen are **ammonium sulphate** and **ammonium nitrate.** They are cheap to make and easy to store. These fertilizers are made from industrially produced **ammonia.** Ammonia used to be made from coal. At the beginning of the 20th Century it was found that if nitrogen and hydrogen are heated together at high pressure, they combine to give ammonia.

Making ammonia from nitrogen and hydrogen



When bones are ground the powder contains a lot of phosphorus. This powder is called bone meal and is used as a phosphorus fertilizer. Phosphorus is also produced as a by-product in steel works.

Another fertilizer used is potash. Some potash fertilizers occur naturally. Potassium sulphate is one of these substances. Bonfire ash and seaweed are also rich in potash and can be used as fertilizers.

Different fertilizers can be mixed together to suit all kinds of plants and soils.

Q16 What substances are used to make ammonia?

Q17 What kind of fertilizer is bone meal?

Q18 Why can dried seaweed be used as a fertilizer?

3 Food from plants

Testing for glucose sugar

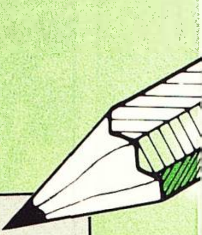
Apparatus

★ tripod ★ gauze ★ heat proof mat ★ Bunsen burner ★ 250 cm³ beaker
★ tongs ★ test tubes ★ test tube rack ★ distilled water ★ glucose
★ Benedict's solution ★ ruler ★ stop clock ★ seeds and plant parts ★ labels
★ safety goggles ★ spatula

You are going to test seeds and plant parts for glucose sugar.

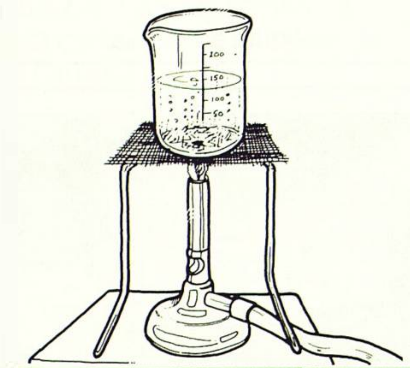
Wear safety goggles.

Q1 Copy this table.

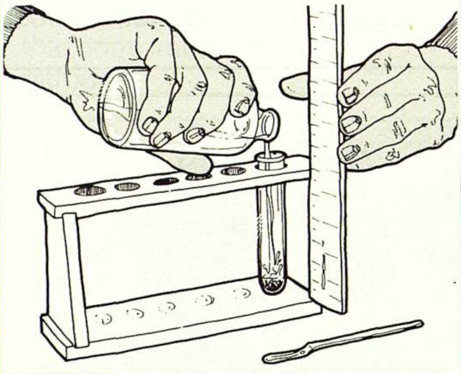


Substance tested	Colour after heating with Benedict's solution and leaving to cool	Is glucose present?

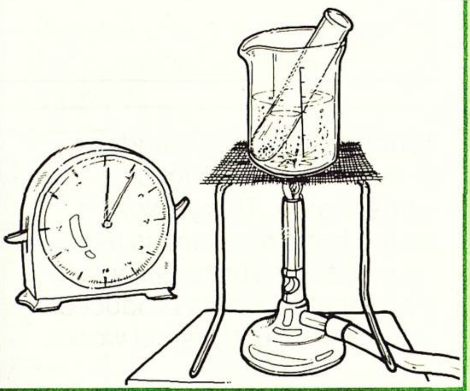
A Half fill a beaker with water. Heat the water until it starts to boil.



B Put 1 spatula full of glucose in a test tube. Add 2 cm³ of Benedict's solution.

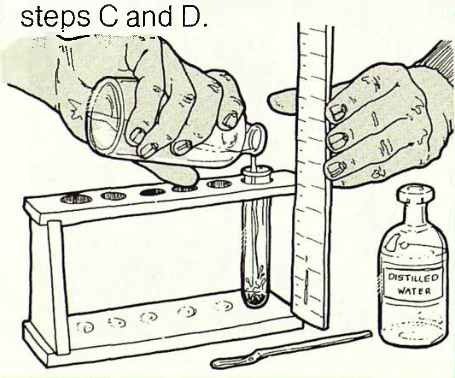


C Put the test tube in the beaker. Heat it for 5 minutes.

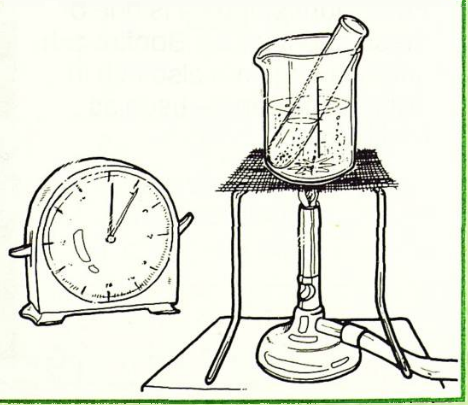


D Remove the test tube. Allow it to cool. Record the colour of the contents in your table.

E Put 1 cm³ of distilled water in a test tube. Add 2 cm³ of Benedict's solution. Repeat steps C and D.



F Repeat steps B, C and D for each seed and plant part.

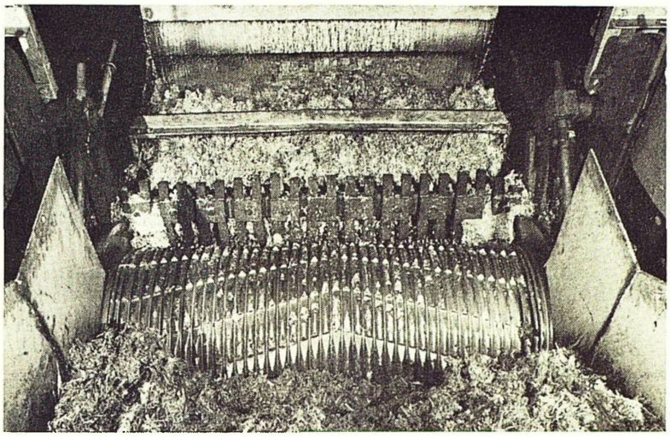


Q2 Why is the test done:
a with pure glucose?
b with distilled water?

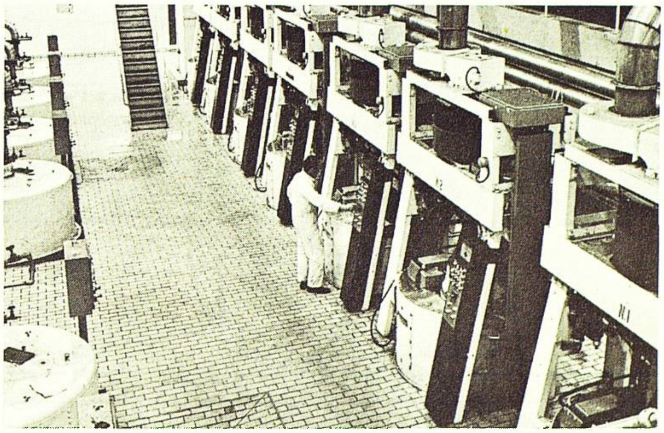
Q3 Which seeds and plant parts contain glucose sugar? How do you know?

Information: Nutrients in plants

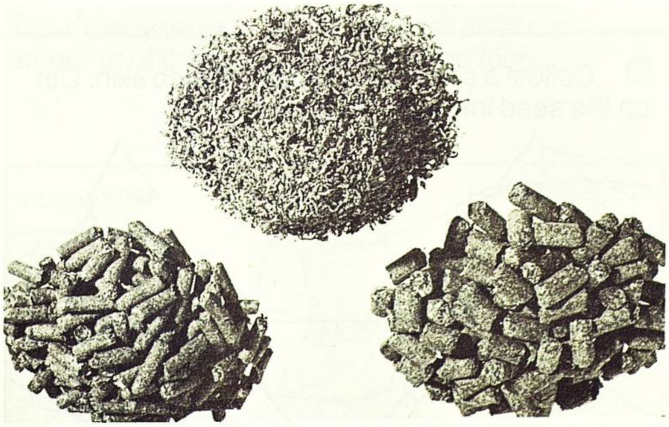
The chemicals in food are divided into 6 groups. These are **carbohydrates, proteins, fats, water, vitamins** and **minerals.** Plant parts that contain a lot of carbohydrates are **sugary** or **starchy.** The 2 plants on the right produce enough sugar to provide the large quantities needed by man.



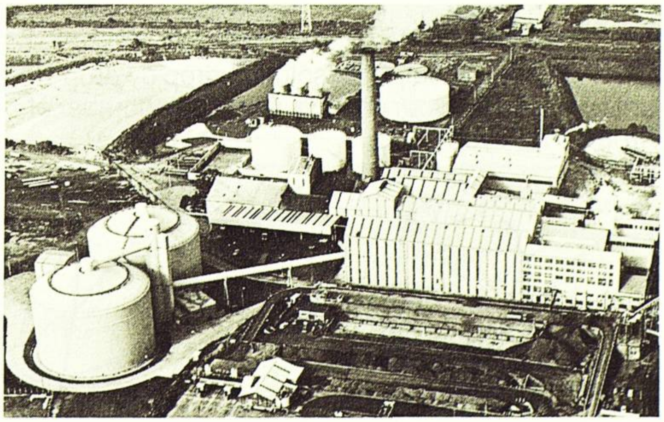
When sugar is made the sugar beet or sugar cane is crushed. The brown **sap** (juice) is squeezed out by heavy rollers.



After the juice is cleaned it is boiled until **crystals** form. The mixture is put in a **centrifugal** (revolving drum) as shown above. Water and juice pass out as it spins round and the crystals are left behind.



The left-over juice is a sweet syrup called **molasses.** It is mixed with the sugar beet pulp to make cattle food.



The British Sugar Corporation factory at Peterborough. The round silos on the left can each hold 30 000 tonnes of sugar.

Q4 Which plants make a lot of sugar?

Q5 What is molasses?

Testing for protein

Apparatus

- ★ egg white
- ★ sodium hydroxide solution
- ★ copper sulphate solution
- ★ 5 cm³ syringe
- ★ test tube rack
- ★ dropper
- ★ test tubes
- ★ glass rod
- ★ seeds and plant parts
- ★ white tile
- ★ knife
- ★ safety goggles

You are going to test seeds and plant parts for protein.

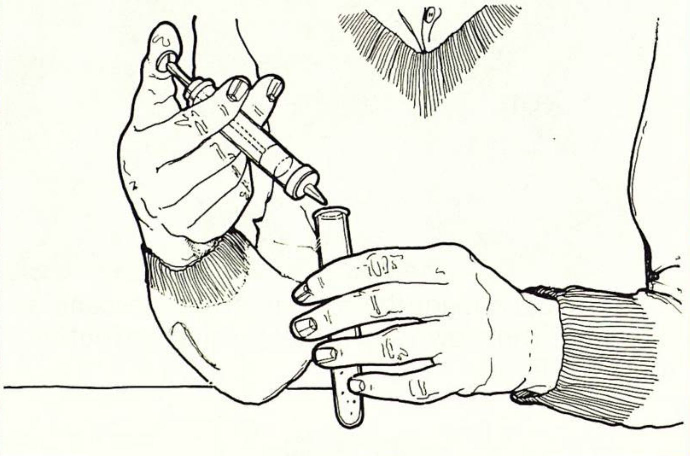
☠ Wear safety goggles.

Q6 Copy this table.

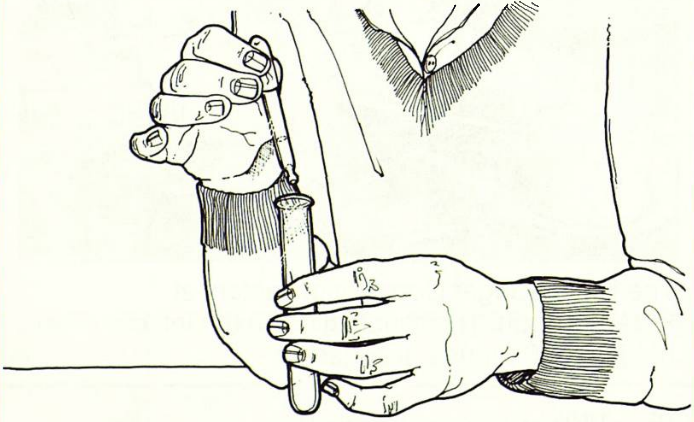
Substance tested	Number of drops of copper sulphate solution added	Colour after adding copper sulphate solution	Is protein present?

A Half fill a test tube with egg white (pure protein).

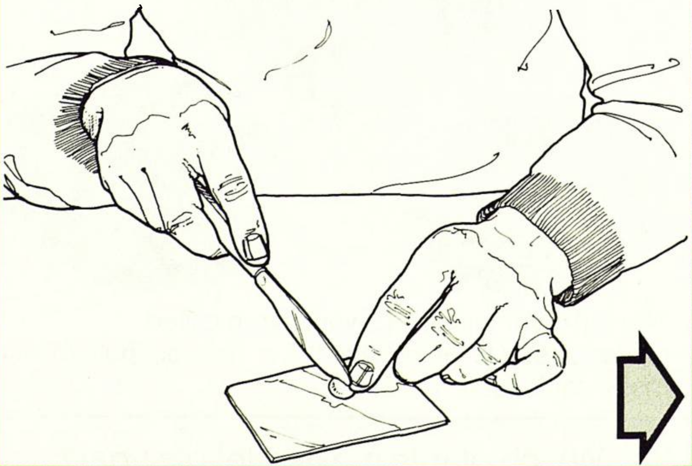
B Add 1 cm³ sodium hydroxide solution to the egg white. Stir.



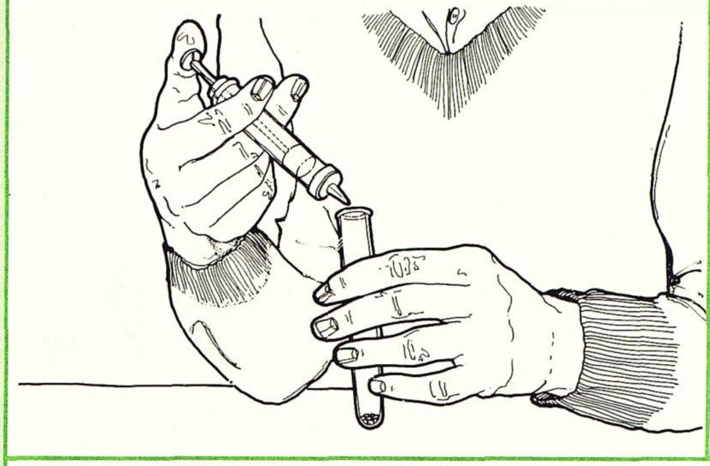
C Add copper sulphate solution drop by drop until you see a colour change. Count the number of drops. Fill in your table.



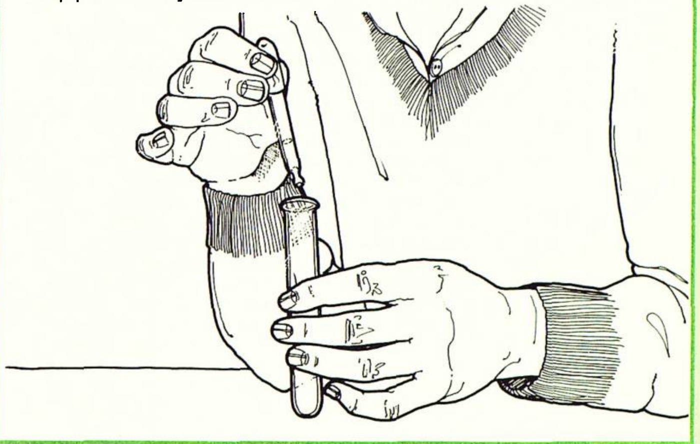
D Collect a seed. Take off the outside skin. Cut up the seed into very small pieces.



E Put the pieces of seed into a test tube. Add 1 cm³ sodium hydroxide solution. Stir.



F Add the same number of drops of copper sulphate solution as you did in step C. Record what happens in your table.



G Repeat steps D to F for each seed and plant part.

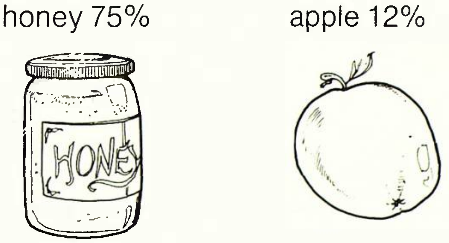
Q7 Why is pure protein used at the start of the experiment?

Q8 Which seeds and plant parts contain protein? How do you know?

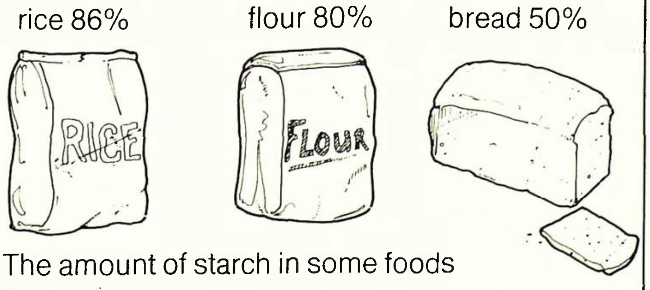
Information: Food from plants

Many plant parts are **processed** to make human food. Wheat is used to make flour. Flour is used in bread and cake. Different foods contain different amounts of carbohydrate, (sugars and starches) and proteins.

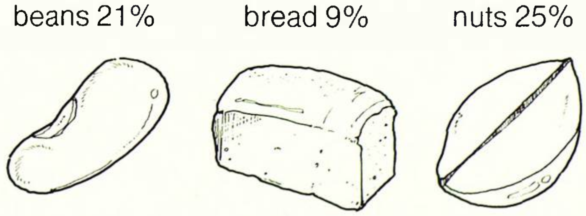
The drawings on the right show the different amounts of these chemicals in some food.



The amount of sugar in some foods



The amount of starch in some foods



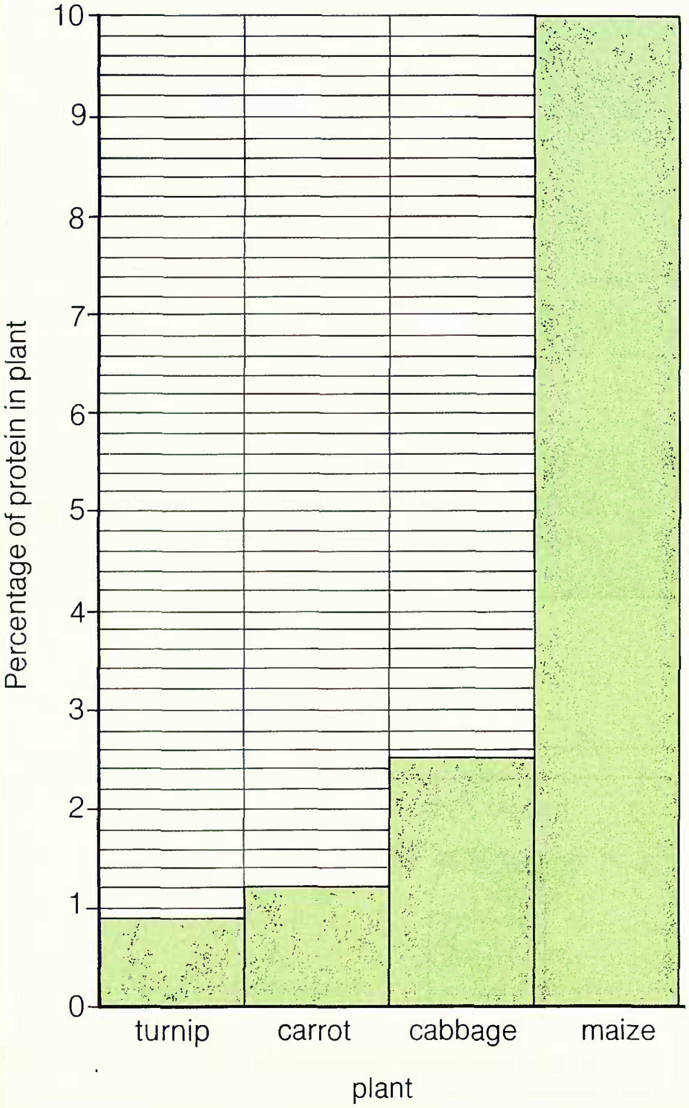
The amount of protein in some foods

Q9 How much sugar is there in an apple?

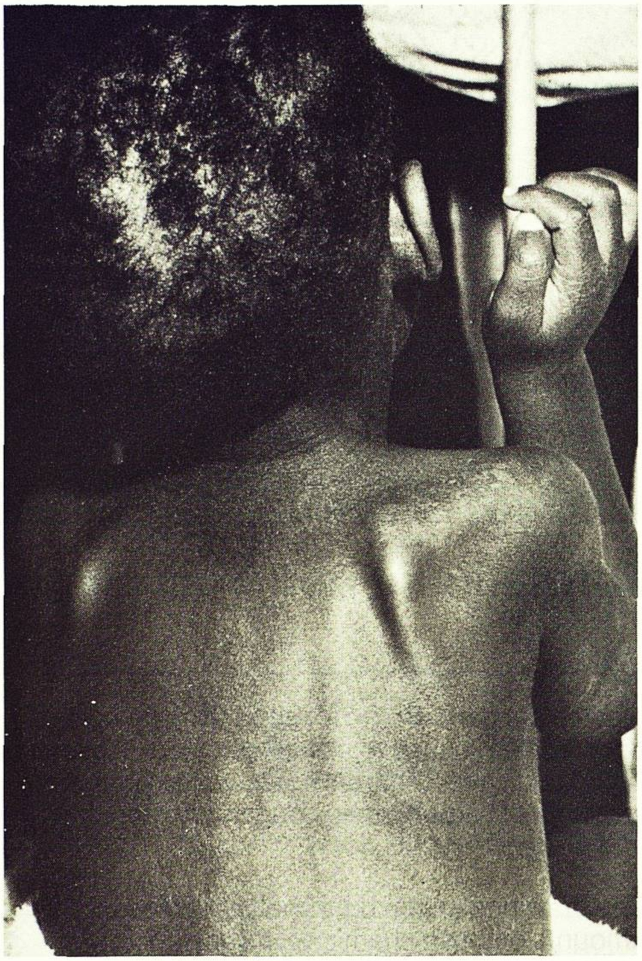
Q10 Which contains the most starch, rice or flour?

Information: Plant proteins

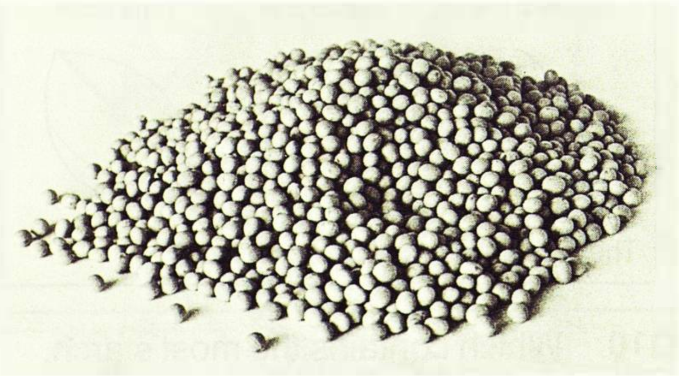
Protein is the chemical needed by plants and animals for growth. Green plants can make their own protein. The amount of protein in plants varies.



Animal protein is found in the muscles of their bodies. Humans get the protein they need from eating plants and animals. A shortage of protein in the human body causes diseases like **kwashiorkor** and **marasmus.**



The child in this photograph is suffering from kwashiorkor.



Many people in the world do not have enough protein in their diets. Scientists have had to work out new ways of getting protein food. The **soya bean** contains a lot of protein. By treating soya beans in different ways **textured vegetable proteins (TVP)** and **spun vegetable proteins (SVP)** have been made. These can be flavoured and shaped to look like meat.

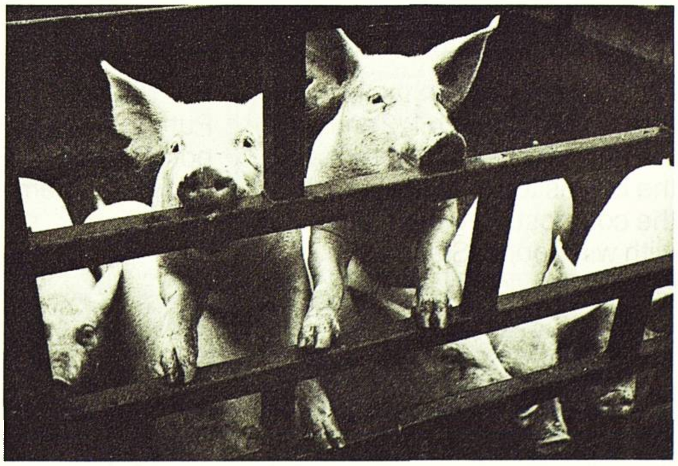
Ground soya beans (soya flour) can be mixed into dough with water, salt and flavourings. The dough is heated and pushed through metal **dies.** This is **extrusion.** A spongy mass forms which can be chopped into pieces, dried and stored. These pieces have to be cooked in water before they are ready to eat.

Dry TVP – extruded soya flour ⇨

Meat consists of muscle fibres which give it its appearance and texture. Purified protein, for example soya protein, can be **spun** to produce fibres which are pressed into blocks. These fibres can be arranged, coloured and flavoured to make the protein look like meat, poultry or fish. Streaky bacon is made by adding red and white colourings and fat.

⇦ SVP – spun soya protein

Microbes such as **yeast** and **bacteria** are used to make protein from simple foodstuffs. A 1000 kg steer will produce only 60 kg of protein for human food. The same amount of soya bean will produce about 300 kg of protein. However, 1000 kg of bacteria will produce 740 kg of protein. Bacterial protein is used to feed farm animals.



These pigs are fed on **Pruteen,** a bacterial protein. ⇨

Q11 How much of a turnip is protein?

Q12 What is marasmus?

Q13 What is TVP?

Q14 What is the difference between extruded TVP and spun SVP?

Q15 How much protein could be made by 10 kg of bacteria?

4 Growing new plants

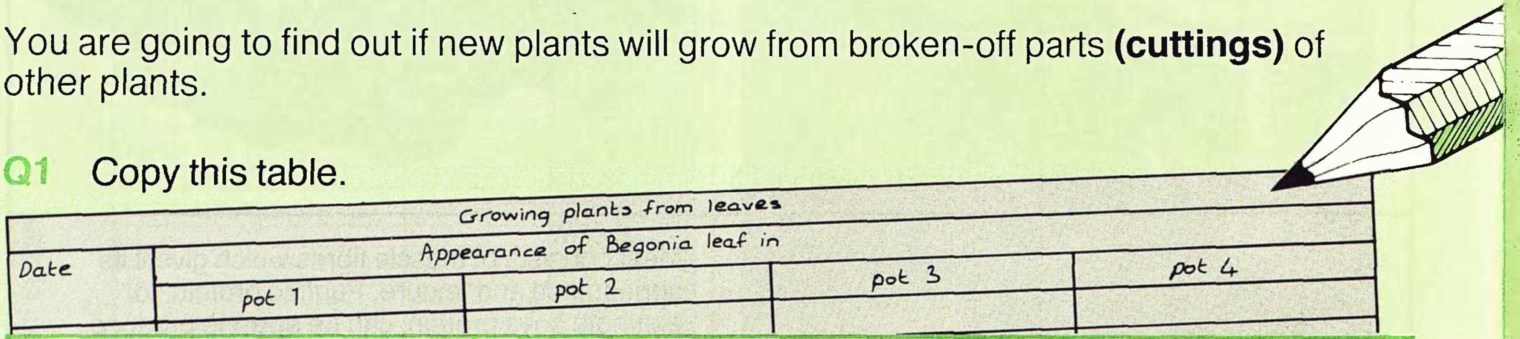
Leaf and stem cuttings

Apparatus

★ 7 pots ★ 7 plastic (margarine) tubs ★ damp potting compost ★ sand
★ broken bits of flower pot ★ elastic bands ★ plant labels ★ knife ★ white tile
★ wire loops ★ pencil ★ plastic bags ★ selection of Begonia and geranium plants
★ plant labels

You are going to find out if new plants will grow from broken-off parts **(cuttings)** of other plants.

Q1 Copy this table.

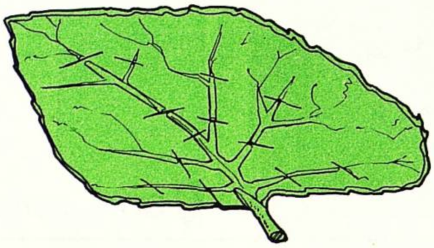


Growing plants from leaves

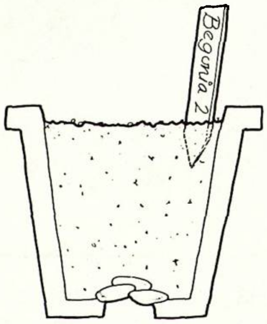
Date	Appearance of Begonia leaf in			
	pot 1	pot 2	pot 3	pot 4

A Write out 4 labels.

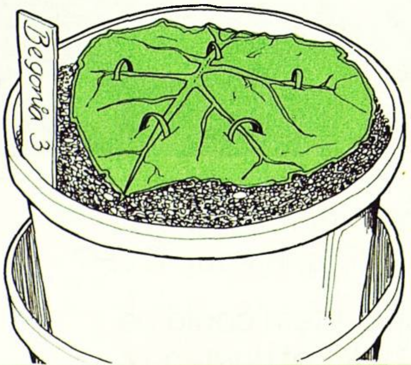
B Cut through the main veins on the underneath side of 3 Begonia leaves.



C Put broken bits of flower pot in the bottom of each pot. Fill each pot with compost. Stick a label in each pot.

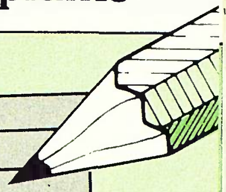


D Put a cut leaf on the top of the compost in pots 1, 2 and 3. Put an uncut leaf into pot 4. Lay the leaves top side upwards in the compost. Peg them down with wire loops. Stand each pot in a plastic tub.



E Put pot 1 in a cold place. Put pot 2 in a warm place. Put pots 3 and 4 in a warm place and water them when needed.

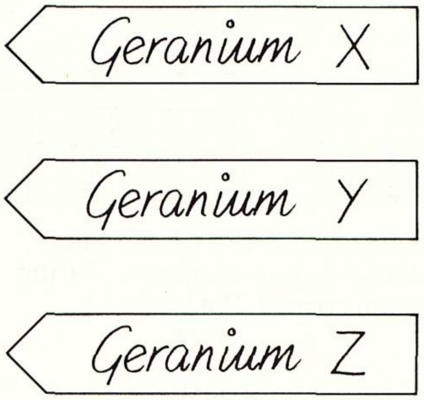
F Record in your table the appearance of each Begonia leaf each lesson for several weeks. Put the date of each recording in your table.



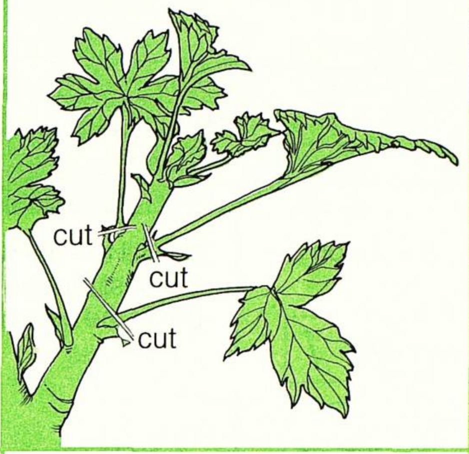
Q2 Copy this table.

Growing plants from stems			
Date	Appearance of Geranium in		
	pot X	pot Y	pot Z

G Write out 3 plant labels.



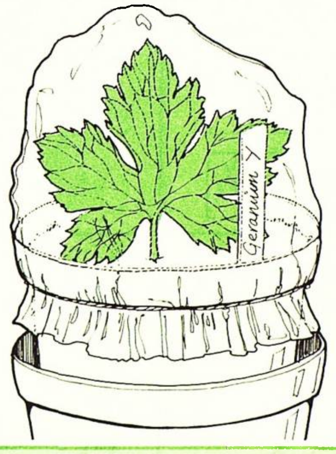
H Cut off 3 stems from a geranium plant as shown. Repeat step C.



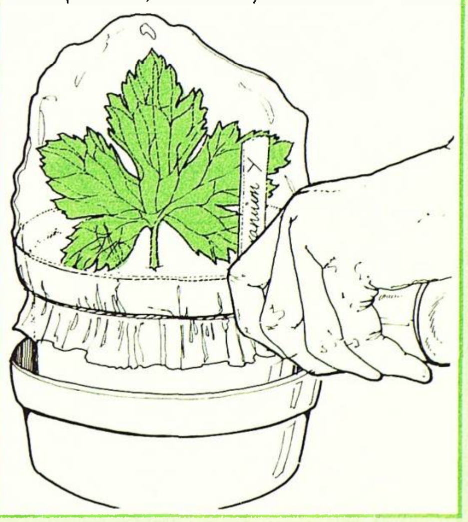
I Make a hole in the compost with the pencil (about 4 cm deep).

J Put a pinch of sand in the bottom of the hole. Put in one of the geranium stem pieces. Press down the soil round the stem. Put in a plant label.

K Repeat steps I and J for the other 2 stems. Cover each pot with a plastic bag. Stand each pot in a plastic tub.



L Repeat steps E and F (as for pots 1, 2 and 3).



Q3 By the time you made your last recording, what happened to:

a Begonia leaf 1?
b Begonia leaf 2?
c Begonia leaf 3?
d Begonia leaf 4?

Q4 What are the best conditions for getting new plants from Begonia leaves?

Q5 By the time you made your last recording, what happened to:

a geranium stem X?
b geranium stem Y?
c geranium stem Z?

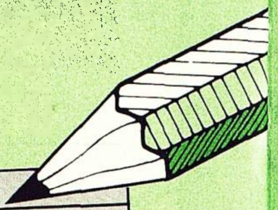
Q6 What happened to the air inside the plastic bags covering the geranium pots?

Root cuttings

Apparatus

- ★ dandelion roots
- ★ knife
- ★ white tile
- ★ potting compost
- ★ pencil
- ★ 1 pot
- ★ seed tray with potting compost
- ★ 6 plant labels

You are going to find out if dandelion roots can grow into new plants.



Q7 Copy this table.

Growing dandelion plants from roots						
Date	Appearance of dandelion root near					
	label 1	label 2	label 3	label 4	label 5	label 6

A Write out 6 plant labels. Collect 4 dandelion roots.

Dandelion root - whole, upright 1

Dandelion root - whole, sideways 2

Dandelion root - bit, upright 3

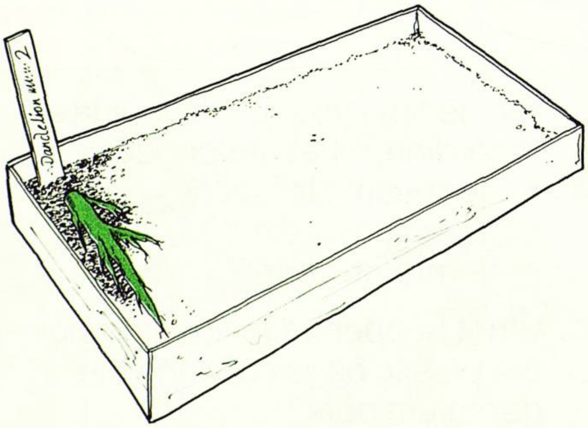
Dandelion root - bit, sideways 4

Dandelion root - bit, peeled, upright 5

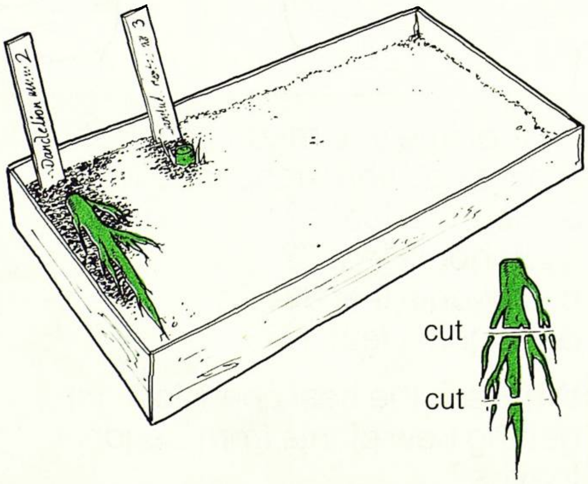
Dandelion root - bit, peeled, sideways 6

B Fill the pot with compost. Make a hole in the compost the same length as one whole root. Put the root in the compost and cover it. Put in label 1.

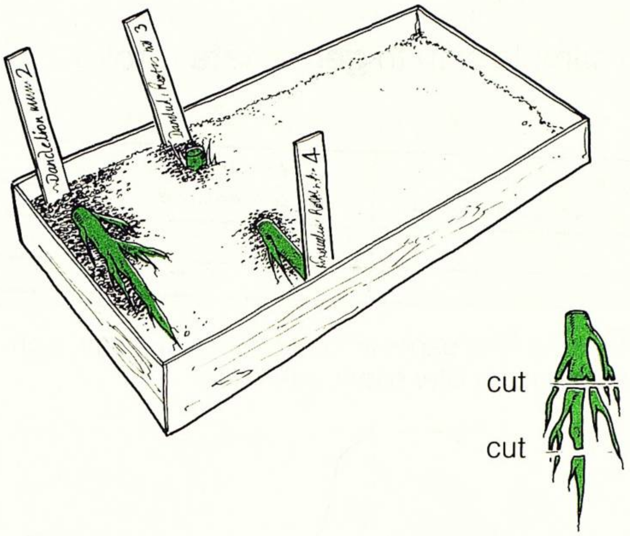
C Make a channel in the compost at one end of the seed tray. Put in a whole root. Put in label 2 beside it. Cover the root with compost.



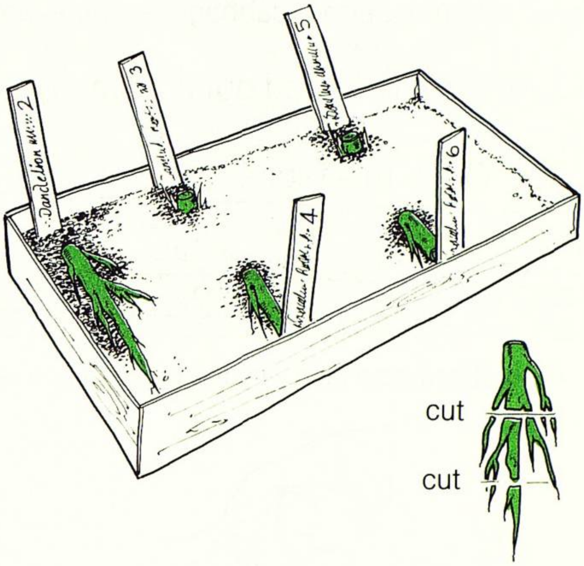
D Cut a root to get 2 bits, 2 cm long. Make a hole in the compost. Put in one of the bits. Put in label 3 beside it. Cover the root with compost.



E Make another channel in the seed tray. Put in the other root bit. Put in label 4 beside it. Cover the root with compost.

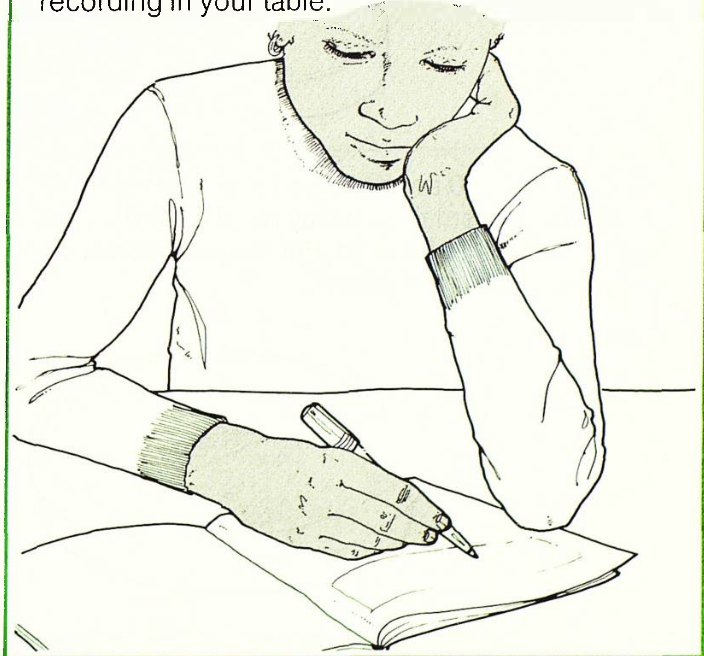


F Peel a dandelion root. Repeat steps D and E, using labels 5 and 6.



G Leave the pot and seed tray in a warm place. Water them when needed.

H During each lesson for several weeks record what happens near each label. Put the date of each recording in your table.



Q8 Did either of the whole dandelion roots produce plants? If so, which?

Q9 Did any of the root bits produce new plants? If so, which ones?

Q10 Which part of the root is important for making new plants?

Growing seeds

Apparatus

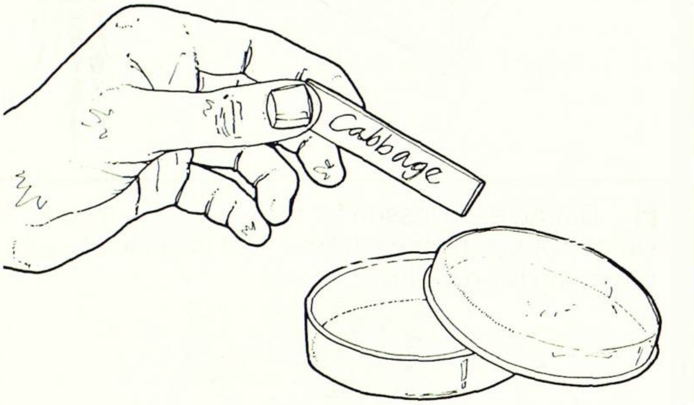
★ petri dishes ★ filter paper ★ labels ★ hand lens
★ selection of seeds (cabbage, sprouts, parsnip, carrot, lettuce)

You are going to find out how many seeds in a sample start to **germinate** (grow).

Q11 Copy this table.

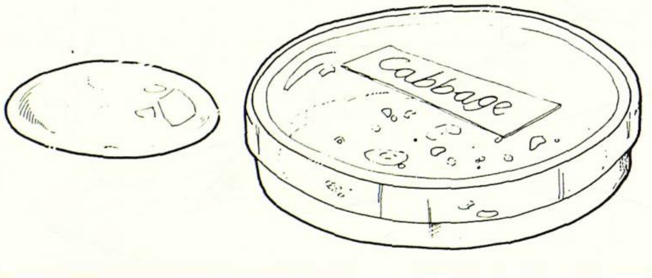
Name of seeds	Number of seeds in petri dish	Number of seeds that have germinated	Germination percentage
cabbage	10		

A Label a petri dish with the name of one seed.

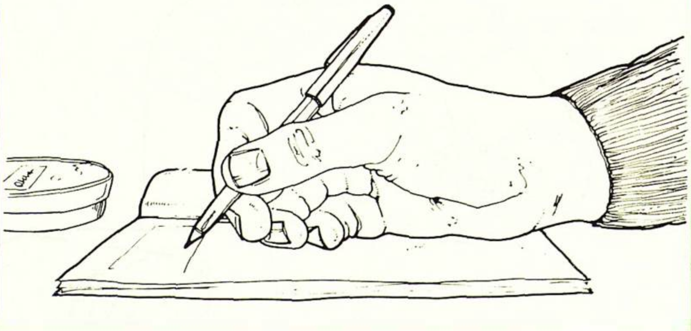


B Put filter paper in the bottom of the petri dish. Moisten the filter paper with water.

C Count out 10 seeds into your dish. (Some seeds are very small, you may need a hand lens to count them.) Put on the lid. Put the petri dish in a warm place until next lesson.



D Repeat steps A to C for each type of seed. Next lesson count the number of seeds that have germinated. Record the results in your table.



If 4 seeds out of 10 germinate, then the number that would germinate out of 100 would be 10 times as many: the germination percentage is 40%.

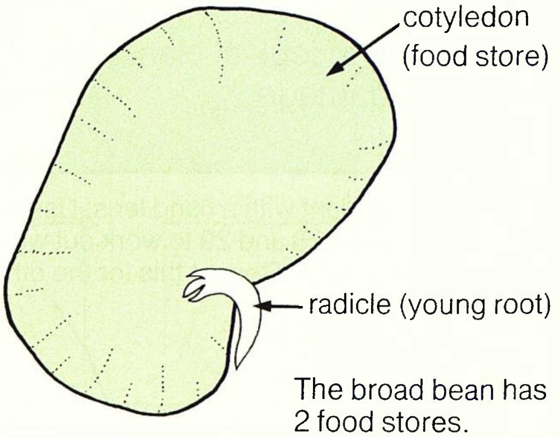
Q12 Work out the germination percentage for each type of seed. Fill in the last column of your table.

Q13 Were all the germination percentages the same?

Information: Seeds

Seeds are made by flowers when they reproduce. Every seed has a tiny plant inside it. It also has a **food store** which the plant uses when it starts to germinate. Many seeds, like the navy bean (baked bean) are eaten by humans.

broad bean cotyledon



The broad bean has 2 food stores.

Most seeds will germinate if they have warmth, water and air. Others have to be specially treated before they germinate. As most seeds start to grow in soil they do not need light. However, seeds of the tobacco plant need light shining on them directly before they will germinate.

Tobacco plants need light to make them germinate.

Q14 List the seeds that you eat as food.

Q15 Why are tobacco plant seeds called **light sensitive?**

Q16 How would you show that cress seeds need warmth, water and air before they will germinate?

5 Damage to plants

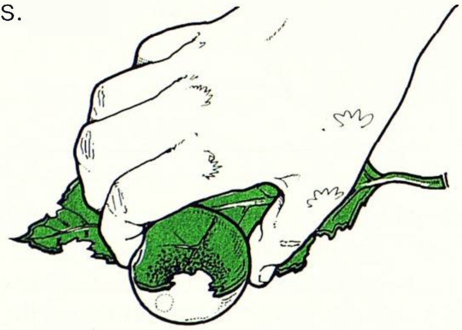
Identifying the cause of plant damage

Apparatus

★ plants with diseased leaves ★ hand lens

You are going to look at plants with diseased leaves and identify the cause of the damage.

A Look at the plant with a hand lens. Use the questions on page 28 and 29 to work out what is wrong with your plant. Repeat this for the other plants.



Did you see animals on your plant?

Start here

No

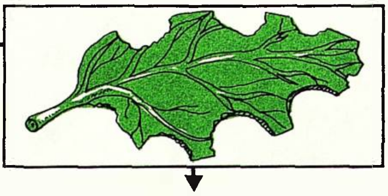
Does the leaf have holes in it?

Yes

The damage was probably caused by a **caterpillar** or **maggot.**

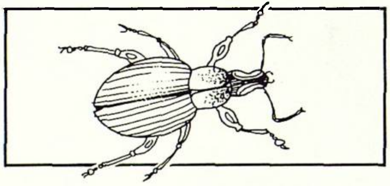
No

Does the leaf have notches at the edges?



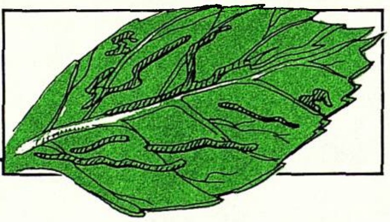
Yes

The damage was probably caused by **weevils.**



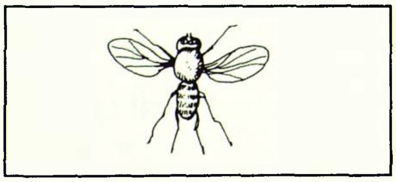
No

Does the leaf have lines or blisters on it?



Yes

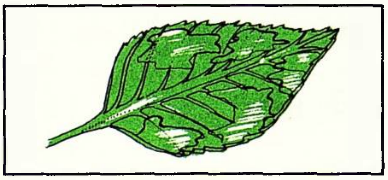
The damage was caused by **leaf miners.**



No

Does the leaf have coloured spots or furry patches on it?

It could be **virus** damage.

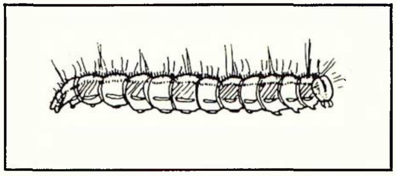


It could be **fungus** damage.

Yes → Is the animal like a caterpillar?

Yes

The animal is eating the plant.

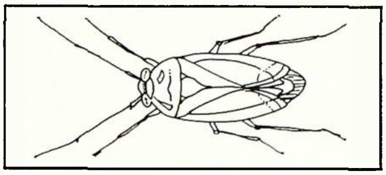


No

Does the animal move about quickly?

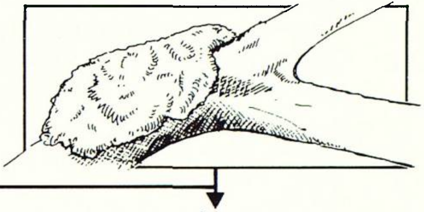
Yes

It could be a **capsid bug** feeding on plant juices.



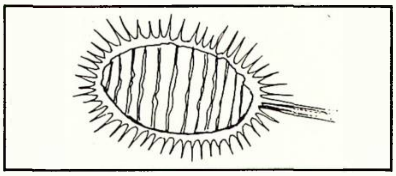
No

Is the animal covered by a **mesh** or woolly substance?

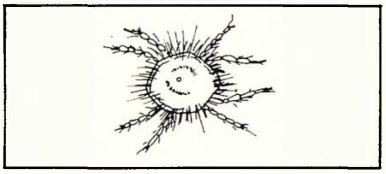


Yes

It could be a **mealy bug** if covered by a woolly mesh.



It could be a **red spider** if covered by a mesh on the underside of leaves.

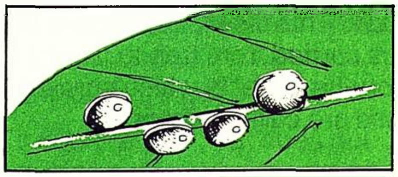


No

Does the animal stay very still on the plant?

Yes

It could be a **scale insect.**

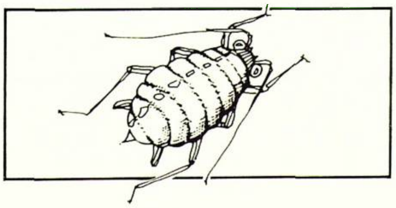


No

Is it plump and green?

Yes

It is a **greenfly** or **aphid.**

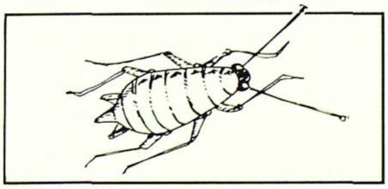


No

Is it black?

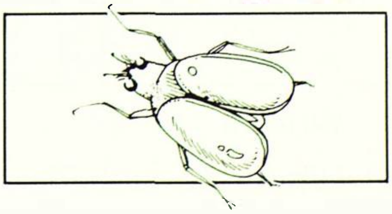
Yes

It is a **black fly.**



No

If it is white it is a **whitefly.**



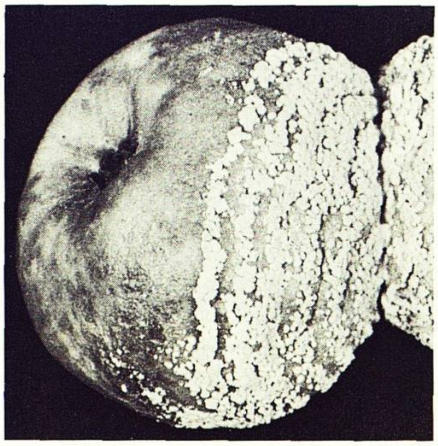
Damage to plants

Information: Fungus and virus damage

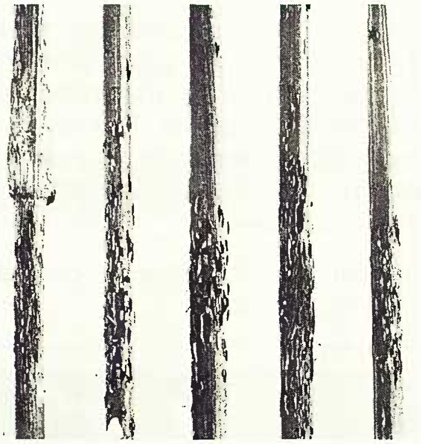
Fungi are plants that cannot make their own food. Some fungi feed on living plants and cause disease. The spread of fungi is controlled by chemicals called **fungicides.**

These photographs show some fungus diseases which can attack plants.

Potato blight is the most serious potato disease. The first signs are brown marks on the leaves.



Brown rot fungus attacks apples and all other fruit.



Rust attacks the stems and leaves of wheat.

Viruses can also cause plant disease. These diseases are very hard to control. Plants infected with a virus disease should be burned.

These photographs show some virus diseases.

⇦ **Cabbage Ringspot** virus can attack Brussels sprouts.

Crinkle is a virus which attacks strawberry plants. ⇨

Q7 What is a fungus?

Q8 How can the spread of fungus disease be stopped?

Q9 What would be the features of a good fungicide?

Teachers' Guide to Plant Science

SCIENCE AT WORK

Introduction

The units

Science at Work is a series of 18 science units for 14-16 year old, less able pupils. Each unit consists of a pupils' book and a teachers' guide. Each provides a complete half-term's course of study. The units are self-contained, and can be taken in any order.

The pupils' books

The pupils' books provide information, practical investigations and questions. Pupils are thus able to work from the books at their own pace; generally, the work becomes more difficult towards the end of each book and the weakest pupils are not expected to finish every unit. The material has been checked by a language specialist, who has ensured that the reading level is as low as possible.

INVESTIGATIONS

Each investigation begins with a list of the apparatus required. The purpose is then stated, and instructions for the investigation given (in words and pictures). Finally, the pupils are asked questions which help them record their results and draw conclusions. (Throughout the books a pupil is expected to make a written response each time a 'Q' appears.)

INFORMATION

Appropriate information from the real world follows most investigations, in most cases from the world of work. Questions are also asked about these information sections.

The teachers' guides

Each unit has a teachers' guide. This contains record sheets and information for the teacher.

RECORD SHEETS

Record sheets in the form of masters are provided in each guide. These sheets will save pupils copying tables, and will help them write answers to questions as complete sentences. One record sheet is provided for each chapter of the pupils' book. Teachers may decide to give record sheets only to those pupils who have difficulty with writing; alternatively, they may be given to all pupils.

OTHER RESOURCES FOR THE TEACHER

Each teachers' guide contains:
course and unit objectives
hints on introducing and teaching the unit
an apparatus list (for technicians)
safety procedures
new scientific words (which pupils may have difficulty reading)
answers to questions in the pupils' book
a resource list.

Specimen questions for a post-unit test are also included.

Examining the course

Science at Work is derived from a successful and well-proven modular scheme developed by teachers in Manchester LEA. Most of the pupils following the course in Manchester gain a CSE Mode III certificate in science. Model CSE papers for most of the regional examination boards are available on request from Addison-Wesley.

Aims of the course

1. To provide a flexible science course based on non-sequential study units. Though developed predominantly for less able pupils, the course can cater for pupils capable of CSE grade 1 by the addition of suitable extension work.
2. To develop pupils' thinking in scientific methodology and the approach to problem solving.
3. To give knowledge and understanding of science relevant to pupils' interests, environment, and future work and leisure needs.
4. To develop pupils' interest in science and enjoyment of science.
5. To provide a wide range of practical experiences and develop practical skills.
6. To develop the ability to work both independently and as a member of a team.

General objectives of the course

1. To develop the ability to carry out experimental procedures and written work according to instructions.
2. To develop manipulative skill in handling equipment and an awareness of safe practice.
3. To develop powers of accurate observation.
4. To develop the ability to check statements and assertions against tests of observation and experiment.
5. To develop skill in handling the interpretation of data.
6. To develop the ability to look for and make generalisations (this objective is likely to be achieved by only the ablest pupils).
7. To be able to understand and recall the factual content of the material.
8. To develop communication skills – verbal, written, and mathematical.
9. To develop the ability to apply knowledge gained.
10. To encourage pride in neatly and accurately produced work.
11. To develop awareness of the responsible use of science and technology.

Objectives of the Plant Science unit

When they have completed this unit, the pupils will have practised the following skills:

the use of a microscope
the use of a hand lens
the use of a Bunsen burner
the use of chemicals to test soils for mineral nutrients
the timing of processes or events
the measurement of liquid volumes
the recording of observations in table form
the calculation of percentage values
the observation of colour changes
the comparison of colours
the preparation of leaf, stem and root cuttings
the chemical tests for glucose and protein
sorting and classifying

In their work on *Plant Science*, pupils will find out:

that soil is formed from rocks
that bacteria rot the dead bodies of animals and plants to form humus
that soils are classified according to the particles they contain
that air is found between soil particles
that rolling soil compacts the particles
that spiking helps to aerate soil
that soils can become waterlogged
that a loam is a balanced, fertile soil
that green plants can synthesise food
that soils contain inorganic nutrients (nitrogen, potash and phosphate)
that an excess or deficiency of nutrients can affect the growth and appearance of plants
that the addition of chemical fertilizers improves soil
that plants contain organic nutrients
that the nutrient composition of plants varies
that humans rely on plants for food
that vegetable protein can be processed
that new plants can be grown from plant parts (leaves, stems and roots)
that seeds contain embryo plants, but that not all embryo plants will grow
that seeds contain a food store
that plant crops can be damaged by animal and plant pests
that plant pests can be controlled by pesticides or biological means

Teaching the Plant Science unit

Introducing the unit

The unit may be introduced in several ways:

1. If a school has a greenhouse, garden or grounds the class could be taken round to plot (and identify) the plants they find.
2. It may be possible to arrange a visit to an arable farm or an horticulturist.
3. Building up a collection of labels from food cans, jars etc. so that the amount of plant food we consume can be realised.
4. Using a film on plant growth, farming techniques or the world food problem. Suitable resources are suggested on page 6.

Teachers must ensure they have a soil test kit and living Begonias, geraniums and dandelions and pest-infected plants for some of the experiments.
The experiments using plant cuttings are long term. Teachers may prefer to begin the unit with these so that observations do not have to continue long after the unit is complete.

Teaching the unit

The pupils' book contains 5 chapters.

Most chapters have practical and information sections. There are sequential questions within each chapter: these indicate when a student has to write in a notebook. For slow readers and writers, there are record sheets to each chapter. The record sheets are copyright free and are contained within this teachers' guide (pages 7–15). Samples of the type of questions that may be used for assessment when pupils have completed the unit are on page 16.

In the pages which follow, each chapter is discussed with reference to: apparatus per working group; new scientific words; safety and teaching hints; answers to practical questions (where necessary); resources.

Detailed teaching notes

1 SOIL

PARTICLES IN SOIL

(pupils' book page 2)

Apparatus: screw-top jar; fresh soil; dry soil; dry clay; dry sand; scoop; 3 slides; microscope; stop clock

New Words: humus, cereal crops

It may be possible to provide a variety of soil types according to a school's location.

Q5–8 Depends on observations.

AIR IN SOIL

(pupils' book, pages 3 and 4)

Apparatus: stick, spade; newspaper; 2 small cans – one labelled X, one labelled Y with a small hole in the bottom; glass rod; 2 x 500 cm^3 measuring cylinders labelled A and B

New Words: aerates, spikes, aeration

Baby food tins are a good size. Once opened the cut edge can be hammered smooth. A hole is made in tin Y using a nail. It is best if the labels X and Y are painted on the side and outside bases of the cans.

Q10–11 Depends on observations.

Q12 Air.

Q13–14 Depends on observations.

Q15 To enable comparison of soil samples.

Q16 Without a hole it would be impossible to push can into soil.

SOIL DRAINAGE

(pupils' book pages 6 and 7)

Apparatus: filter funnel; 3 soil samples; scoop; clampstand with boss head; gauze square; 2 x 10 cm^3 cylinders

New Words: waterlogged, loam

It is best if the soil samples are a loam, a sandy soil and a clay soil. These names could be used on the labels as well as X, Y and Z.

The gauze should fit snuggly at the funnel base so that no soil drops through.

Q21–23 Depends on observations.

Q24 No. Roots need air to breathe so they can grow.

2 SOIL NUTRIENTS

TESTING SOILS FOR NITROGEN

(pupils' book page 10)

Apparatus: white-corked test tube; bottle of nitrogen test solution; spoon; small beaker; 2 samples of dry soil, X and Y; stop clock; pestle and mortar; colour chart (nitrogen); spatula; safety goggles

New Words: nutrients, nitrogen, phosphate, potash, infertile, pH value, lime, fallow, manure, fertilizer, muck spreading

The plastic corked tubes, chemicals, and colour cards can be purchased individually from:

Sudbury Technical Products Ltd
Corwen
Clwyd LL21 0DR
Tel: 0490 2502

Soil test kits can be bought separately from garden centres and large stores. It is best if one of the two samples is a nitrogen deficient soil. (The presence of clover in a lawn indicates this.)

Q8–9 Depends on observations.

TESTING SOILS FOR POTASH

(pupils' book page 11)

Apparatus: yellow-corked test tube; bottle of potash test solution; 2 samples of dry soil X and Y; spoon, small beaker; stop clock; pestle and mortar; spatula; colour chart (potash); safety goggles

See above information for suppliers.
It is best if one of the two samples is a potash deficient soil.
Q10–11 Depends on observations.

TESTING SOILS FOR PHOSPHORUS

(pupils' book pages 12 and 13)

Apparatus: blue-corked test tube; bottle of phosphorus test solution; 2 samples of dry soil X and Y; spoon; small beaker; stop clock; pestle and mortar; tin rod; piece of sandpaper; spatula; colour chart (phosphorus); safety goggles

See above information for suppliers.
It is best if one of the two samples is a phosphorus deficient soil.
Some teachers may wish to test soil for pH. Instructions for this are on pages 16–17 of the *Forensic Science* unit.
Q12–13 Depends on observations.

PLANT NUTRIENTS

(pupils' book page 14)

Apparatus: drawings in pupils' book

Further information on plant nutrients can be obtained from the reference books and resources on page 6.

Q14 a) Stunted growth, pale, small leaves.
  b) Leaves discoloured 'scorched' at edges and crinkled.
  c) Stunted plant growth, small fruit, poor root growth.

Q15 Grow one plant in an iron free soil and another in an iron rich soil. Compare growth.

3 FOOD FROM PLANTS

TESTING FOR GLUCOSE SUGAR

(pupils' book page 16)

Apparatus: tripod; gauze; heat proof mat; Bunsen burner; 250 cm^3 beaker; tongs; test tubes; test tube rack; distilled water; glucose; Benedict's solution; ruler; stop clock; seed and plant parts; labels; safety goggles; spatula
New Words: carbohydrates, proteins, fats, vitamins, sap, centrifugal, molasses

Benedict's solution can be purchased ready prepared from Griffin and George Ltd, 285 Ealing Road, Alperton, Wembley HA0 1HJ and Philip Harris Biological Ltd, Oldmixon, Weston-Super-Mare BS24 9BJ.
It can be made up by dissolving 173 g hydrated sodium nitrate and 100 g sodium carbonate in 800 cm^3 warm distilled water. Filter and make filtrate up to 850 cm^3. Dissolve 17.3 copper (II) sulphate in 100 cm^3 cold distilled water. Add the copper sulphate solution slowly to the citrate/carbonate solution, stirring constantly. Make up the volume to 1 dm^3.
Suitable materials for testing are: broad beans, peanuts, peas, rice, barley, *apple, *onion, *potato, *sultana.
*Can be used in dehydrated form to prevent wastage. It would be useful if pictures of the growing crops could be displayed.

Q2 a) To observe colour change with pure glucose so that the results of a 'positive' test are known.
  b) So that the colour of the solution being tested can be checked against it for any colour change.

Q3 Depends on observations.

TESTING FOR PROTEIN

(pupils' book page 18)

Apparatus: egg white; sodium hydroxide solution; copper sulphate solution; 5 cm^3 syringe; test tube rack, test tubes; dropper; glass rod; seeds and plant parts; white tile; knife; safety goggles

New Words: processed, kwashiorkor, marasmus, soya bean, textured vegetable protein (TVP), spun vegetable protein (SVP), dies, extrusion, yeast, bacteria

Egg white could be solution made with dried egg albumen. Any pure protein can be used, eg casein powder. If so, the amount of protein used in step A should be reduced.

Use the same seeds and plants as on page 16.

Sodium hydroxide is 2 Molar.

Copper (II) sulphate is 0.1 Molar.

The test may work better if warm solutions of the foods to be tested are used.

Usually a mauve colour develops after 1 drop of copper sulphate solution is added.

Q7 To observe colour change with pure protein so that the results of a 'positive' test are known.

Q8 Depends on observations.

4 GROWING NEW PLANTS

LEAF AND STEM CUTTINGS

(pupils' book pages 22 and 23)

Apparatus: 7 small plastic pots; 7 margarine tubs; damp potting compost; sand; broken bits of flower pot; elastic bands; plant labels; knife; white tile; wire loops; pencil; plastic bags; Begonias; geraniums

Begonia and geranium are the specimens used here. It may be possible for a group to attempt to take cuttings from the following:

Leaf – African Violet, Mother-in-law's tongue

Stem – Tradescantia (Wandering Jew), Ivy, Impatiens (Busy Lizzie), Coleus

A useful reference is *Nuffield Secondary Science No 2, Continuity of Life*, pp 70–71, Longmans.

Yoghurt pots could be used instead of flower pots but a hole must be made in the base for drainage.

Use John Innes No 2 potting compost.

Q3 Depends on observations.

Q4 Should be ones with cut veins, that are kept warm and moist in light.

Q5 Depends on observations.

Q6 It becomes humid. (More able pupils may comment on changes in amount of oxygen and carbon dioxide present.)

ROOT CUTTINGS

(pupils' book pages 24 and 25)

Apparatus: dandelion roots; knife; white tile; potting compost; pencil; seed tray with potting compost; pot; 6 plant labels

Use John Innes No 2 potting compost.

The lesson could be a useful introduction to the problems of weed control.

Materials may be available from addresses listed in Resources on page 6.

Q8–10 Depends on observations, but these could take up to 10 weeks.

GROWING SEEDS

(pupils' book page 26)

Apparatus: petri dishes; filter paper; labels; hand lens; selection of seeds

New Words: food store, light sensitive

Marian Ray, (see Resources for address) has a set of three film strips on seeds. Reference is made in the printed commentary to germination percentage and seed dormancy.

Instead of petri dishes, margarine cartons with lids pierced for ventilation may be used.

The lesson could be used as an introduction to seed dormancy and shelf life of seed packets. Once the seeds have germinated, teachers may want to plant them in seed trays, prick out and then plant out so that pupils can grow crops of lettuce etc.

Q12–13 Depends on observations.

5 DAMAGE TO PLANTS

IDENTIFYING THE CAUSE OF PLANT DAMAGE

(pupils' book pages 28 and 29)

Apparatus: plants with diseased leaves; hand lens

New Words: pests, vectors, Dutch elm disease, pesticides, insecticides, DDT, biological control, fungi, fungicides, viruses

The key is not a comprehensive one. If it is not possible to identify the leaf damage, the following references may help:

Ministry of Agriculture, Fisheries and Food pamphlets – *No 106 Apple Aphids, No 187 Woolly Aphids* Tolcarne Drive, Pinner, Middx.

N.B. Any diseased plant must be kept away from healthy plants in greenhouses and conservatories. To prevent contamination any specimen brought into school must be burned after use.

Sycamore leaves are often damaged by leaf miners.

If broad bean seeds are planted out in March they usually become infested with black-fly in June/July.

Rose trees may be affected by green fly.

Reference books

W.N. Townsend, *An Introduction to the Scientific Study of Soil*, Edward Arnold

E.W. Russell, *Soil Conditions and Plant Growth*, Longmans

D.G. Hessayon, *Be Your Own Vegetable Doctor*, Pan Britannica Industries Ltd, 1978

D.G. Hessayon, *Be Your Own Gardening Expert*, Pan Britannica Industries Ltd, 1978

G. Seddon, *Your Indoor Garden*, Mitchell Beazley Publishers Ltd, 1976

H.W. Miles & Mary Miles, *Insect Pests of Glasshouse Crops*, Crosby Lockwood & Son Ltd

Resources

Centre for World Development Education, Parnell House, 25 Wilton Road, London SW1V 1SS

Concord Films Council, 201 Felixstowe Road, Ipswich, Suffolk IP3 3BF (Third World films)

ICI Film Library, 15 Beaconsfield Road, London NW10 2LE (16 mm films on agriculture)

Marian Ray, 36 Villiers Avenue, Surbiton, Surrey KT5 8BD (film strips)

Philip Darvill Associates, 280 Chartridge Lane, Chesham, Bucks HP5 2SG (16 mm film on pesticides)

Rentokil Ltd, Selcourt, East Grinstead, West Sussex RH19 2JY (charts, also films available)

Unilever Education Section, PO Box 68, Unilever House, Blackfriars, London EC4 4BQ (many charts, eg aphids and film available)

RECORD SHEET

1 Soil

INFORMATION: WHAT IS SOIL? (page 1)

Q1 . . . . of the earth's surface is land.

Q2 Soil is important because . . . .

. . . .

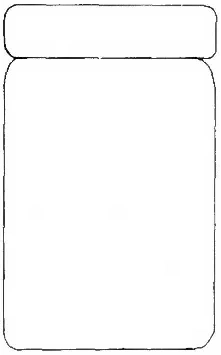
Q3 Humus is . . . .

Q4 Soil bacteria are important because . . . .

. . . .

PARTICLES IN SOIL (page 2)

Q5



Q6 Some particles sink and others float because . . . .

. . . .

Q7 Under the microscope the differences I saw between the sand and clay particles were . . . .

. . . .

Q8 All the soil particles *are/are not* the same size.

AIR IN SOIL (pages 3 and 4)

Q9

1 Volume of water in can X	cm^3
2 Volume of soil in can Y	cm^3
3 Expected total volume of 1 and 2	cm^3
4 Actual volume of soil and water mixed	cm^3
5 Difference between 3 and 4	cm^3

Q10 Volumes (3) and (4) *are/are not* the same.

Q11 The smaller volume is . . . .

1 SOIL (Continued)

AIR IN SOIL (pages 3 and 4 continued)

Q12 The difference in volume between (3) and (4) was caused by ....

Q13 There was .... air in my sample.

Q14 The percentage of air in the soil sample was .... percent.

Q15 It is useful to work out a percentage because ....

....

Q16 The soil is collected in a can with a hole in the bottom ....

....

INFORMATION: SOIL AIR (page 5)

Q17 The gases found in soil air are ....

Q18 Lawns must be aerated to ....

SOIL DRAINAGE (pages 6 and 7)

Q19

Soil sample	Amount of water poured into funnel (P)	Amount of water passed through in 5 min (Q)	Amount of water left in funnel (P — Q)
X			
Y			
Z			

Q20 Most water drained through soil ....

Q21 Soil .... retained most water.

Q22 Soil .... could get waterlogged.

Q23 Plants *would/would not* grow well in waterlogged soil because ....

....

INFORMATION: LOAM (page 7)

Q24 Loam is ....

Q25 A loam soil is good for growing crops because ....

....

RECORD SHEET

2 Soil nutrients

INFORMATION: FERTILE SOIL (pages 8 and 9)

Q1 Green plants need .... and .... and .... to make food.

Q2 Nutrients in the soil are replaced in nature by ....

Q3 Lime is added to soil ....

Q4 A soil becomes infertile if ....

Q5 The difference between manure and a factory made fertilizer is ....

....

Q6 Farmers put manure and fertilizer on their land to ....

....

Q7 The advantage of using fertilizers in pellet form is ....

....

TESTING SOILS FOR NITROGEN (page 10)

Q8 The percentage figure next to the colour on the chart was:

a) ...... % for soil X. b) ...... % for soil Y.

Q9 a) 10 square metres of soil X needs ...... g of nitrogen fertilizer.

b) 10 square metres of soil Y needs ...... g of nitrogen fertilizer.

TESTING SOILS FOR POTASH (page 11)

Q10 The percentage figure next to the colour on the chart was:

a) ...... % for soil X. b) ...... % for soil Y.

Q11 a) 10 square metres of soil X needs ...... g of potash fertilizer.

b) 10 square metres of soil Y needs ...... g of potash fertilizer.

TESTING SOILS FOR PHOSPHORUS (pages 12 and 13)

Q12 The percentage figure next to the colour on the chart was:

a) ...... % for soil X. b) ...... % for soil Y.

Q13 a) 10 square metres of soil X needs ...... g of phosphorus fertilizer.

b) 10 square metres of soil Y needs ...... g of phosphorus fertilizer.

RECORD SHEET

2 SOIL NUTRIENTS (Continued)

PLANT NUTRIENTS (page 14)

Q14 a) If plants do not get enough nitrogen they . . . .

b) If plants do not get enough potash they . . . .

c) If plants do not get enough phosphate they . . . .

Q15 To find out if green plants need iron for growth I would . . . .

. . . .

. . . .

. . . .

INFORMATION: TYPES OF FERTILIZERS (page 15)

Q16 . . . . and . . . . are used to make ammonia.

Q17 Bone meal is a . . . . fertilizer.

Q18 Dried seaweed can be used as a fertilizer because . . . .

3 Food from plants

TESTING FOR GLUCOSE SUGAR (page 16)

Q1

Substance tested	Colour after heating with Benedict's solution and leaving to cool	Is glucose present?

3 FOOD FROM PLANTS (Continued)

TESTING FOR GLUCOSE SUGAR (page 16 continued)

Q2 a) The test is done with pure glucose ....

....

b) The test is done with distilled water ....

....

Q3 The seeds and plant parts that contain glucose are ....

....

INFORMATION: NUTRIENTS IN PLANTS (page 17)

Q4 .... and .... make a lot of sugar.

Q5 Molasses is ....

TESTING FOR PROTEIN (pages 18 and 19)

Q6

Substance tested	Number of drops of copper sulphate solution added	Colour after adding copper sulphate solution	Is protein present?

Q7 Pure protein is used ....

Q8 The seeds and plant parts that contain protein are ....

....

....

INFORMATION: FOOD FROM PLANTS (page 19)

Q9 There is ...... % of sugar in an apple.

Q10 *Rice/flour* contains the most starch.

RECORD SHEET
3 FOOD FROM PLANTS (Continued)

INFORMATION: PLANT PROTEINS (pages 20 and 21)

Q11 . . . . . . % of a turnip is protein.

Q12 Marasmus is . . . .

Q13 TVP is . . . .

Q14 The difference between extruded TVP and spun TVP is . . . .

. . . .

Q15 . . . . . . kg of protein can be made from 10 kg of bacteria.

4 Growing new plants

LEAF AND STEM CUTTINGS (pages 22 and 23)

Q1

Growing plants from leaves				
Date	Appearance of Begonia leaf in			
	pot 1	pot 2	pot 3	pot 4

Q2

Growing plants from stems			
Date	Appearance of geranium stem in		
	pot X	pot Y	pot Z

RECORD SHEET
4 GROWING NEW PLANTS (Continued)

LEAF AND STEM CUTTINGS (pages 22 and 23 continued)

Q3 By the time of the last recording:

a) Begonia leaf 1 had ....

b) Begonia leaf 2 had ....

c) Begonia leaf 3 had ....

d) Begonia leaf 4 had ....

Q4 The best conditions for getting new plants from Begonia leaves are ....

....

Q5 By the time of the last recording:

a) geranium stem X had ....

b) geranium stem Y had ....

c) geranium stem Z had ....

Q6 The air inside the plastic bags ....

ROOT CUTTINGS (pages 24 and 25)

Q7

	Growing dandelion plants from roots					
Date	Appearance of dandelion root near					
	label 1	label 2	label 3	label 4	label 5	label 6

4 GROWING NEW PLANTS (Continued)

ROOT CUTTINGS (pages 24 and 25 continued)

Q8 The whole dandelion roots *did/did not* produce plants.

The whole dandelion root that produced a plant was near label . . . .

Q9 The root bits that produced new plants were near label . . . .

Q10 The part of the root that is important for making new plants is . . . .

GROWING SEEDS (page 26)

Q11 and 12

Name of seed	Number of seeds in petri dish	Number of seeds that have germinated	Germination percentage

Q13 The germination percentages *were/were not* all the same.

INFORMATION: SEEDS (page 27)

Q14 Seeds eaten as food are . . . .

Q15 Tobacco plant seeds are called light sensitive because . . . .

. . . .

Q16 I would show that cress seeds need warmth, water and air to germinate by . . . .

. . . .

. . . .

RECORD SHEET

5 Damage to plants

INFORMATION: INSECTS AS PESTS (page 30)

Q1 A pest is ....

Q2 The cabbage white butterfly is a pest because ....

Q3 A vector is ....

INFORMATION: PESTICIDES (page 31)

Q4 An insecticide is ....

Q5 Biological control is ....

Q6 A pesticide must be cheap to use because ....

INFORMATION: FUNGUS AND VIRUS DAMAGE (page 32)

Q7 A fungus is ....

Q8 The spread of fungus disease can be stopped by ....

Q9 The features of a good fungicide would be

a) ....

b) ....

c) ....

d) ....

e) ....

Specimen Post-unit questions

For questions 1 to 5, tick (√) your answer.

1 Biological control is a way of controlling plant pests by:
 a) using chemical sprays.
 b) using pesticides.
 c) using other living organisms.
 d) using fungicides.
 e) using insecticides.

2 Which of the following is likely to be the pH of a fertile, loam soil?
 a) 4.5 b) 5.0
 c) 5.5 d) 6.0
 e) 6.5

3 Why is lime added to soil?
 a) To make the soil lighter in colour.
 b) To make the soil more acid.
 c) To make the soil less acid.
 d) To rot humus.

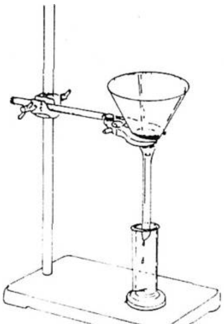
4 Which of the following is **not** a nutrient made by green plants?
 a) Sugar b) Nitrogen
 c) Starch d) Protein
 e) Glucose

5 Twenty cress seeds were put on to damp filter paper and were kept warm and moist. After one week, five seeds had germinated. The germination percentage was:
 a) 5% b) 20%
 c) 25% d) 50%
 e) 100%

6 On the line next to each of the sentences below, write if the statement is TRUE or FALSE.
 a) If a tiny piece of dandelion root is left in soil, the root bit will grow into a new plant. . . . .
 b) All soils contain the same kinds of particles in the same amounts. . . . .
 c) Plants will only grow in soil of pH 6.5. . . . .
 d) Ammonium sulphate is a fertilizer that contains nitrogen. . . . .
 e) Seeds of the tobacco plant need light before they will germinate. . . . .
 f) The blue colour of Benedict's solution does not change when it is heated with pure glucose sugar. . . . .
 g) Bonfire ash contains potash. . . . .

7 Write one sentence about each of the following.
 Your sentence must show you understand what the word means.
 a) Humus b) Manure
 c) Fertilizer d) Kwashiorkor
 e) Pesticide

8 Apparatus was set up as shown.



One scoopful of soil X was put in the funnel. 10 cm^3 of water was poured over the sample. The amount of water that had dripped through into the cylinder was recorded after 5 minutes. The experiment was repeated with soils Y and Z. All the results are shown in the table.

1	2	3	4
Soil sample	Amount of water poured over soil sample	Amount of water collected after 5 minutes	Amount of water retained by soil
X	10 cm^3	9 cm^3	
Y	10 cm^3	1 cm^3	
Z	10 cm^3	6 cm^3	

 a) Complete column 4 of the table.
 b) Which soil is likely to get waterlogged?
  Explain your answer.
 c) Which soil sample is likely to be a sandy soil?
  Explain your answer.

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