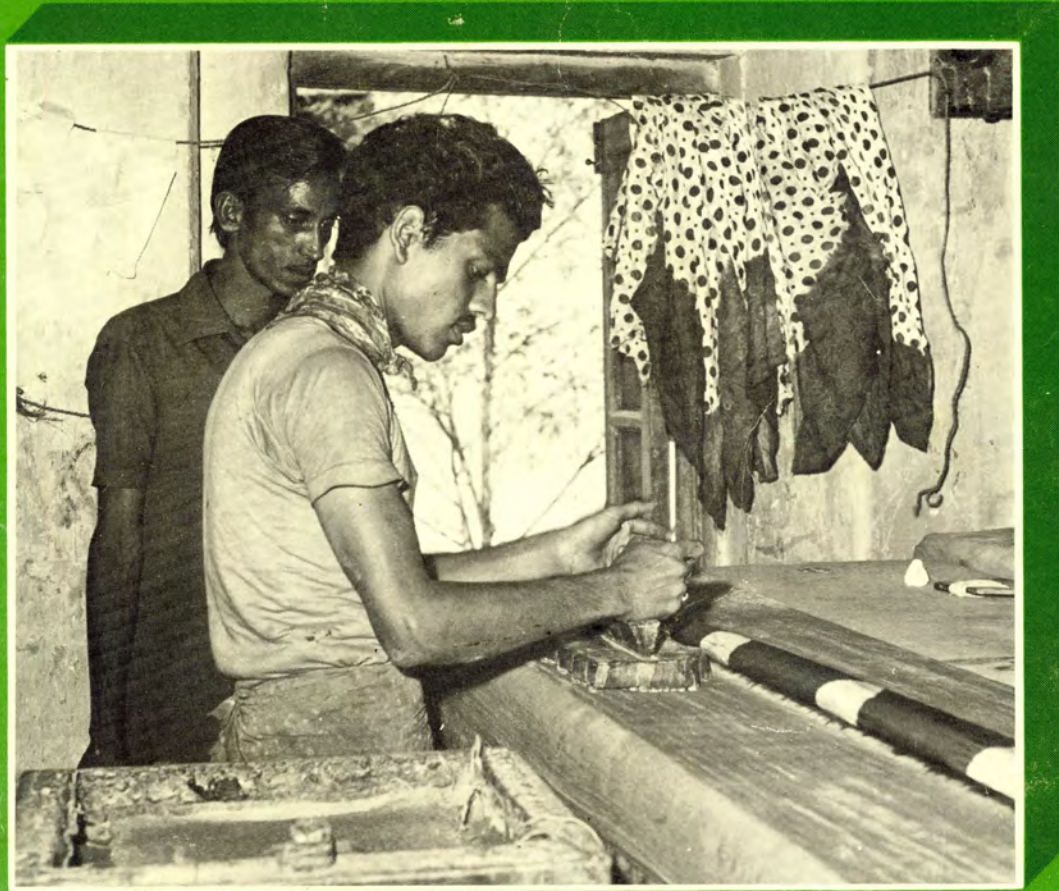


SCIENCE AT WORK



Dyes and Dyeing

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SCIENCE AT WORK

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1 Natural dyes

Using vegetable dyes

Apparatus

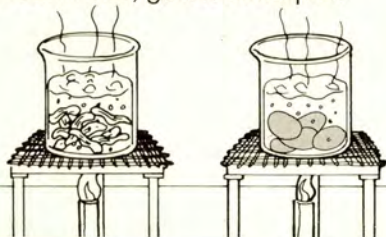
- ★ pieces of cotton and linen
- ★ onion skins
- ★ beetroot slices
- ★ 4 beakers
- ★ filter funnel
- ★ filter papers
- ★ clamp stand
- ★ glass rod
- ★ 2 Bunsen burners
- ★ 2 tripods
- ★ 2 gauzes
- ★ 2 heatproof mats
- ★ scissors
- ★ sticky tape
- ★ tongs

You are going to get juices from 2 vegetables and then use these coloured juices to dye cotton and linen.

Q1 Copy this table. Make it large enough to stick in pieces of fabric.

Fabric name	Treatment:		
	untreated	onion dye	beetroot dye

A Put some onion skins into a beaker. Put beetroot slices into another. Add 100 cm³ water to each beaker. Boil for 15–20 minutes to get out the juices. Meanwhile, go on to step B.



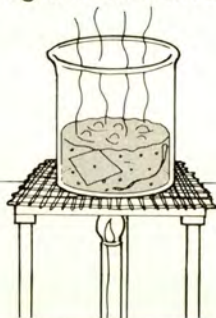
B Cut each piece of fabric into 3. Cut a corner off each piece of linen. Fill in the 1st column of your table. Stick one piece of each fabric in the 2nd column.



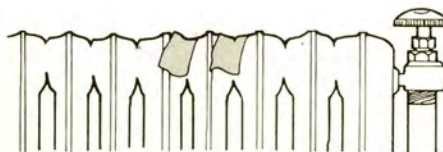
C When the dye is ready, let the beaker cool a little. Filter the onion juice from the onion skin into a clean beaker. This is your dye bath.



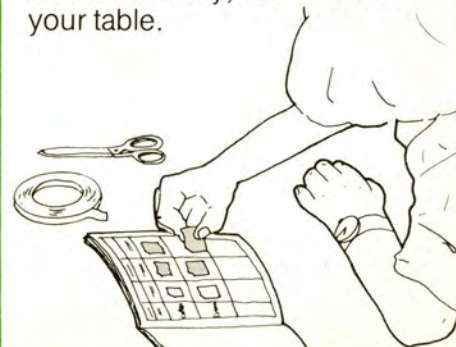
D Using tongs, put 1 piece of each fabric into the dye bath. Boil them together for 10 minutes. Stir with a glass rod from time to time.



E Remove the cotton and linen from the beaker with tongs. Leave them to dry.



F Repeat steps C to E with the beetroot dye. When all the pieces of fabric are dry, stick them in your table.



Q2 What was the colour of each vegetable juice?

Q4 What was the colour of beetroot-dyed cotton?

Q3 What was the colour of onion-dyed linen?

National STEM Centre



N24714

Natural dyes

Dyeing different fabrics directly

Apparatus

- ★ pieces of cotton, wool, nylon and polyester
- ★ 150 cm³ red cabbage dye
- ★ 150 cm³ blackcurrant dye
- ★ two 250 cm³ beakers
- ★ tongs
- ★ gauze
- ★ measuring cylinder
- ★ scissors
- ★ Bunsen burner
- ★ tripod
- ★ heatproof mat
- ★ sticky tape
- ★ glass rod
- ★ stop clock

You are going to find out how well dye sticks to natural fabrics (cotton and wool) and man-made fabrics (nylon and polyester).

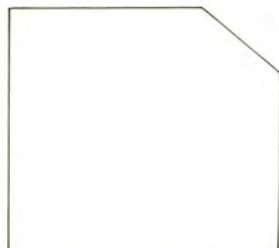
Q5 Copy this table. Make it big enough to stick in pieces of fabric.

Fabric name	Treatment:		
	untreated	red cabbage dye	blackcurrant dye

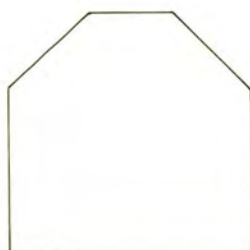
A Look at the pieces of cotton, wool, nylon and polyester. Cut each piece of fabric into 3. Then cut off corners to identify the fabrics as shown. (Leave the cotton pieces whole.)



cotton



wool

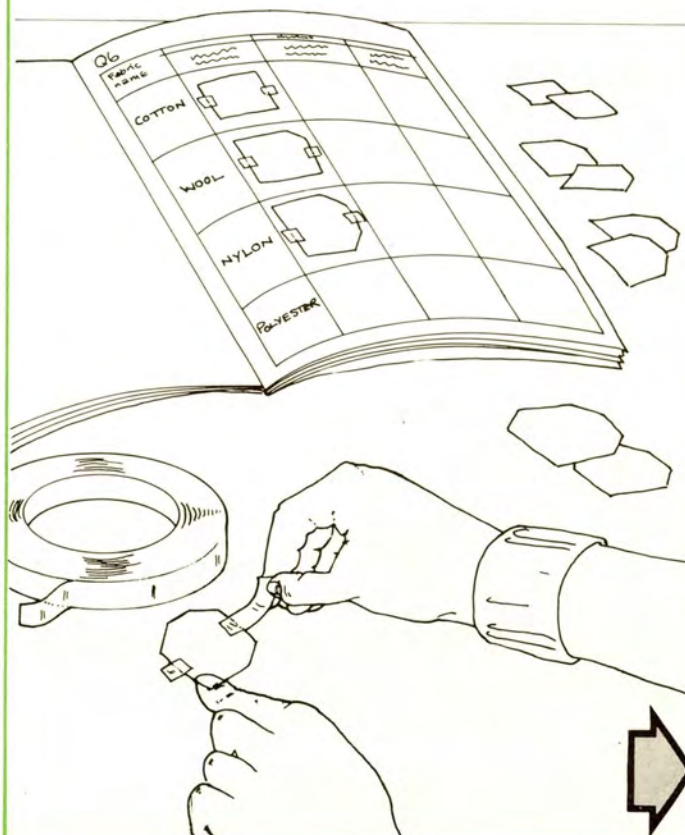


nylon

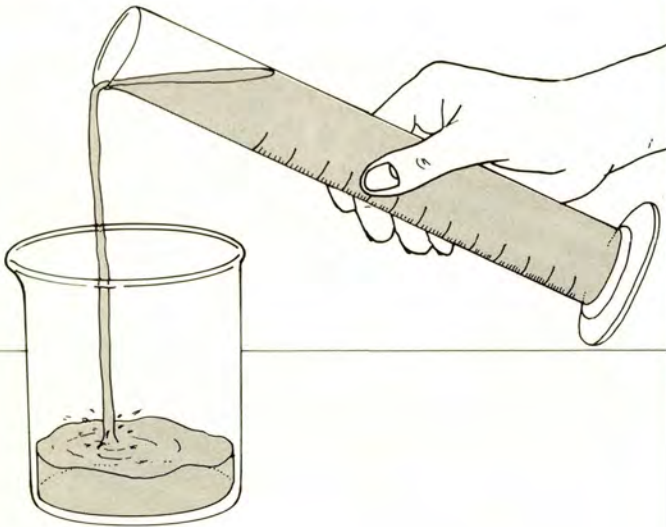


polyester

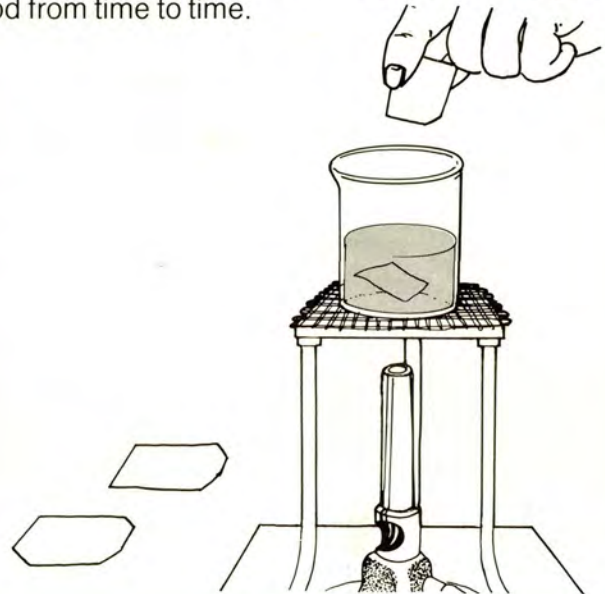
B Fill in the fabric names in the first column of your table. Stick one piece of each untreated fabric in the 2nd column of your table.



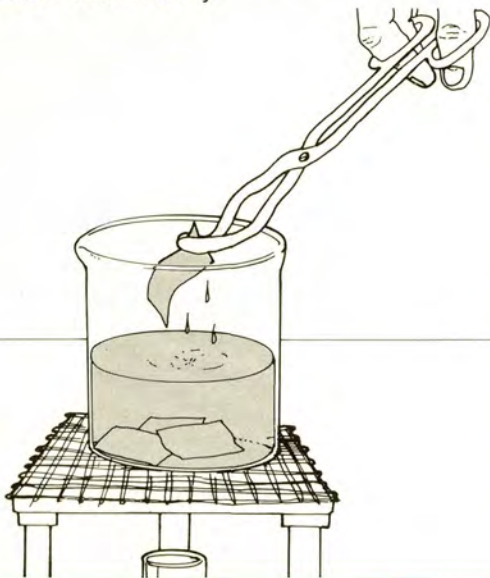
C Pour 150 cm³ of red cabbage dye into a beaker. This is your dye bath.



D Put one piece of each fabric into the dye bath. Boil them together for 10 minutes. Stir with a glass rod from time to time.



E After 10 minutes, turn off the Bunsen burner. Use tongs to remove the pieces of fabric from the dye bath. Leave them to dry.



F Repeat steps C to E with clean pieces of fabric and blackcurrant dye. When all the pieces of fabric are dry, stick them in the correct places in your table.



Q6 Which fabric dyed the deepest colour with red cabbage dye?

Q7 Which fabric dyed the deepest colour with blackcurrant dye?

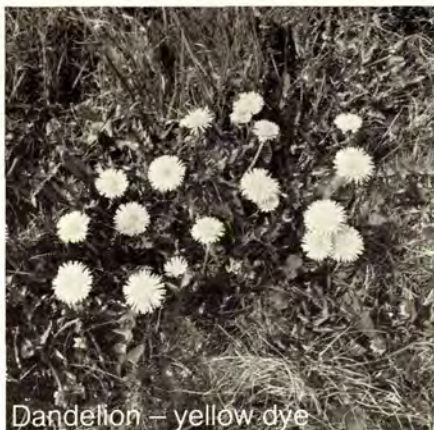
Q8 Were the dyes patchy or an even colour on the fabric?

Q9 Did the natural fabrics (cotton and wool) take up the dye better than man-made fabrics?

Natural dyes

Information: Where natural dyes come from

Cloth used to be **dyed** (or coloured) with natural materials. Dyes can be obtained from plants, animals or minerals.



Dandelion – yellow dye

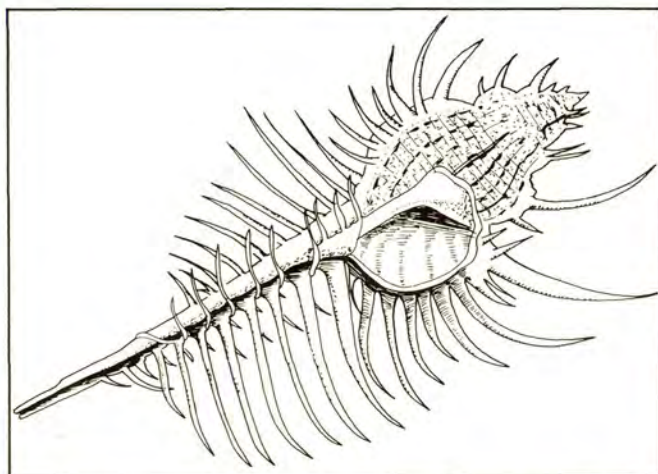


Lichens – various colours

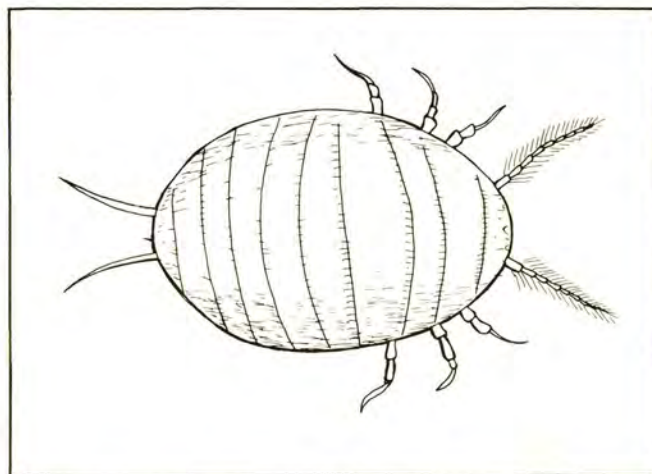


Heather – green and mauve

Vegetable dyes from plants are the easiest to get. They are **extracted** (got out) by boiling the plant part in water. The photos show some plants that provide dyes, and the colours they produce. Dyes from lichen are still used to colour tweed, a fabric which is made in Scotland. Dyes can also be made from the bark of some trees, such as apple.



One animal dye is a purple colour which was used by the Romans. It came from a shellfish called **Murex**. It was a very good dye for wool. The drawing shows a murex shell.



A red dye, called **cochineal**, is extracted from a beetle found in Mexico. It was used for dyeing British guardsmen's jackets.

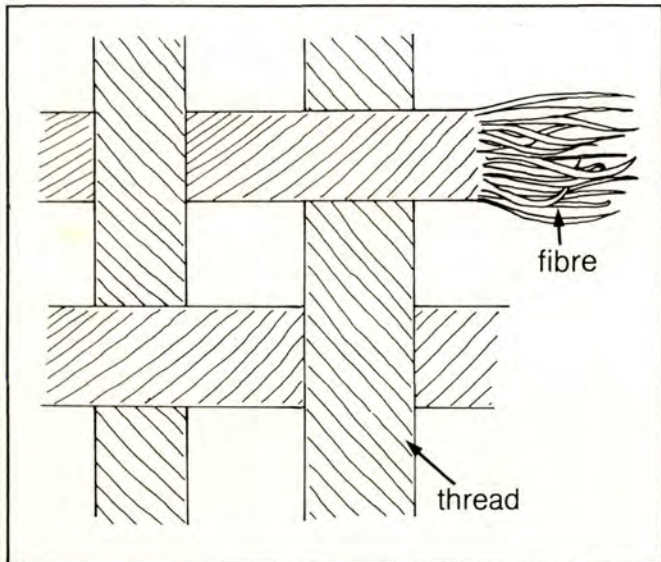
Q10 What plant would you use to get a yellow coloured natural dye?

Q11 How are vegetable dyes extracted?

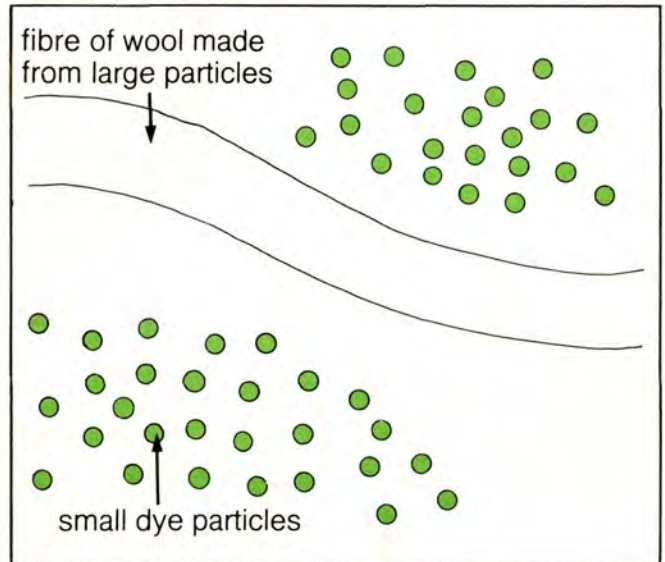
Q12 Where did the purple dye come from that the Romans used?

Q13 Why do you think natural dyes are not used in industry?

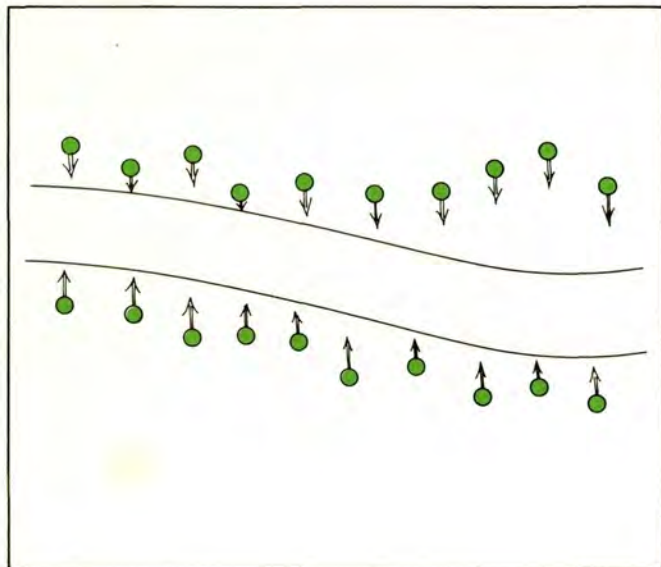
Information: How dyes stick to cloth



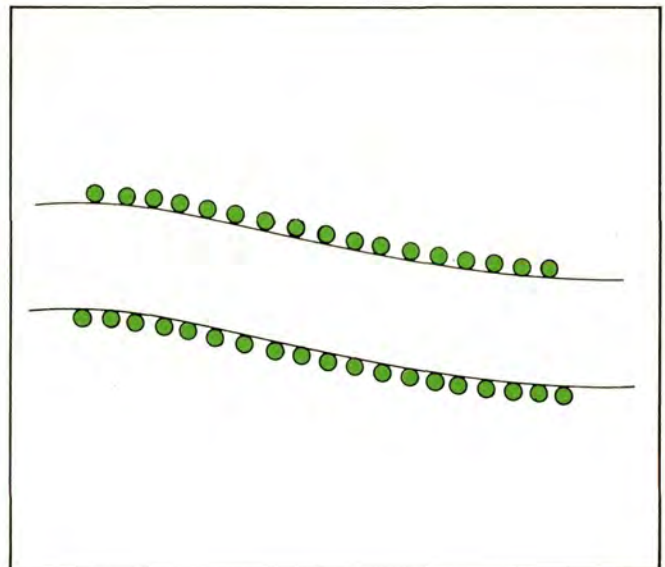
Fabrics are made from threads woven together. Each thread is made of hundreds of **fibres** (hairs) twisted together as shown.



Each type of fabric is made of a different type of **particle**. The fibre particles can attract dye particles.



The wool particles and the dye particles are attracted to each other by strong forces. The dye sticks to the surface of the wool.



The dye particles form a coloured layer all round the fibres. Chemical **bonds** hold the dye particles to the wool particles.

Some fabrics and dyes do not stick to each other. Man-made fabrics, such as polyester, are very difficult to dye. Special chemicals are often used to help the dye stick to the fabric.

Q14 How do dyes change the colour of fabrics?

Q15 Which type of fabric cannot be dyed easily?


2 Mordants and fastness

Testing the fastness of dyed fabrics

Apparatus

- ★ pieces of cotton, wool, linen and polyester
- ★ 150 cm³ red dye solution
- ★ detergent
- ★ two 250 cm³ beakers
- ★ tongs
- ★ thermometer
- ★ Bunsen burner
- ★ tripod
- ★ gauze
- ★ heatproof mat
- ★ glass rod
- ★ scissors
- ★ sticky tape
- ★ rubber gloves
- ★ safety glasses

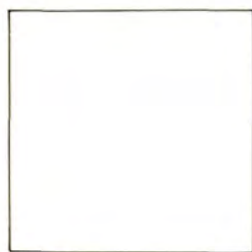
You are going to find out if dyes are **fast** on different fabrics. If dyes wash out easily they are **not** fast.

 Wear safety glasses and gloves.

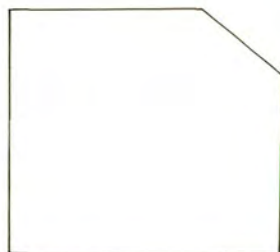
Q1 Copy this table. Make it big enough to stick in pieces of fabric.

Fabric name	Treatment:		
	untreated	dyed and rinsed in water	dyed and washed in detergent

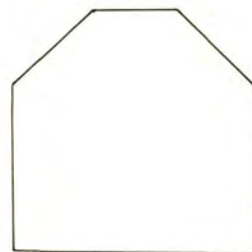
A Cut each piece of fabric into 3. Then cut corners off the fabric pieces to identify them, as shown. Fill in the 1st column of your table. Stick one piece of each untreated fabric in the 2nd column.



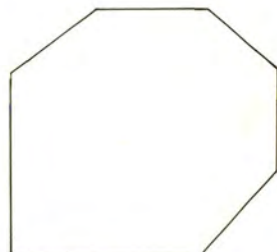
cotton



wool

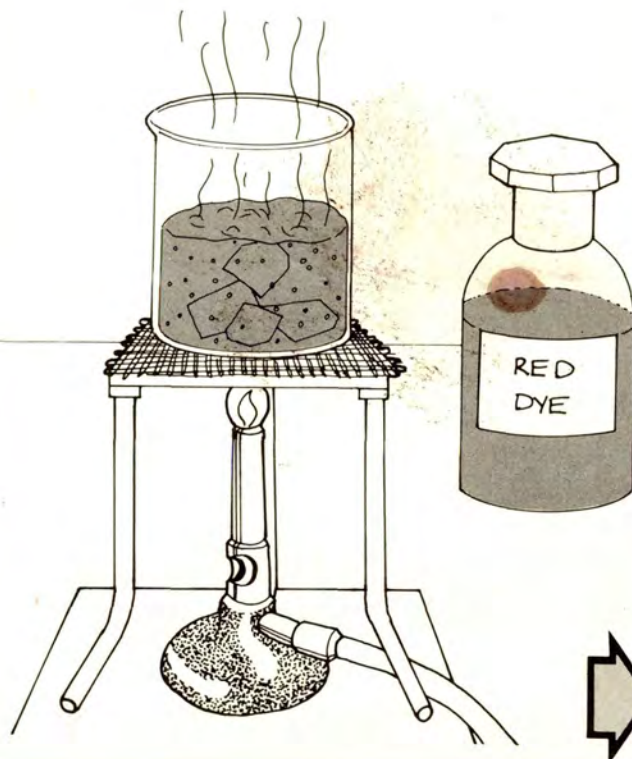


linen



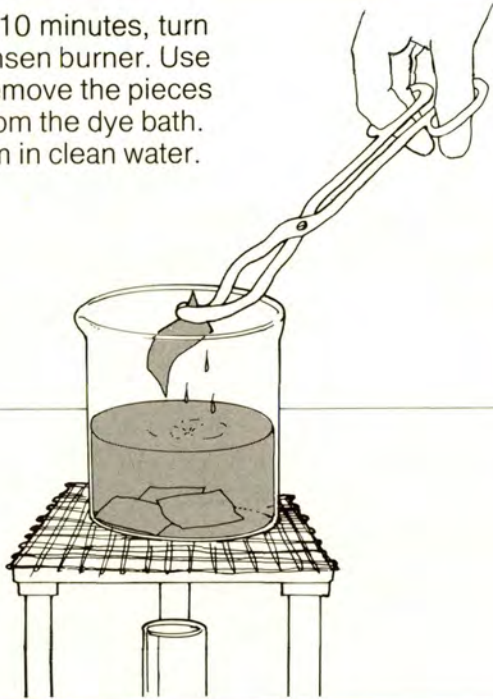
polyester

B Put on gloves and glasses. Pour 150 cm³ of red dye solution into a beaker. This is your dye bath. Put all the remaining pieces of fabric into the dye bath. Boil them together for 10 minutes. Stir with a glass rod, from time to time.

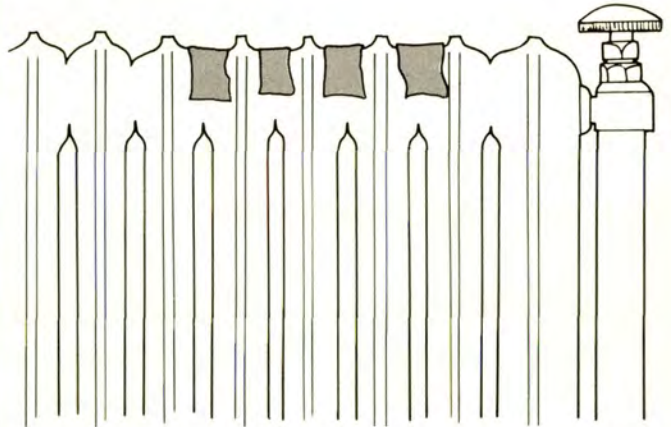


Mordants and fastness

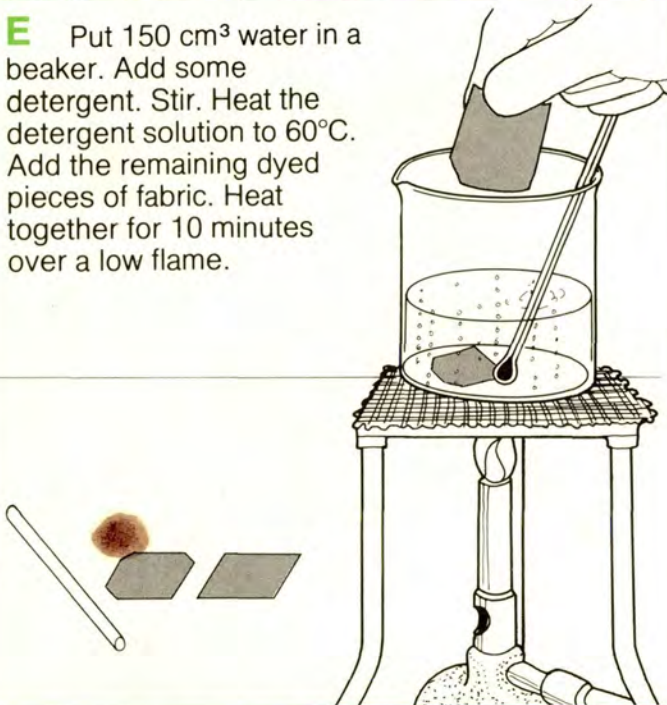
C After 10 minutes, turn off the Bunsen burner. Use tongs to remove the pieces of fabric from the dye bath. Rinse them in clean water.



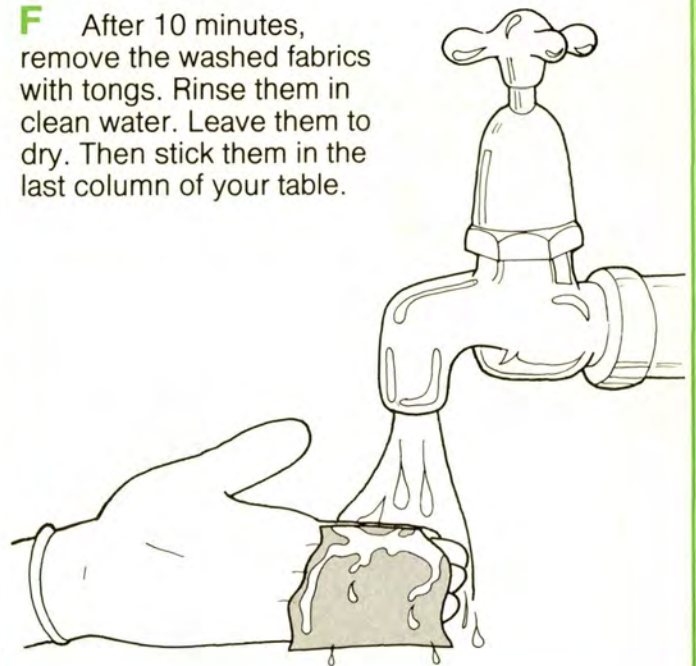
D Put one dyed piece of each fabric to dry. When they have dried, stick them in the 3rd column of your table. Meanwhile, go on to step E.



E Put 150 cm³ water in a beaker. Add some detergent. Stir. Heat the detergent solution to 60°C. Add the remaining dyed pieces of fabric. Heat together for 10 minutes over a low flame.



F After 10 minutes, remove the washed fabrics with tongs. Rinse them in clean water. Leave them to dry. Then stick them in the last column of your table.



If dye stays in fabric when it is washed, it is colour fast.

Q2 Did any fabric lose dye during washing?

Q3 Was the dye colour fast on the fabrics you washed?

Q4 Would this method of dyeing be suitable for linen blouses?


Mordants and fastness

Using mordants

Apparatus

- ★ pieces of linen and polyester
- ★ 150 cm³ alizarin dye
- ★ tongs
- ★ 100 cm³ ammonia solution
- ★ 150 cm³ alum solution
- ★ fume cupboard
- ★ three 250 cm³ beakers
- ★ thermometer
- ★ glass rod
- ★ Bunsen burner
- ★ measuring cylinder
- ★ tripod
- ★ gauze
- ★ heatproof mat
- ★ scissors
- ★ safety glasses
- ★ rubber gloves
- ★ sticky tape
- ★ stop clock

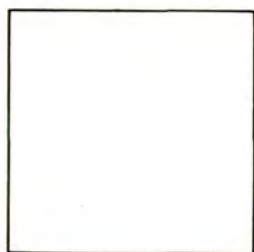
You are going to find out how you can help a dye stick to fabric.

 Wear safety glasses and gloves.

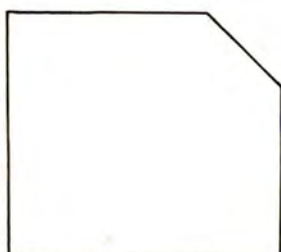
Q5 Copy this table. Make it big enough to stick in pieces of fabric.

Fabric name	Treatment:		
	untreated	chemically treated, dyed and washed	dyed and washed

A Cut each piece of fabric into 3. Cut one corner off each piece of polyester. Fill in the 1st column of your table. Stick one piece of each untreated fabric in the 2nd column.

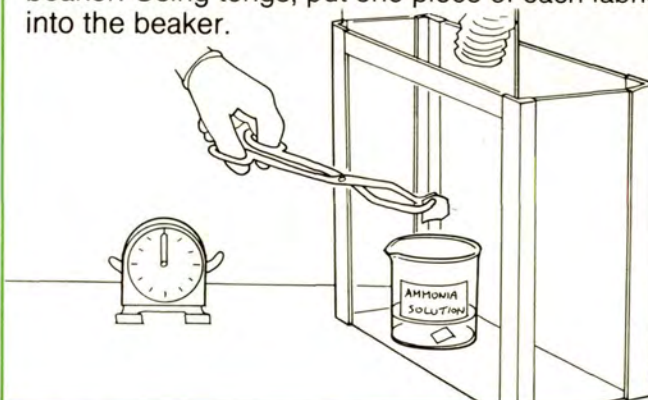


linen

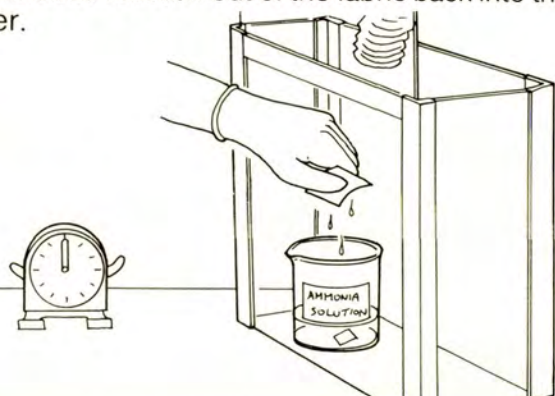


polyester

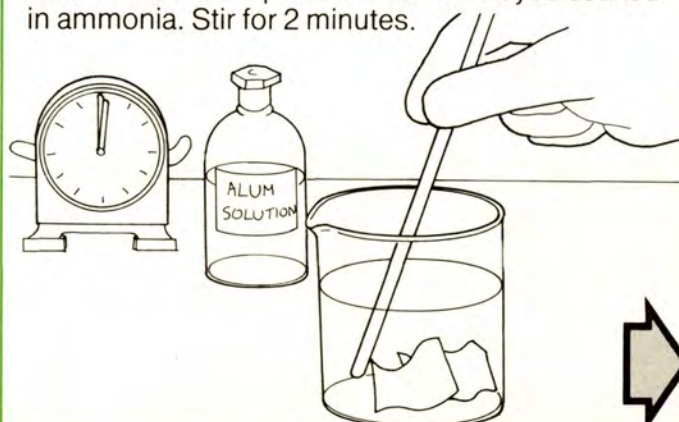
B Put on safety glasses and gloves. In a fume cupboard, pour 100 cm³ of ammonia into a beaker. Using tongs, put one piece of each fabric into the beaker.



C With a glass rod, stir the fabrics for 2 minutes. Then remove them with tongs. Squeeze most of the ammonia solution out of the fabric back into the beaker.

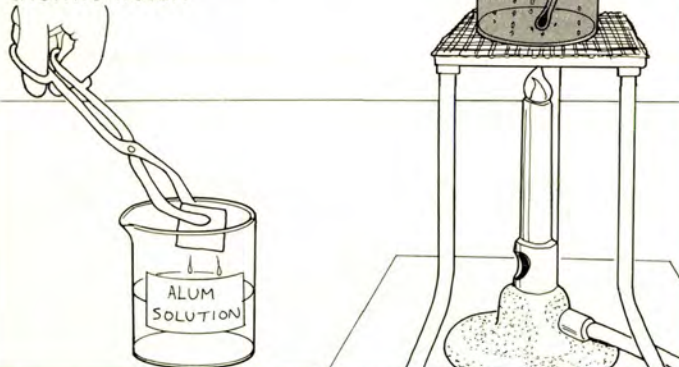


D Pour 150 cm³ alum solution into a clean beaker. Add the 2 pieces of fabric that you soaked in ammonia. Stir for 2 minutes.

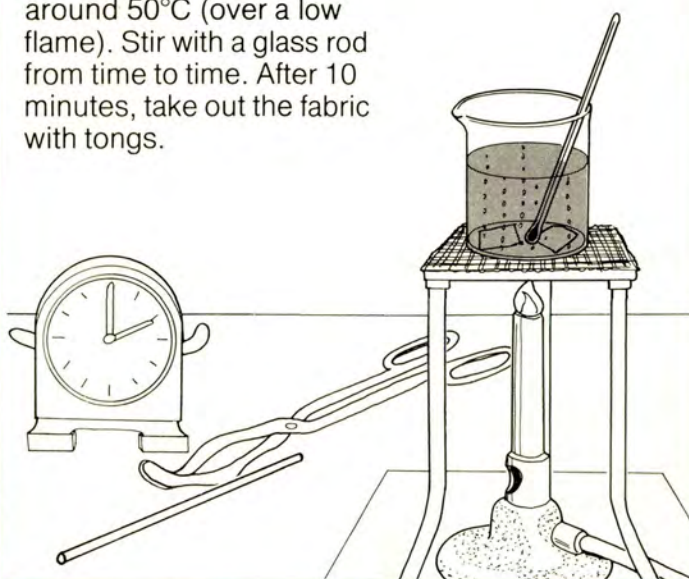


Mordants and fastness

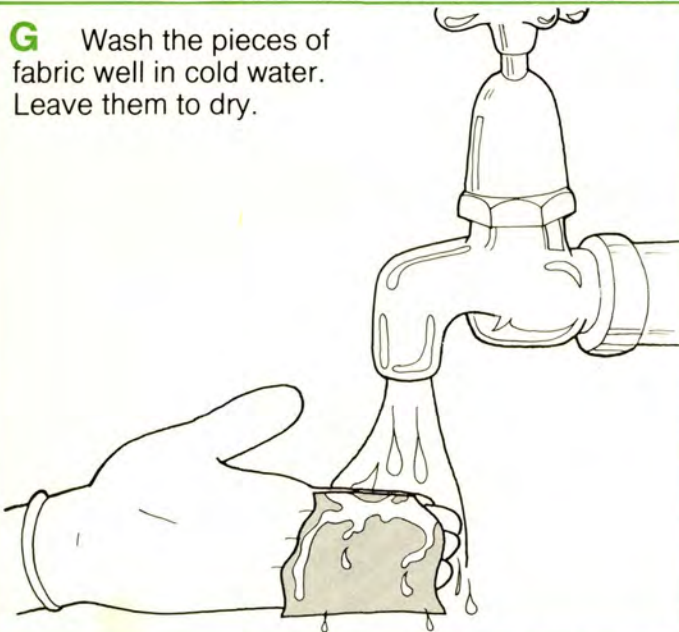
E Make a dye bath by pouring 150 cm³ alizarin dye into a clean beaker. Use tongs to take the fabric out of the alum. Put the fabric into the dye bath and heat to 50°C. Use a thermometer.



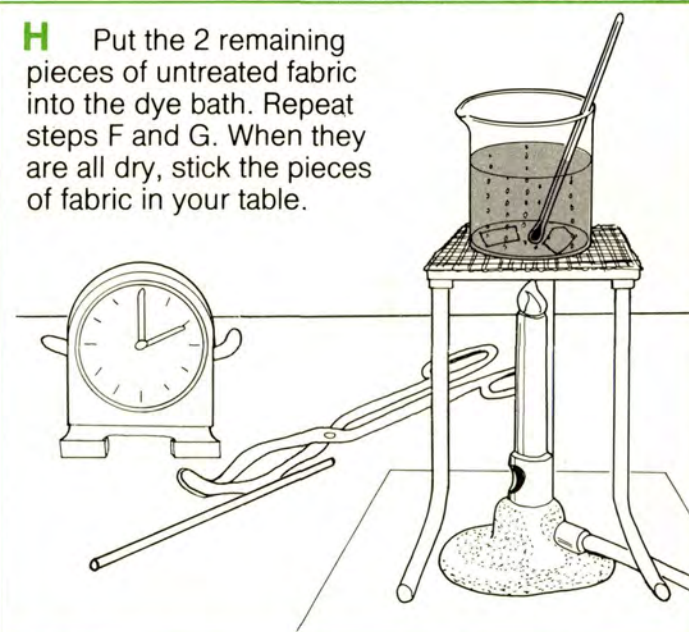
F Keep the dye bath at around 50°C (over a low flame). Stir with a glass rod from time to time. After 10 minutes, take out the fabric with tongs.



G Wash the pieces of fabric well in cold water. Leave them to dry.



H Put the 2 remaining pieces of untreated fabric into the dye bath. Repeat steps F and G. When they are all dry, stick the pieces of fabric in your table.



A chemical that helps to fix a dye to fabric is called a mordant.

Q6 What is the effect of soaking linen in ammonia and alum before dyeing?

Q7 Do mordants help dye stick to man-made fabrics?

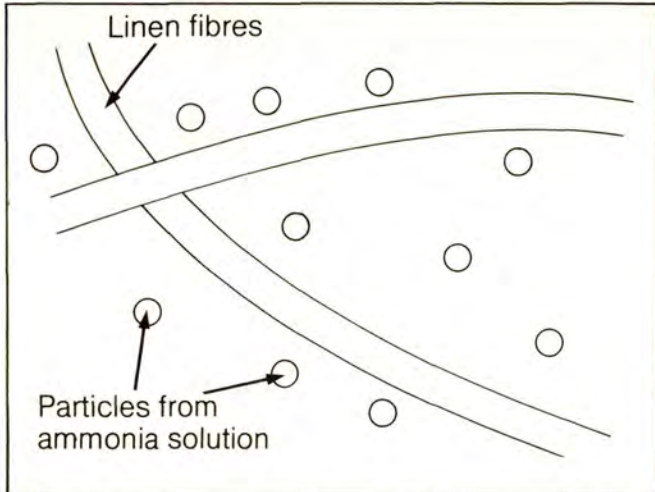
Q8 Which fabrics are most colourful after dyeing, those dyed with mordants or without?

Q9 Sometimes, mordants change the colour of a dye on a fabric. Did this happen to either of your fabrics?

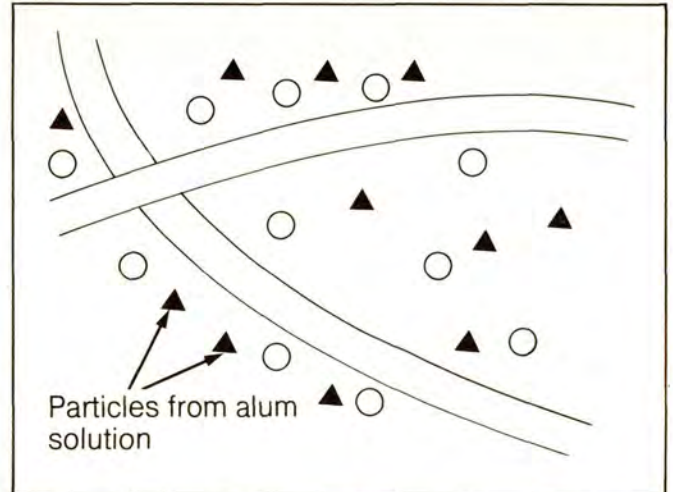
Mordants and fastness

Information: How mordants work

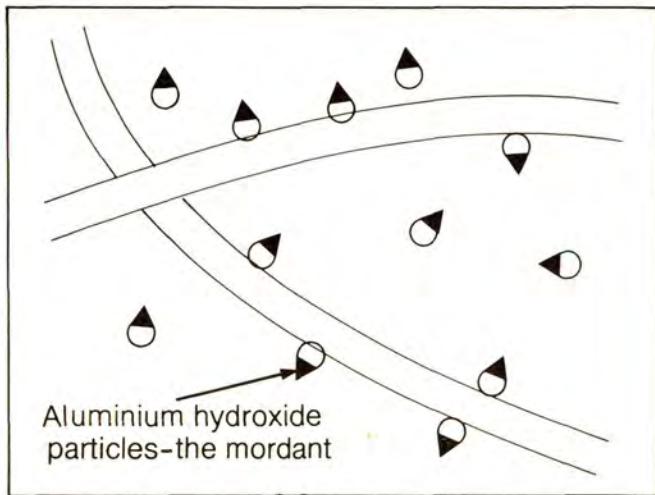
A mordant works like a glue which sticks a dye to a fabric.



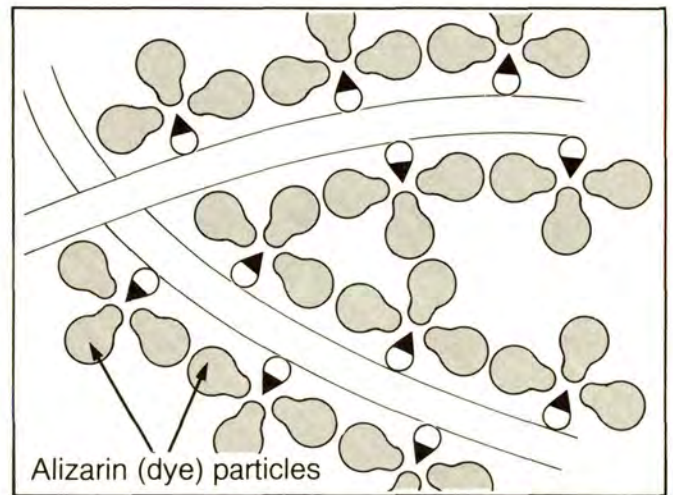
In the last experiment, the fabric was soaked in ammonia solution. This contains hydroxide particles.



The fabric was then soaked in alum solution. This contains aluminium particles. The particles from each solution come close together among the fibres.



Particles from each solution join together to make aluminium hydroxide. This is the mordant which sticks to the fabric fibres.



The mordant attracts the alizarin (dye) particles. The alizarin joins to the mordant particles and coats the fibre with colour.

- Q10** A man wanted to dye a white cotton sheet. He put it straight into warm alizarin dye for 10 minutes. Would this work? Give your reasons.

Q11 How do mordants work?

Q12 Name two solutions that can be used to make a mordant.

Q13 Give the name of a mordant which can be used for dyeing linen.


3 Creative dyeing

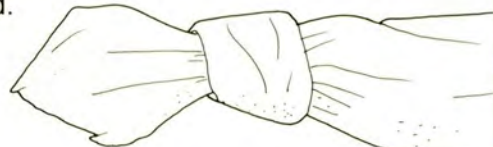



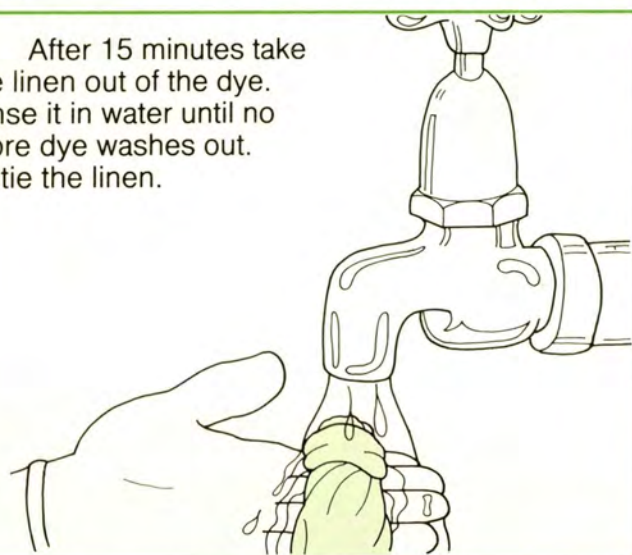
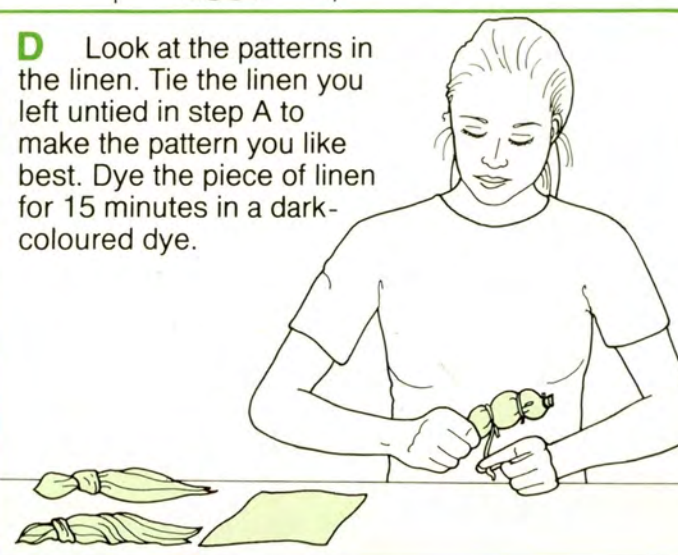
Tie dyeing

Apparatus

- ★ 4 pieces of linen
- ★ 2 buckets of dye (one a light colour, one dark)
- ★ string
- ★ scissors
- ★ 3 marbles
- ★ bowl of water
- ★ tongs
- ★ rubber gloves

You are going to find out how patterns can be made by tying fabric before dyeing it.

 Wear gloves.

<p>A Tie 3 pieces of linen in the ways shown. Leave 1 piece untied.</p> <p>tie a knot in 1 corner</p>  <p>twist the linen, then tie it</p>  <p>wrap marbles in the linen and tie with string</p> 	<p>B Soak all 4 pieces of linen in cold water. Put on gloves. Then, using tongs, put all the pieces of linen in a bucket of light-coloured dye.</p> 
<p>After 15 minutes take the linen out of the dye. Rinse it in water until no more dye washes out. Untie the linen.</p> 	<p>D Look at the patterns in the linen. Tie the linen you left untied in step A to make the pattern you like best. Dye the piece of linen for 15 minutes in a dark-coloured dye.</p> 

Q1 How are the patterns produced in tie dyeing?

Q2 When you use two colours in tie dyeing, why must the lighter colour be used first?


Creative dyeing

Batik

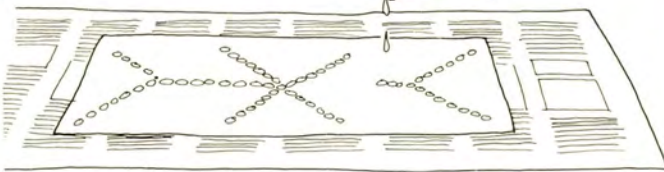
Apparatus

- ★ piece of white cotton
- ★ candle
- ★ bucket of dye solution
- ★ knife
- ★ newspaper
- ★ tongs
- ★ rubber gloves

You are going to use wax to make a pattern on fabric before dyeing it.

 Wear gloves.

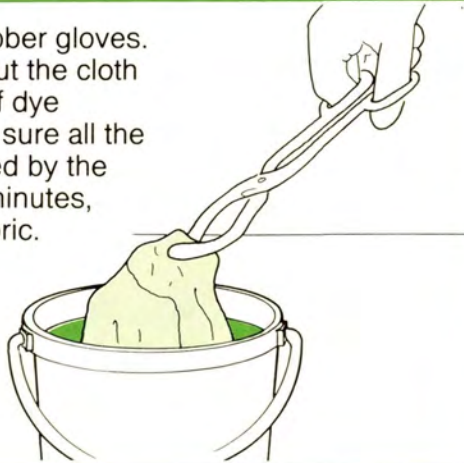
A Put a sheet of newspaper on the bench. Lay a piece of white cotton on it. Hold a lighted candle so that the hot wax drops on to the cotton. Make a pattern with the drops of wax.



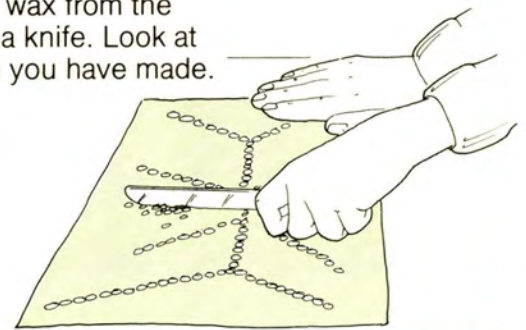
B When the pattern is as you like it, leave the wax to cool and harden. Then roll the fabric up to crack the wax.



C Put on rubber gloves. Using tongs, put the cloth into a bucket of dye solution. Make sure all the fabric is covered by the dye. After 15 minutes, remove the fabric.



D Gently, squeeze out most of the dye from the fabric. Let it dry. Then scrape the wax from the fabric with a knife. Look at the pattern you have made.



Q3 Why did you put wax on to the fabric?

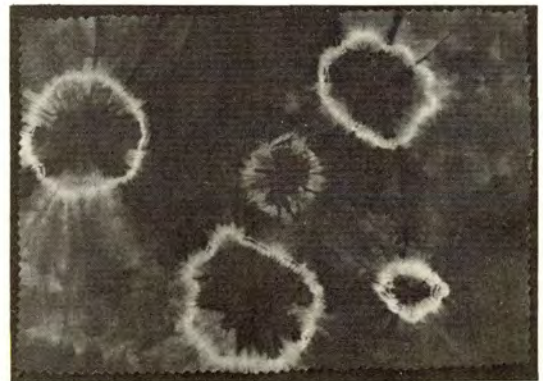
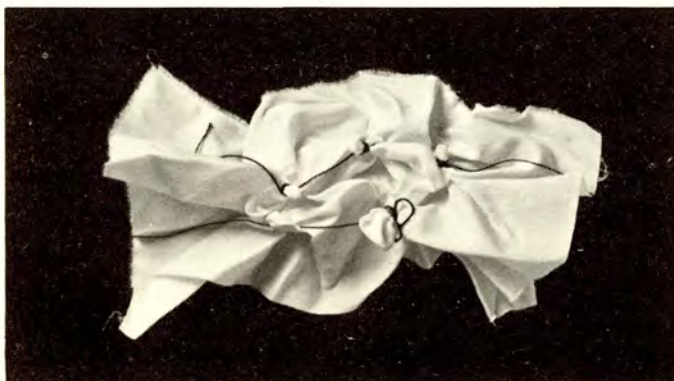
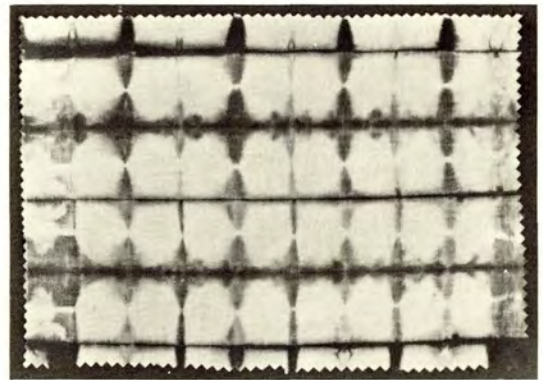
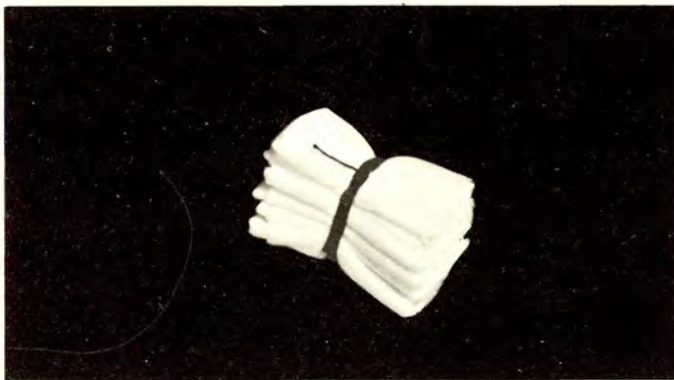
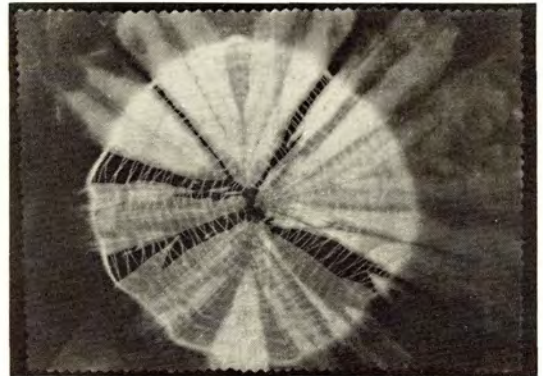
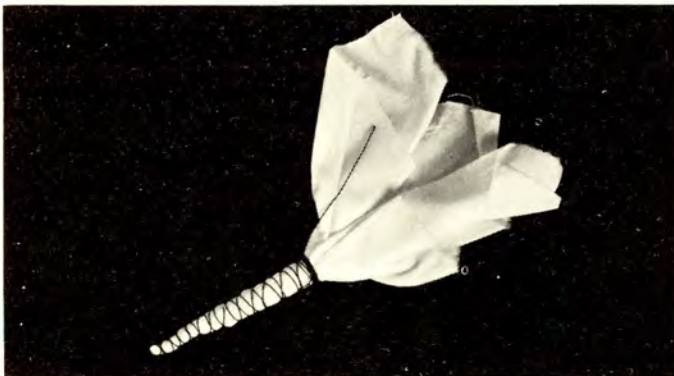
Q4 In what way is batik similar to tie dyeing?

Q5 A girl made a pattern on white fabric with wax. She dyed the cloth in yellow dye. She scraped off the wax. Then she dyed the fabric in blue dye. What colours would be produced on the fabric?

Information: Resist dyeing

When a flat piece of fabric is put into a dye, the whole surface becomes coloured. If the fabric is tied or parts are covered in some way, only the uncovered area is dyed. This method of producing patterns is called **resist dyeing**. The parts of the fabric that do not take up the dye are called **resist areas**. **Tie dyeing** and **batik** are methods of resist dyeing.

Tie dyeing is a popular method of dyeing fabric in West African countries. Many different patterns can be produced by tying the fabric in various ways. Some are shown here.



Q6 What is resist dyeing?

Q7 What name is given to the parts of the fabric that do not take up dye?

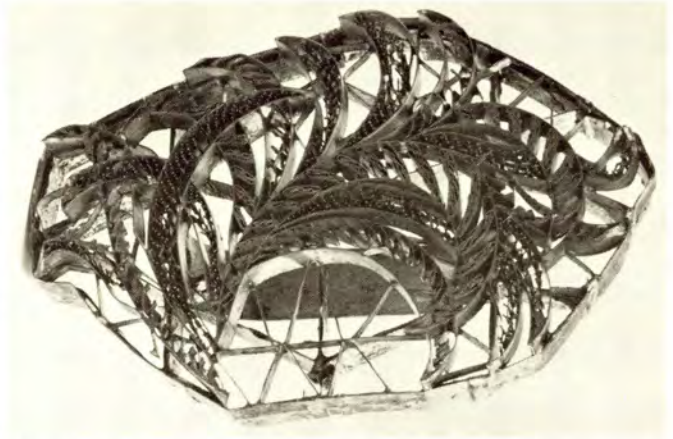
Creative dyeing

Information: Batik

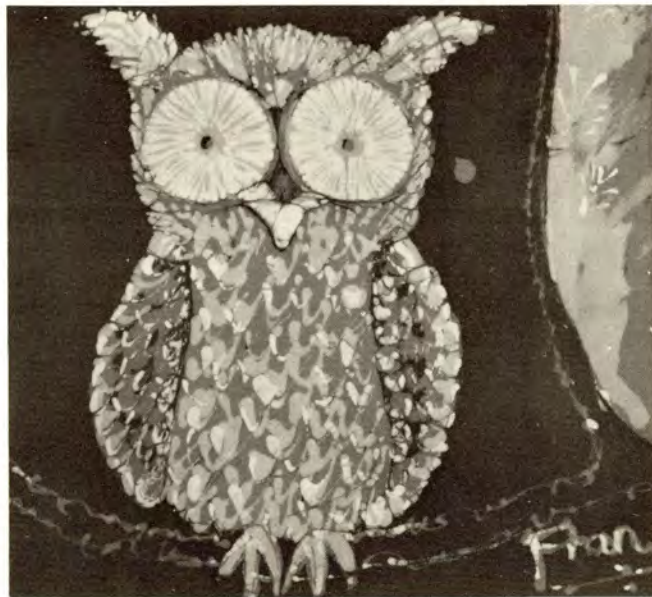
The most common method of resist dyeing is **wax resist**, or **batik**. The word batik comes from Indonesia where this method of dyeing is still popular.



There are several different ways of making a wax pattern on fabric. One way is to heat paraffin wax or candle wax in a saucepan. The wax can be painted on to the fabric with a brush or **trailer** (as shown in the photo). The wax is removed after dyeing, by boiling the fabric in water and detergent.



Another method is to let hot wax soak into a felt pad in a pan. The pan is kept warm to stop the wax going hard. Printing blocks like the one shown are then pressed into the pad of wax. These are quickly pressed on to the fabric to form the resist area.



The photo on the left shows that even complicated designs can be made using the batik method. A paste made from flour and water can be used instead of wax. The dry paste is rubbed off the fabric after it has been dyed.

Q8 What is the name given to wax resist dyeing?

Q9 Name two different ways of putting wax on to fabric.

Q10 What can be used instead of wax to make resist areas?

4 Making and testing dyes

Making two brown dyes

Apparatus

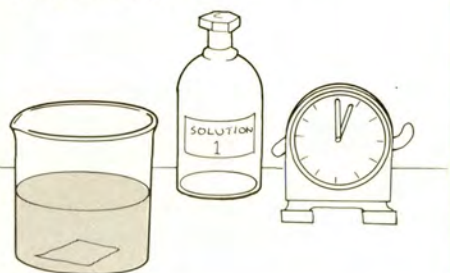
- ★ 2 pieces of white cotton fabric
- ★ 150 cm³ solution 1
- ★ 150 cm³ solution 2
- ★ three 250 cm³ beakers
- ★ measuring cylinder
- ★ stop clock
- ★ 100 cm³ ammonia solution
- ★ 100 cm³ household bleach
- ★ glass rod
- ★ tongs
- ★ spatula
- ★ safety glasses
- ★ rubber gloves

You are going to make two brown dyes called iron buff and khaki. The dyes will be used to colour white cotton.

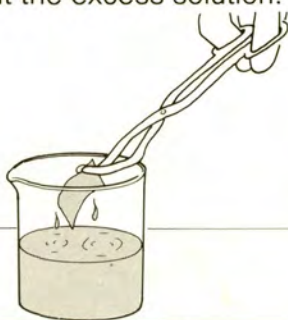


Wear safety glasses and rubber gloves.

A Pour 150 cm³ of solution 1 into a beaker. Soak one piece of cotton in this solution for 5 minutes.



B Put on gloves and safety glasses. Remove the cotton using tongs. Gently squeeze out the excess solution.



C In a fume cupboard, pour 100 cm³ of ammonia solution into a beaker. Use tongs to put the wet fabric into the ammonia.



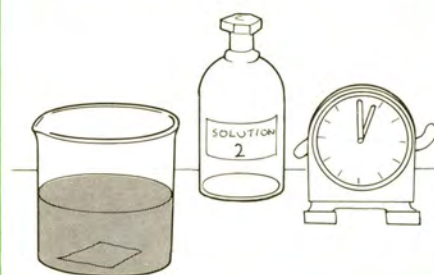
D Soak the cloth for 5 minutes, stirring gently. Remove the fabric with tongs. Rinse it in clean water.



E Pour out 100 cm³ of bleach into a beaker. Put the fabric into the beaker for 10 minutes. Remove the fabric with tongs. Wash and dry it.



F Repeat steps A to E using solution 2. Use the second piece of white cotton.



Q1 What is the colour of solution 1?

Q2 What is the colour of solution 2?

Q3 What colours were the two pieces of cotton when dry?

Q4 What does bleach do in the experiment and why is this surprising?


Making and testing dyes

Dyeing fabrics with a mixture of dyes.

Apparatus

- ★ squares of cotton, wool, viscose rayon and polyester
- ★ blue dye solution
- ★ soap solution
- ★ measuring cylinder
- ★ Bunsen burner
- ★ sticky tape
- ★ yellow dye solution
- ★ red dye solution
- ★ watchglass
- ★ spatula
- ★ glass rod
- ★ heatproof mat
- ★ hand lens
- ★ 20 g sodium sulphate
- ★ 250 cm³ beaker
- ★ thermometer
- ★ gauze
- ★ dropper
- ★ balance
- ★ tripod
- ★ stop clock
- ★ tongs
- ★ safety glasses
- ★ scissors
- ★ rubber gloves

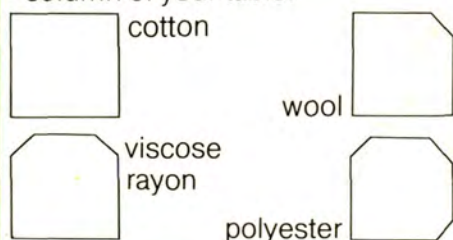
You are going to find out which fabrics take up which dye(s).

 Wear safety glasses and gloves

Q5 Copy this table. Make it big enough to stick in pieces of fabric.

Fabric name	Piece of fabric after dyeing	Colour of dye(s) that fabric has taken up
-------------	------------------------------	---

A Cut corners off the 4 pieces of fabric to identify them as shown. Fill in the 1st column of your table.



B On a watch glass, weigh out 20 g of sodium sulphate. Put it into a beaker. Add 50 cm³ of yellow dye solution.



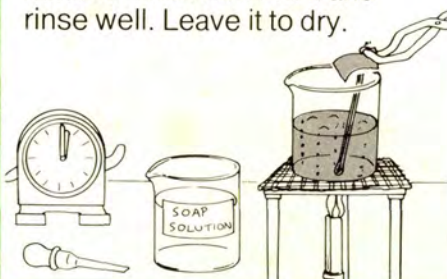
C Add 50 cm³ red dye solution and 50 cm³ blue dye solution to the beaker. Stir. This is your dye bath.



D Heat the dye bath to 80°C. Use a thermometer. Add 10 drops of soap solution.



E With tongs put the cotton fabric in the dye bath for 1 minute. Then remove it and rinse well. Leave it to dry.



F Repeat step E with each piece of fabric. When they are all dry, look at the pieces of fabric with a hand lens. Complete your table.



Q6 Were all the fabrics dyed the same colour?

Q7 Which fabric(s) did not take up any of the dyes well?

Q8 Did any of the fabrics dye green or purple? How could this happen?

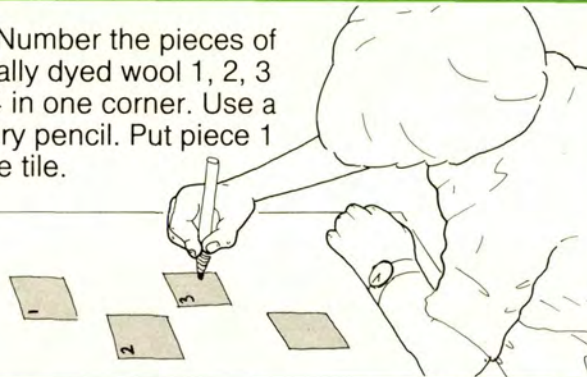
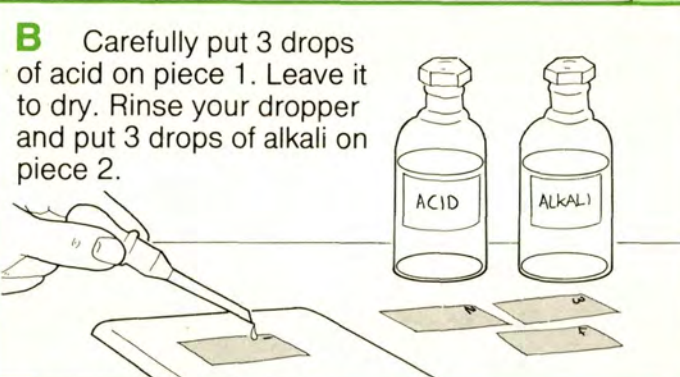
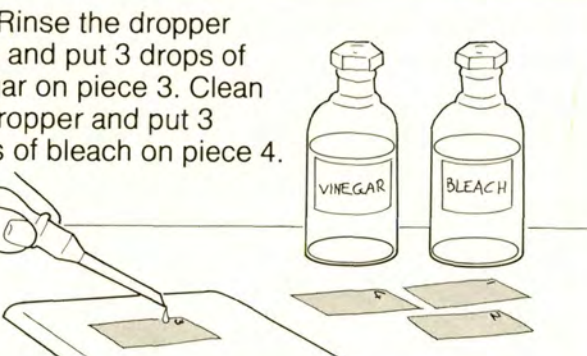
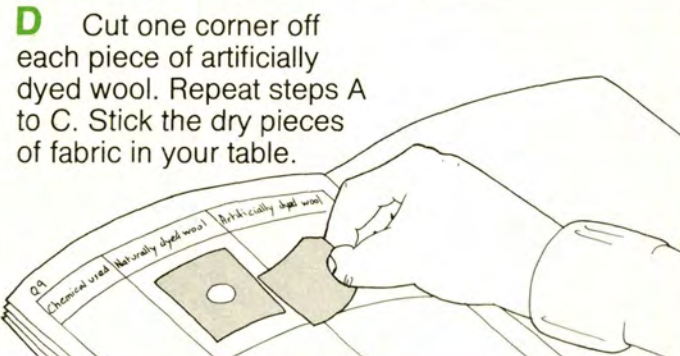
The effect of chemicals on dyed fabrics

Apparatus

- ★ 4 pieces each of naturally dyed wool and artificially dyed wool
- ★ bottle of acid
- ★ bottle of alkali
- ★ bottle of vinegar (weak acid)
- ★ bottle of bleach
- ★ scissors
- ★ laundry pencil
- ★ white tile
- ★ dropper
- ★ sticky tape

You are going to find out how dyed fabrics are affected by chemicals.

Q9 Copy this table. Make it big enough to stick in eight pieces of fabric.

Chemical used	Naturally dyed wool	Artificially dyed wool
<p>A Number the pieces of naturally dyed wool 1, 2, 3 and 4 in one corner. Use a laundry pencil. Put piece 1 on the tile.</p> 	<p>B Carefully put 3 drops of acid on piece 1. Leave it to dry. Rinse your dropper and put 3 drops of alkali on piece 2.</p> 	
<p>C Rinse the dropper again and put 3 drops of vinegar on piece 3. Clean the dropper and put 3 drops of bleach on piece 4.</p> 	<p>D Cut one corner off each piece of artificially dyed wool. Repeat steps A to C. Stick the dry pieces of fabric in your table.</p> 	

Q10 What happened to each piece of naturally dyed fabric?

Q11 What happened to each piece of artificially dyed fabric?

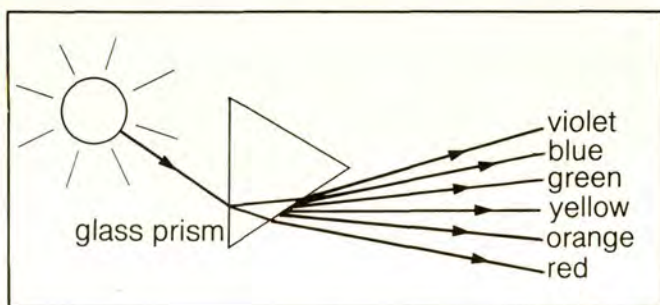
Q12 Which type of dye is best?

Q13 Sweat is a very weak acid. What might happen to the clothes of people in hot climates?

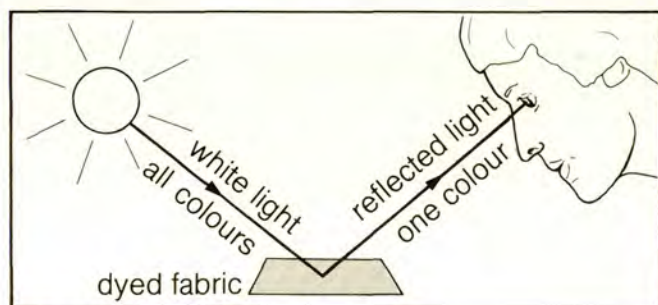
Q14 The natural dye was red cabbage. How could you use this dye to show that a liquid was **acidic**?

Making and testing dyes

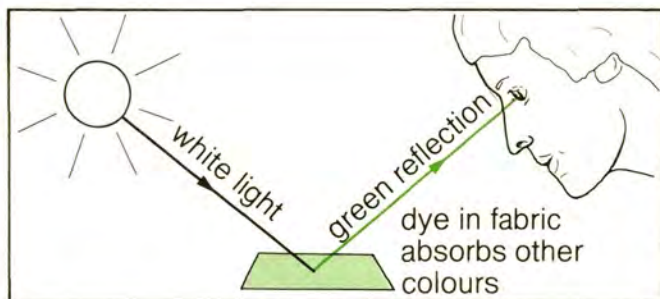
Information: Why dyes are so colourful.



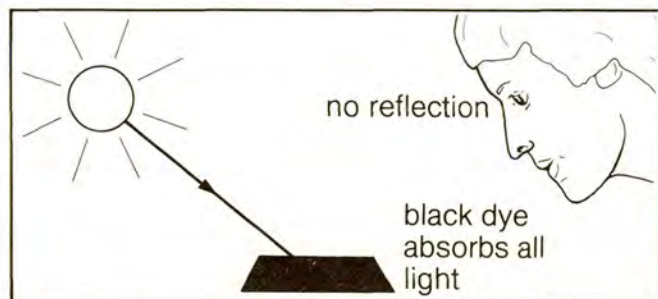
1. Sunlight is white light. It is made up from all the colours of the rainbow. This set of colours is the **spectrum**. The white light can be split by sending it through a glass block called a **prism**.



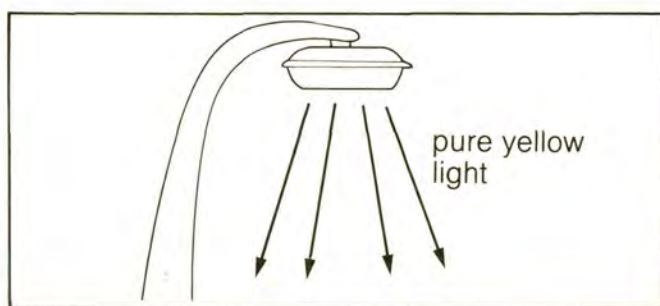
2. When white light falls on dyed fabric the dye particles **absorb** (take in) some of the colours. The remaining colour is **reflected** (bounced off) into our eyes.



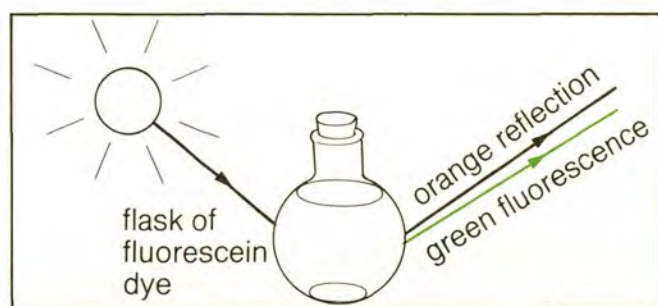
3. Green dye absorbs violet, blue, yellow, orange and red light. It does not take in green. The green light is reflected into our eyes. So the fabric looks green.



4. Black objects absorb all the colours in white light. Fabrics dyed black do not reflect any light. White cloth reflects all the colours of the spectrum at once.



5. Some street lamps send out a pure yellow light. In this light clothes look strangely coloured. This is because yellow light is absorbed and reflected differently from white light.



6. **Fluorescent** dyes give off more than one colour at once. This gives the dye a glowing appearance. **Fluorescein** dye looks orange and green at the same time.

Q15 White light was shone on to a red shirt. Which colours are absorbed by the red dye? Which colour is reflected?

Q16 How do fluorescent dyes work?

Information: Colour and camouflage



This jacket uses a fluorescent dye for safety. Car drivers will spot the person more easily because of the bright, unusual fluorescence. Pictures in advertisements sometimes use the same idea.



Camouflage is a way of confusing an enemy. Men and animals often use camouflage to blend in with their surroundings. This makes them less noticeable to their enemies. Soldiers in Northern Norway wear white clothing to match the snow. Troops in woodland wear clothes dyed in patches of brown and green.



Camouflage is very necessary for animals to prevent them being seen by **predators** (animals that attack and eat them). This chameleon can produce different **pigments** (coloured substances) in its skin to suit its background. It can change colour in a few minutes.

Q17 What is camouflage?

Q18 Why is camouflage needed by soldiers?

Q19 Suggest a uniform for soldiers in the Sahara Desert.

Q20 Why is camouflage needed by some wild animals?

Q21 Make a list of animals whose bodies are camouflaged?

5 Stains

Removing stains from cotton

Apparatus

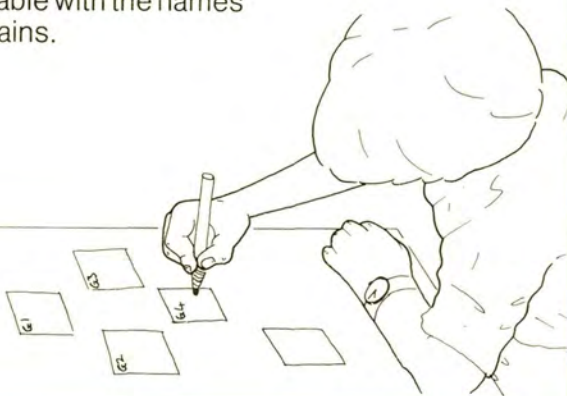
- ★ Stains: labelled watch glasses of grease, cold tea and orange juice; bottle of nail varnish; ballpoint pen
- ★ labelled beakers of solvents
- ★ laundry pencil
- ★ 25 pieces of cotton (each 2 cm × 2 cm)
- ★ cotton wool
- ★ 2 droppers
- ★ spatula
- ★ glass rod
- ★ heatproof mat
- ★ white tile
- ★ sticky tape
- ★ stop clock
- ★ scissors
- ★ white paper
- ★ tongs

You are going to stain some pieces of cotton and find out how to remove the stains.

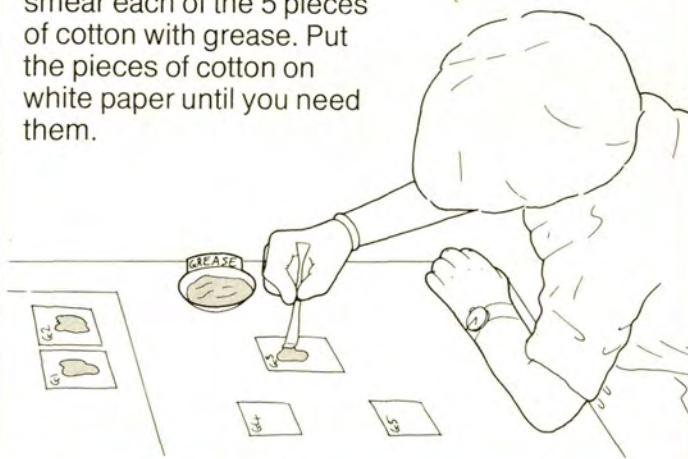
Q1 Copy this table. Make it big enough to stick in 25 pieces of fabric.

Name of stain	Treatment of stain on fabric:				
	1 Cold water	2 Hot water	3 Vinegar	4 Methylated spirit	5 Propanone

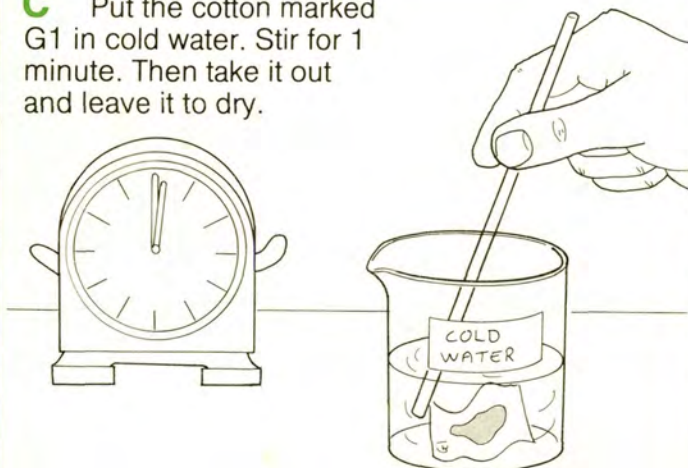
A Use a laundry pencil to label 5 pieces of cotton G1 to G5. Fill in the 1st column of your table with the names of the stains.



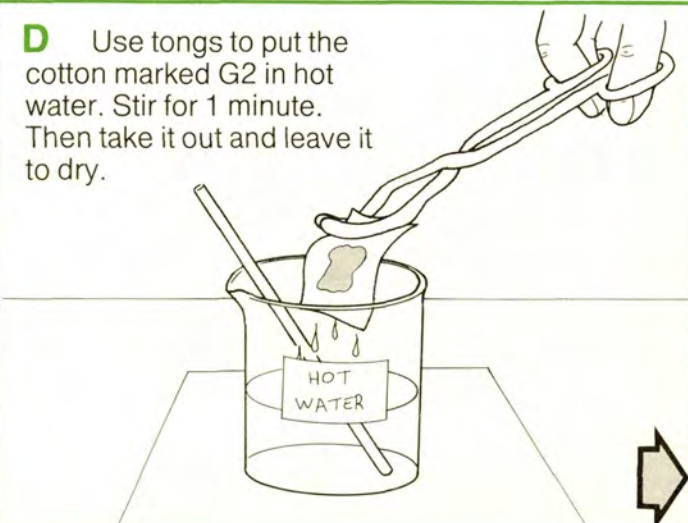
B Use the spatula to smear each of the 5 pieces of cotton with grease. Put the pieces of cotton on white paper until you need them.



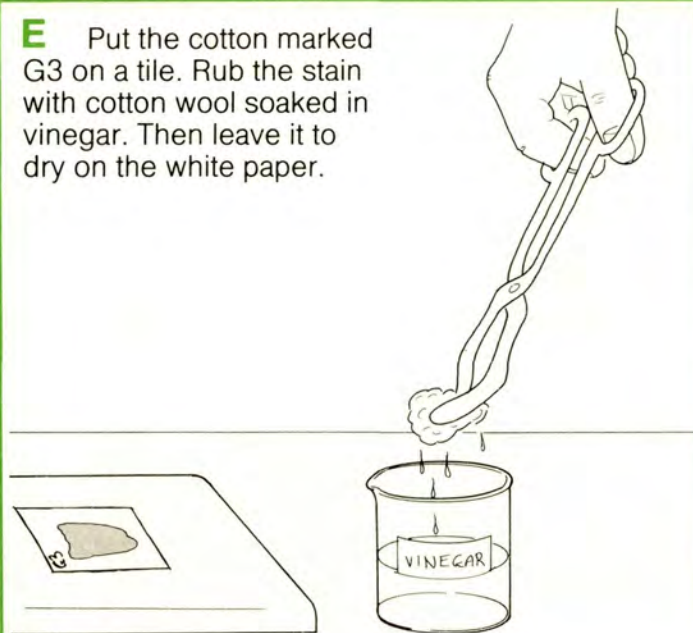
C Put the cotton marked G1 in cold water. Stir for 1 minute. Then take it out and leave it to dry.



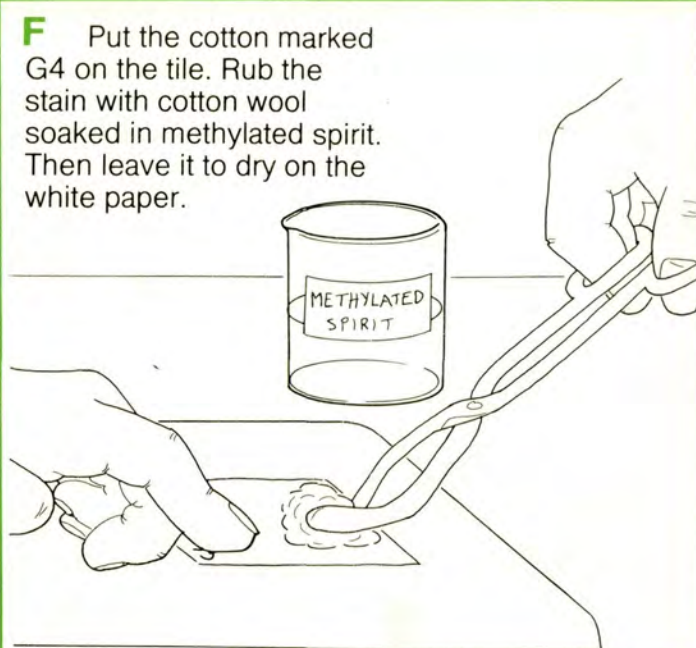
D Use tongs to put the cotton marked G2 in hot water. Stir for 1 minute. Then take it out and leave it to dry.



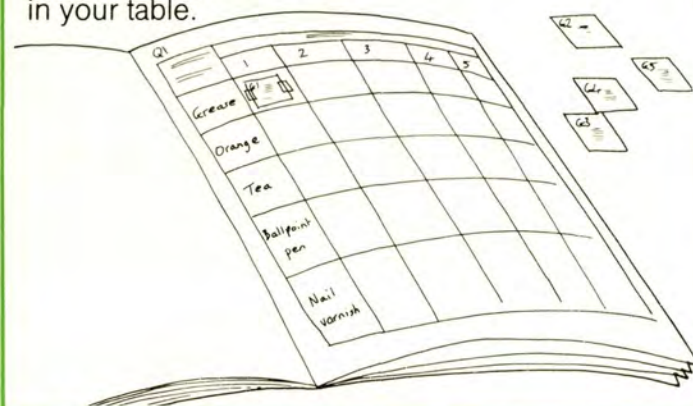
E Put the cotton marked G3 on a tile. Rub the stain with cotton wool soaked in vinegar. Then leave it to dry on the white paper.



F Put the cotton marked G4 on the tile. Rub the stain with cotton wool soaked in methylated spirit. Then leave it to dry on the white paper.

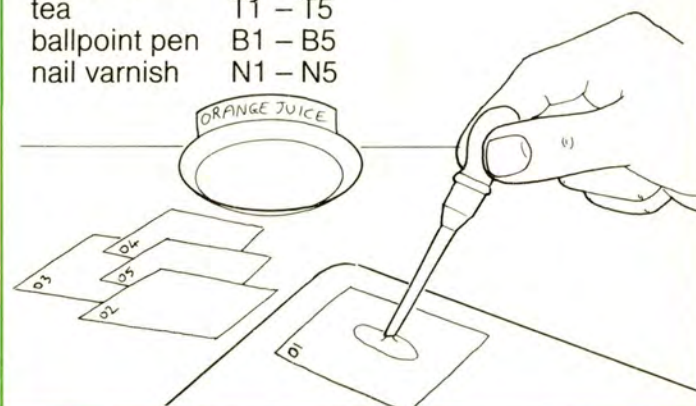


G Put the cotton marked G5 on the tile. Rub the stain with cotton wool soaked in propanone. When all the pieces of cotton are dry, stick them in your table.



H Repeat steps A to G for each of the other stains. Put orange juice and tea stains on the fabric with a clean dropper. Put nail varnish on the fabric using the brush inside the bottle. Label the fabrics as follows:

orange juice O1 – O5
 tea T1 – T5
 ballpoint pen B1 – B5
 nail varnish N1 – N5



Anything that removes a stain is called a solvent, because the stain dissolves in it.

Q2 Was any stain removed by soaking the cotton in cold water?

Q3 Which stains were removed by propanone?

Q4 Did any one solvent remove all the stains?

Q5 Did any of the stain removers act as a solvent on ballpoint pen stain?

Q6 Do you think the stains would have been harder to remove if they had been left to dry on the fabrics for a week?


Stains

Damage to fabrics by solvents

Apparatus

- ★ 5 pieces each of nylon, acetate rayon, cotton and triacetate
- ★ laundry pencil
- ★ stop clock
- ★ labelled beakers of hydrogen peroxide, trichloroethane, white spirit and propanone
- ★ tongs
- ★ scissors
- ★ sticky tape
- ★ white tile
- ★ fume cupboard

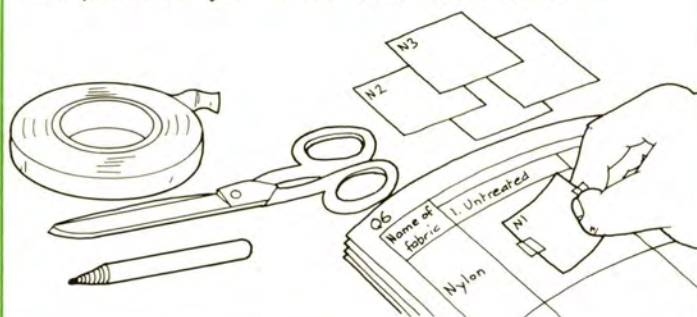
You are going to find out if solvents damage fabrics.

 Wear safety glasses and gloves. Keep solvents away from fire.

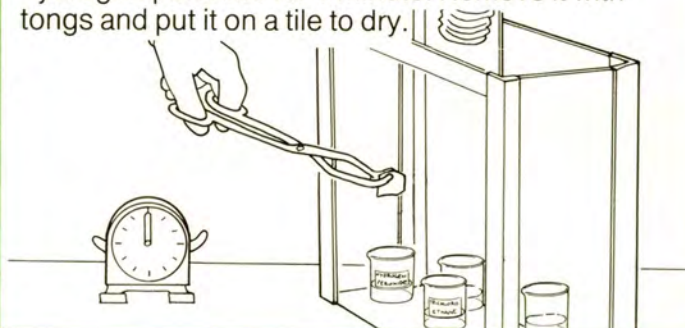
Q7 Copy this table. Make it big enough to stick in 20 pieces of fabric.

Name of fabric	Treatment:				
	1 Untreated	2 Hydrogen peroxide	3 Trichloroethane	4 White spirit	5 Propanone

A Use a laundry pencil to label 5 pieces of nylon N1 to N5. Fill in the 1st column of your table. Stick one piece of nylon in the "untreated" column.



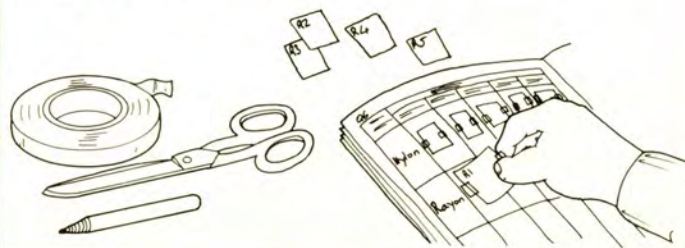
B Put on glasses and gloves. In a fume cupboard, put the nylon marked N2 into a beaker of hydrogen peroxide for 1 minute. Remove it with tongs and put it on a tile to dry.



C Repeat step B with the other pieces of nylon and other solvents. Put N3 in trichloroethane, N4 in white spirit and N5 in propanone.



D Repeat steps A to C with rayon, then cotton and lastly, triacetate. Label the rayon pieces R1 to R5; the cotton C1 to C5 and the triacetate T1 to T5. When they are dry stick them in the correct places on your table.



Q8 How did propanone affect the 4 fabrics?

Q9 Was there a solvent which had no effect on all the fabrics?

Q10 Why should a small piece of fabric from a garment be tested with a solvent before the solvent is used on a stain?

Information: Stain removal

A stain is not like ordinary dirt—which simply attaches itself to the fabric. A stain is more like a dye which **penetrates** (goes into) the fibres. A stain can often be removed if the fabric is rinsed well in cold water before the stain has time to 'set'. Some stains have to be treated with chemicals.



Beer stains can be washed off at a very high temperature. This may be too hot for the fabric. If so, mix 1 part ethanoic acid (vinegar) with 4 parts water to use as a solvent.



Egg stains can often be removed by soaking in a biological washing powder. If this does not work a mixture of 1 part hydrogen peroxide (10 vol.), 9 parts water and 5 drops of ammonia can be used. Rinse well afterwards.



Make-up stains such as lipstick or face cream can be removed quite easily. Use either methylated spirit or tetrachloromethane as shown below. Wash the garment after removing the stain.



Manufactured dry cleaning solvents can be used to remove many different stains. If a solvent is used to remove a stain, special rules must be followed:

Always use solvents in a well-ventilated room.

Solvents must not be used near flames.

Propanone must not be used on fabrics containing acetate fibres.

Always test a small piece of the fabric for colour fastness before treating a stain.

Always rinse or wash the fabric after treatment, or leave to air.

Q11 What is a stain?

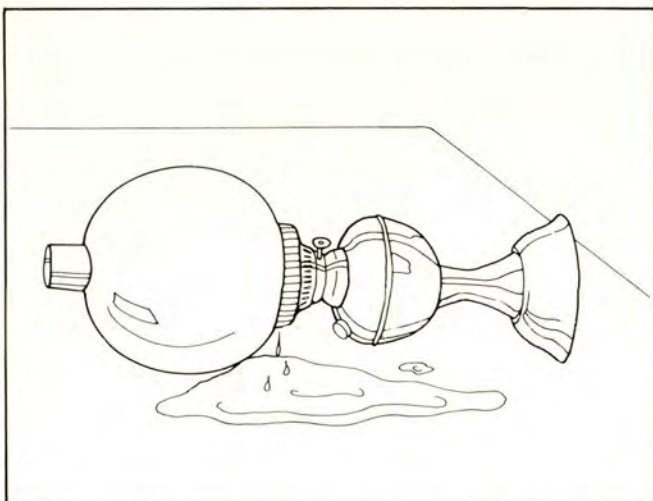
Q12 What is the best time to treat a stain?

Q13 Why should fabrics be tested for colour fastness before treating a stain?

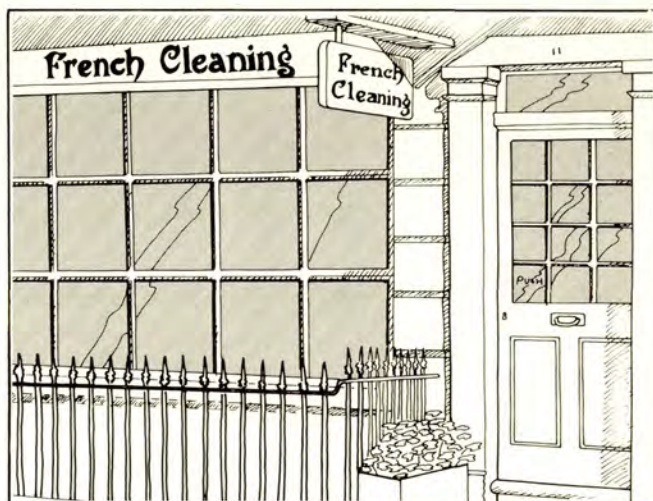
Q14 Why must some solvents not be used near a flame?

Stains

Information: Dry cleaning



Dry cleaning was discovered by accident in 1825. Jean-Baptiste Jolly owned a dye factory in France. One day his maid knocked over a paraffin lamp. The spilt paraffin removed stains from the tablecloth.



Jolly started using paraffin to clean fabrics in his factory. Others copied his idea all over the world. The method was at first called **French cleaning**. Later it was called dry cleaning because no water is used.



Solvents are liquids in which substances dissolve. The stain dissolves in the solvent and so is removed. Paraffin was replaced by benzene which worked better but is highly **flammable**. Next, white spirit was used as it is slightly less inflammable.



There are now many modern dry cleaning solvents such as Perk, trichloroethane, solvent 113 and solvent 11. None of these is inflammable. The **vapour** (fumes) of these solvents can cause sleepiness if too much is breathed in.

Q15 What was the first solvent to be used for dry cleaning?

Q16 Why was benzene a bad solvent to use?

Q17 Which solvent replaced benzene?

Q18 Why must modern solvents be used in a well-ventilated (airy) place?


6 Colouring metals

Treating and colouring aluminium

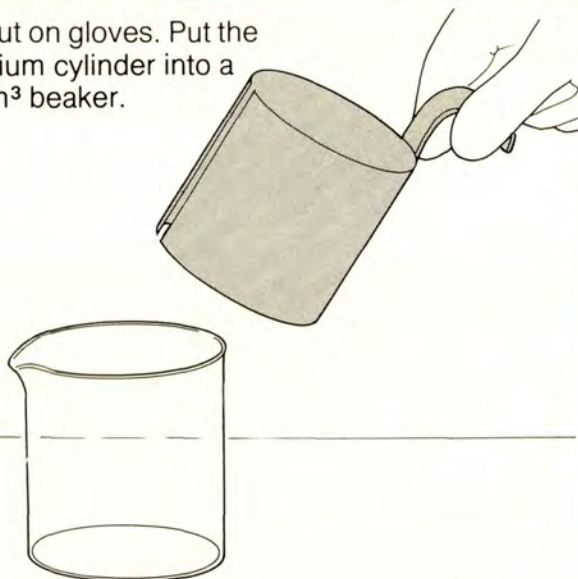
Apparatus

- ★ 2 flat pieces of aluminium (each 5 cm × 8 cm)
- ★ aluminium cylinder to fit beaker
- ★ hot soap solution
- ★ crocodile clip with wood and wire lead attached
- ★ stop clock
- ★ 400 cm³ beaker
- ★ green dye
- ★ sponge
- ★ electrical lead and clip connector
- ★ rubber gloves
- ★ tongs
- ★ beaker of sulphuric acid
- ★ low voltage d.c. power supply

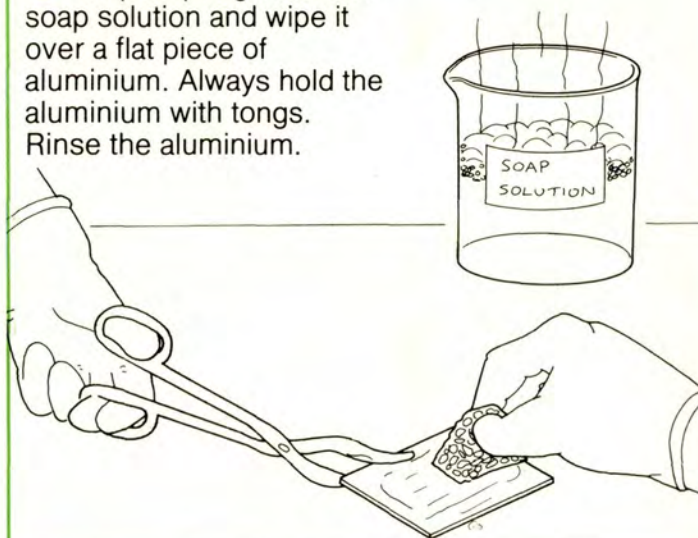
You are going to cover aluminium with a film of **oxide** before colouring it.

 Wear gloves. The acid is stronger than you would normally use in school.

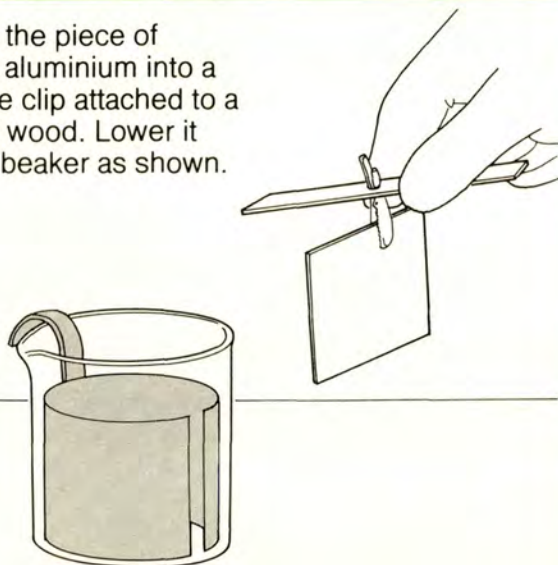
A Put on gloves. Put the aluminium cylinder into a 400 cm³ beaker.



B Dip a sponge into hot soap solution and wipe it over a flat piece of aluminium. Always hold the aluminium with tongs. Rinse the aluminium.



C Fix the piece of cleaned aluminium into a crocodile clip attached to a piece of wood. Lower it into the beaker as shown.

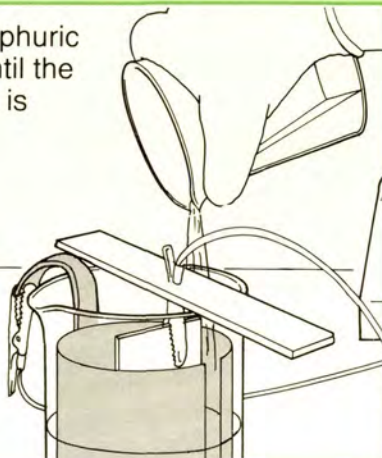


D Connect the aluminium cylinder to the (+) terminal of a power supply. Connect the crocodile clip from the flat piece of aluminium to the (-) terminal. Do **not** switch on yet.

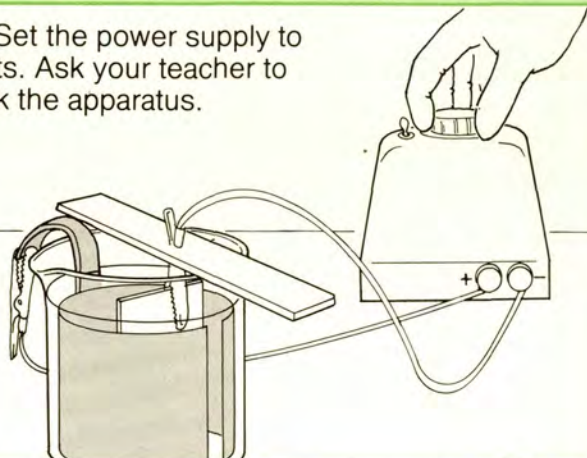


Colouring metals

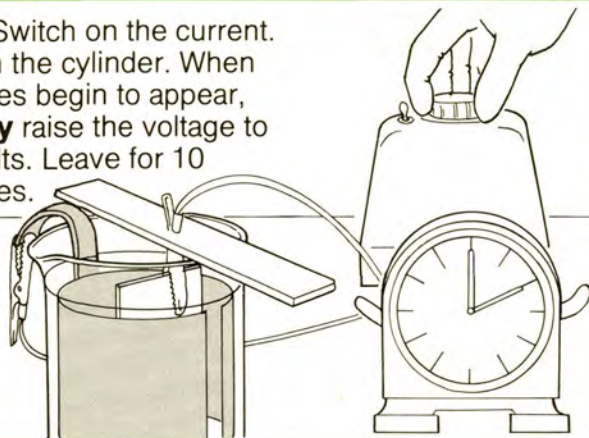
E Carefully pour sulphuric acid into the beaker until the flat piece of aluminium is almost covered.



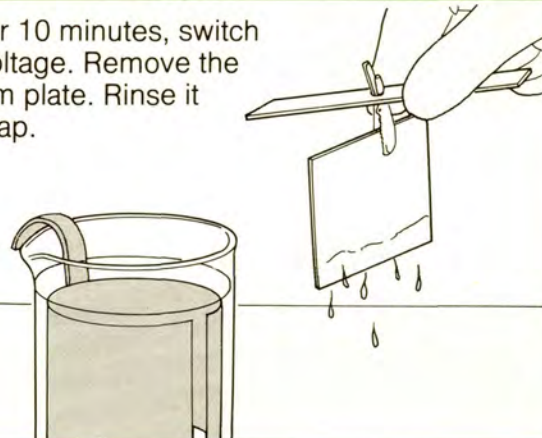
F Set the power supply to 6 volts. Ask your teacher to check the apparatus.



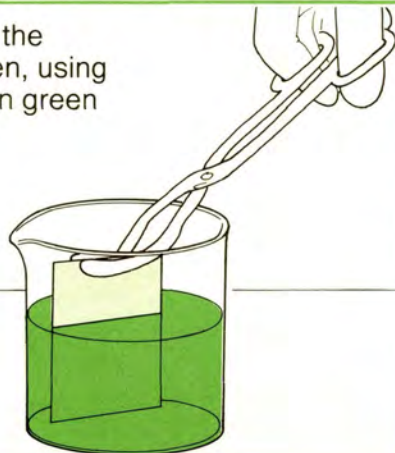
G Switch on the current. Watch the cylinder. When bubbles begin to appear, **slowly** raise the voltage to 12 volts. Leave for 10 minutes.



H After 10 minutes, switch off the voltage. Remove the aluminium plate. Rinse it under a tap.



I Look carefully at the aluminium plate. Then, using tongs, dip the plate in green dye. Leave it to dry.



J Using tongs, dip a piece of untreated aluminium into the dye. Let it dry. Then compare the 2 pieces of aluminium.



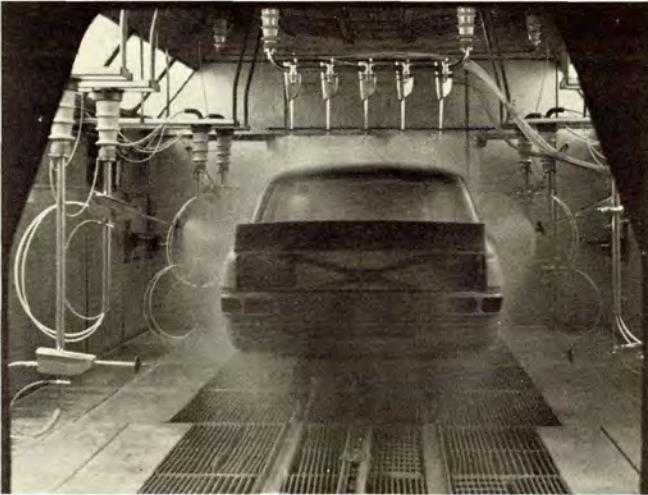
The sulphuric acid is diluted with water. The electric current, acid and water together form a film of aluminium oxide over the aluminium.

Q1 What did the plate look like after you removed it from the beaker in step H?

Q2 Which plate took up the green dye best, the treated or untreated one?

Q3 Why is it important to have your apparatus checked by the teacher in step F?

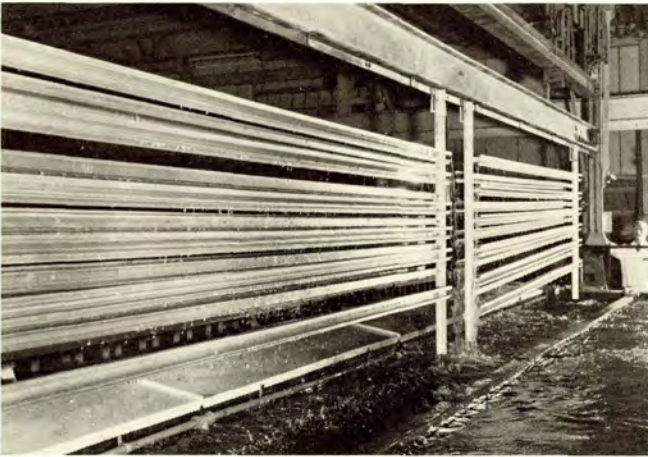
Information: Treating and colouring metals



The surfaces of products made in metal can be treated in many ways. Special paints have been developed to cover car bodies. These are **acrylic** paints made with chemicals obtained from oil.



The salt in sea water makes steel rust very quickly. Special marine paints must be used to protect ships. These paints are made from **epoxy resin**. The photo shows a warship entering **dry dock** for re-painting.



Some metals are difficult to paint. **Anodising** puts a thin layer of oxide on metals. The film of oxide can then be dyed. In the last experiment aluminium was anodised. The photo shows aluminium being lifted from a large anodising bath.



Metal surfaces can also be coated with another metal. This protects the metal from wear. The process is called **plating**. One way of plating metal is metal spraying as shown above. Metal particles are heated to a very high temperature and sprayed over the article.

Q4 Where do the chemicals used to make acrylic paints come from?

Q5 Why do ships need special paints?

Q6 What is meant by anodising?

Q7 Why are metals plated?

7 Uses of dyes

Dyeing and removing plaque

Apparatus

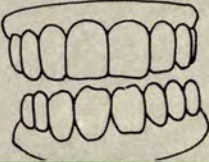
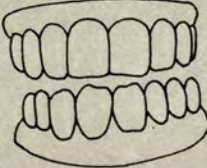
- ★ 2 disclosing tablets
- ★ drinking water in a well-washed beaker
- ★ toothpaste
- ★ toothbrush
- ★ biscuit
- ★ hand mirror
- ★ beaker of mouthwash
- ★ bucket of disinfectant
- ★ nail brush

Plaque is a layer of bacteria and dissolved food on your teeth. You are going to stain plaque with a harmless red dye and try to remove it from your teeth.

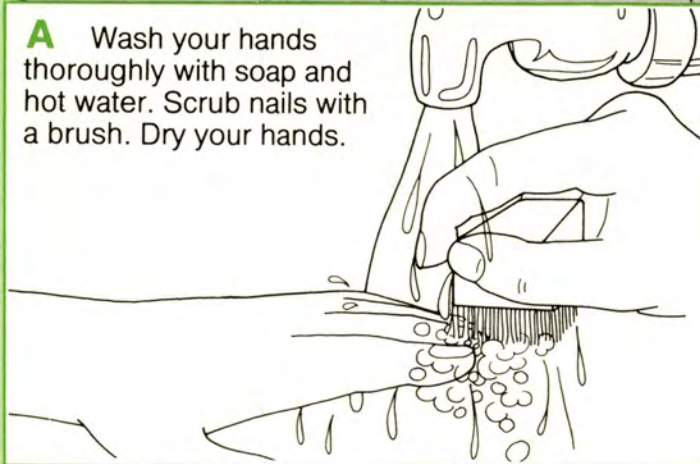


Follow hygienic procedures as explained by your teacher.

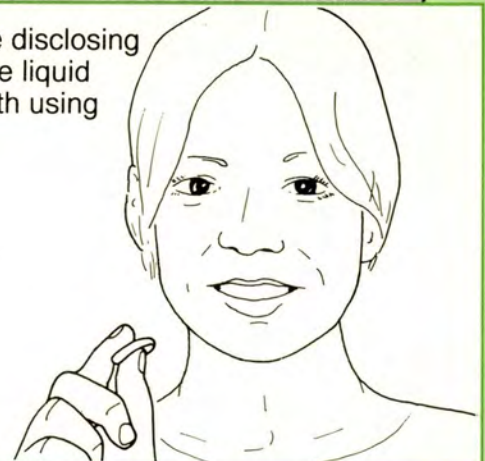
Q1 Copy this table.

Position of plaque on teeth before brushing	Position of plaque on teeth after brushing
	

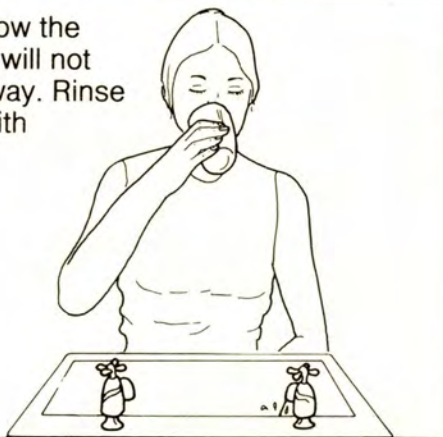
A Wash your hands thoroughly with soap and hot water. Scrub nails with a brush. Dry your hands.



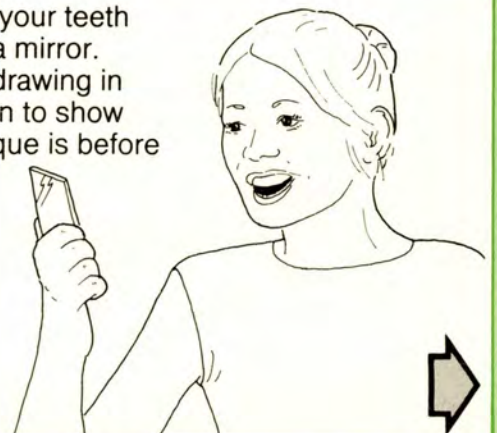
B Chew one disclosing tablet. Move the liquid round your teeth using your tongue.



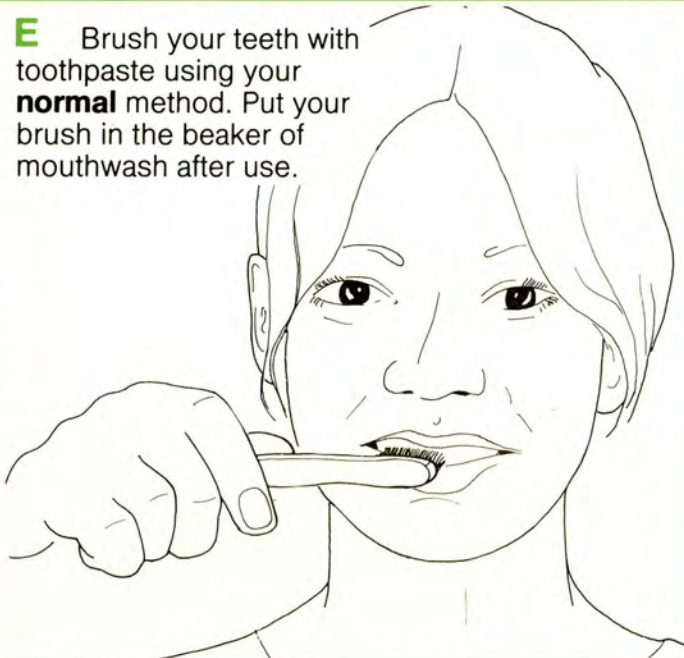
C Do not swallow the tablet. If you do it will not harm you in any way. Rinse out your mouth with drinking water.



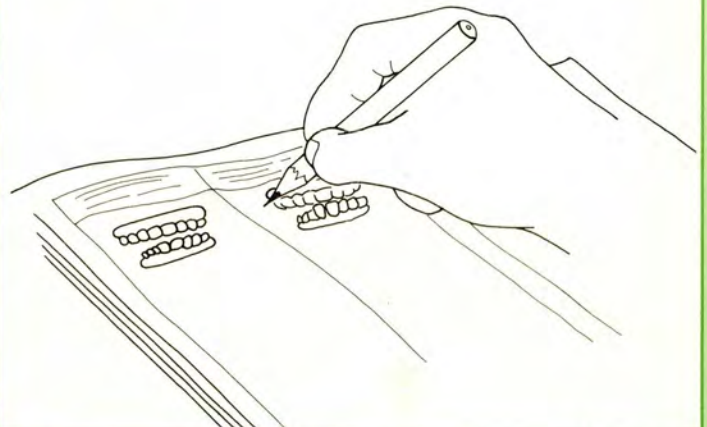
D Examine your teeth carefully with a mirror. Colour in the drawing in the first column to show where the plaque is before brushing.



E Brush your teeth with toothpaste using your **normal** method. Put your brush in the beaker of mouthwash after use.



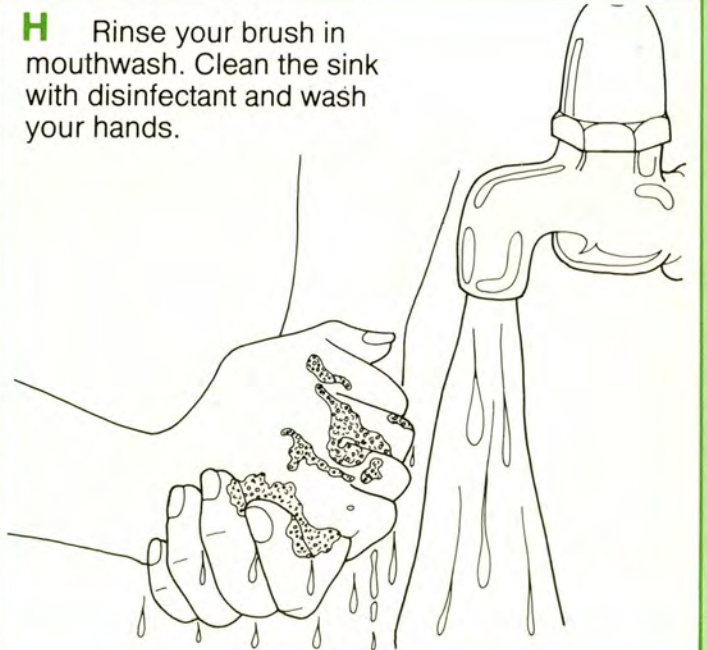
F Look at your teeth in the mirror. Colour in the drawing to show where the plaque is after brushing.



G Eat a biscuit. Chew another disclosing tablet and look at your teeth again. This time, brush your teeth until **all** the plaque has gone.



H Rinse your brush in mouthwash. Clean the sink with disinfectant and wash your hands.



Plaque is one of the main causes of tooth decay and gum disease.

Q2 Look at the 2 pictures in your table. How good is your normal method of brushing at removing plaque?

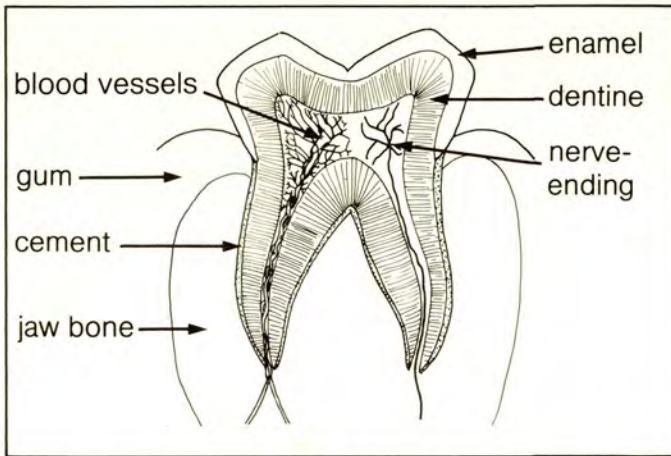
Q3 Where is the plaque on your teeth after eating a biscuit?

Q4 How must you brush your teeth to remove all the plaque?

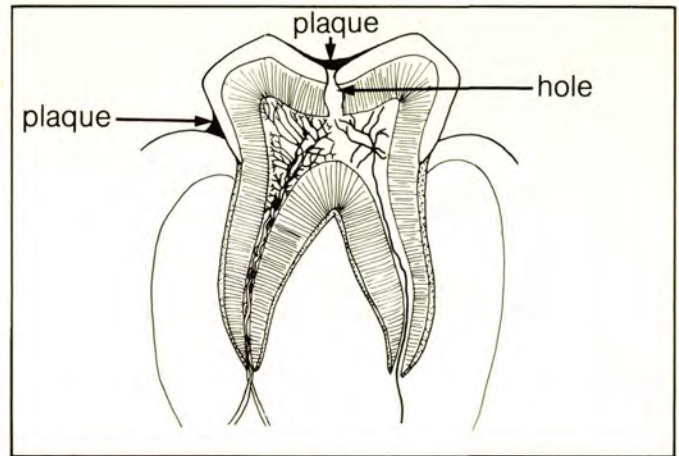
Q5 How can using disclosing tablets make teeth and gums stay healthy?

Uses of dyes

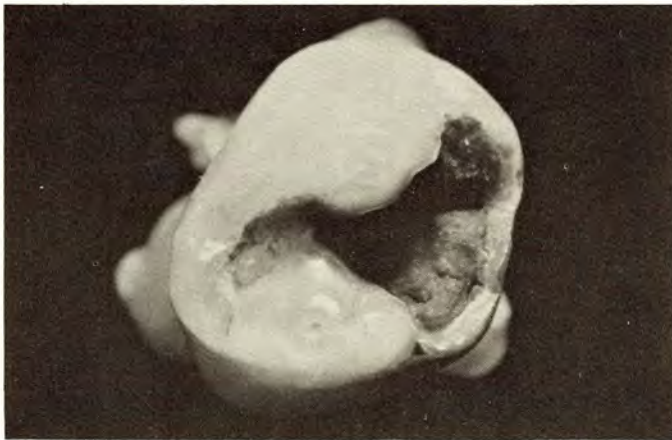
Information: The dangers of plaque



The drawing above shows a cross-section through a tooth. **Enamel** is the white outer layer. It is the hardest substance in the body. **Dentine** makes up most of the tooth and is like bone.



Plaque is the mixture of bacteria and dissolved food. This gets stuck between the teeth as shown above. The bacteria feed on the dissolved food, especially sugar. The bacteria make waste acids which dissolve the enamel and dentine. This is tooth decay. The nerve-ending causes the feeling of pain.



This photo shows a hole or cavity in a tooth. The photo on the right shows how the dentist fills cavities to stop further damage. The plaque can also cause a gum disease called **gingivitis**. Here the gums bleed easily and teeth later become loose. To care for your teeth remember the following points:



Have as little sugar as possible in your diet. Try to avoid sweets, chocolates, sugary foods and drinks. Brush teeth thoroughly to remove all plaque at least once a day. Use disclosing tablets occasionally to check for plaque. Use a fluoride toothpaste and visit your dentist regularly.

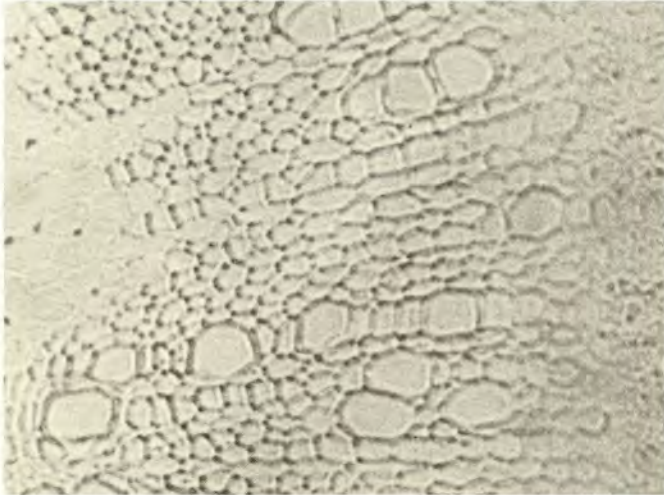
Q6 How does plaque decay teeth?

Q7 What are enamel and dentine?

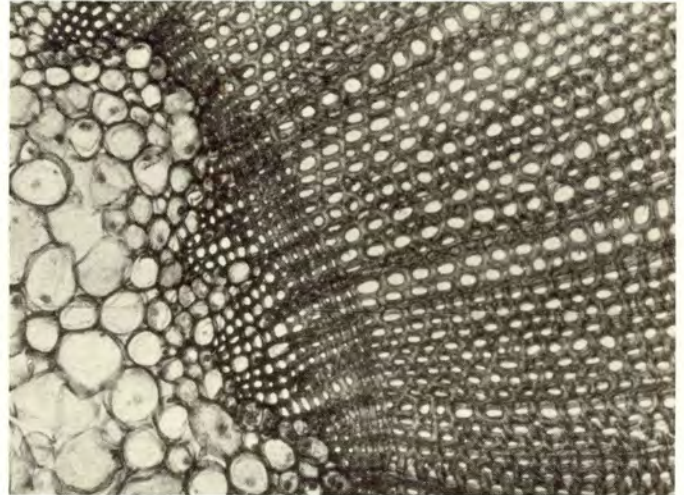
Q8 What advice would you give someone about caring for their teeth properly?

Information: Dyes in biology and medicine

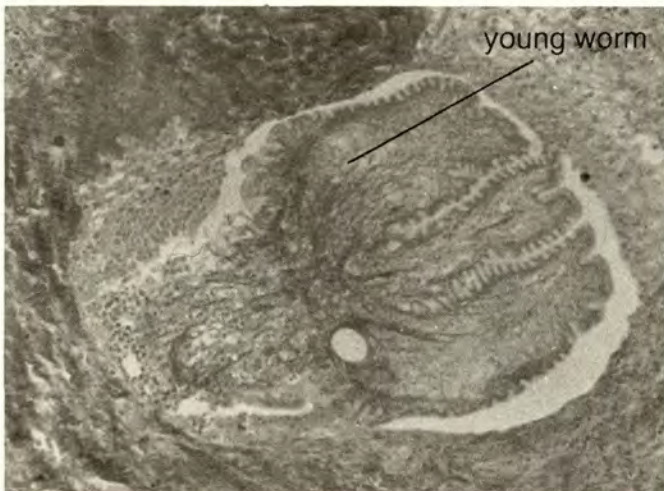
The bodies of plants and animals are made up of extremely small **cells**. Most of the cells are colourless. A biologist can use special dyes called **biological stains** so that he can study the cells under the microscope. The stain soaks into the cells and shows up their shape and contents.



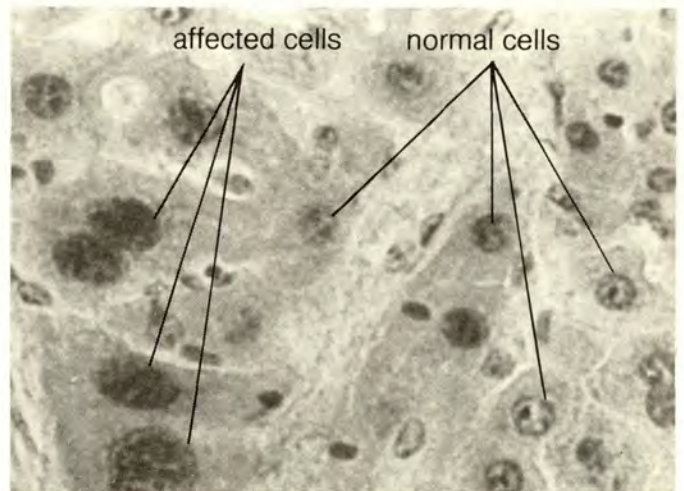
The stem of this plant has not been stained for long enough. It is difficult to make out much detail. (Magnification: $\times 160$.)



This plant stem has been stained for the correct length of time. The small clear cells with thick dark walls are tubes for carrying water up the stem. (Magnification: $\times 160$.)



The photo above shows part of the body of a rat suffering from **tapeworm**. The young stage of the worm is buried among groups of different types of cells. (Magnification: $\times 320$.)



The tapeworm has affected some of the cells. They have started growing and dividing in an uncontrolled way. Cells behave like this in the illness **cancer**. (Magnification: $\times 400$.)

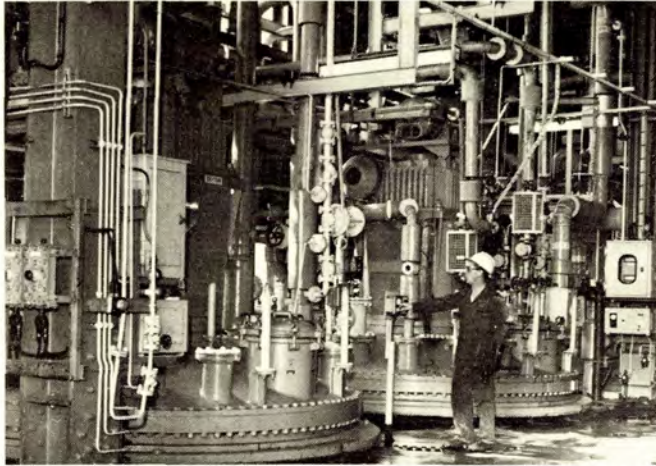
Q9 Why do cells need to be stained before being studied with a microscope?

Q10 How may cells behave in the illness cancer?

Uses of dyes

Information: Dyes in industry

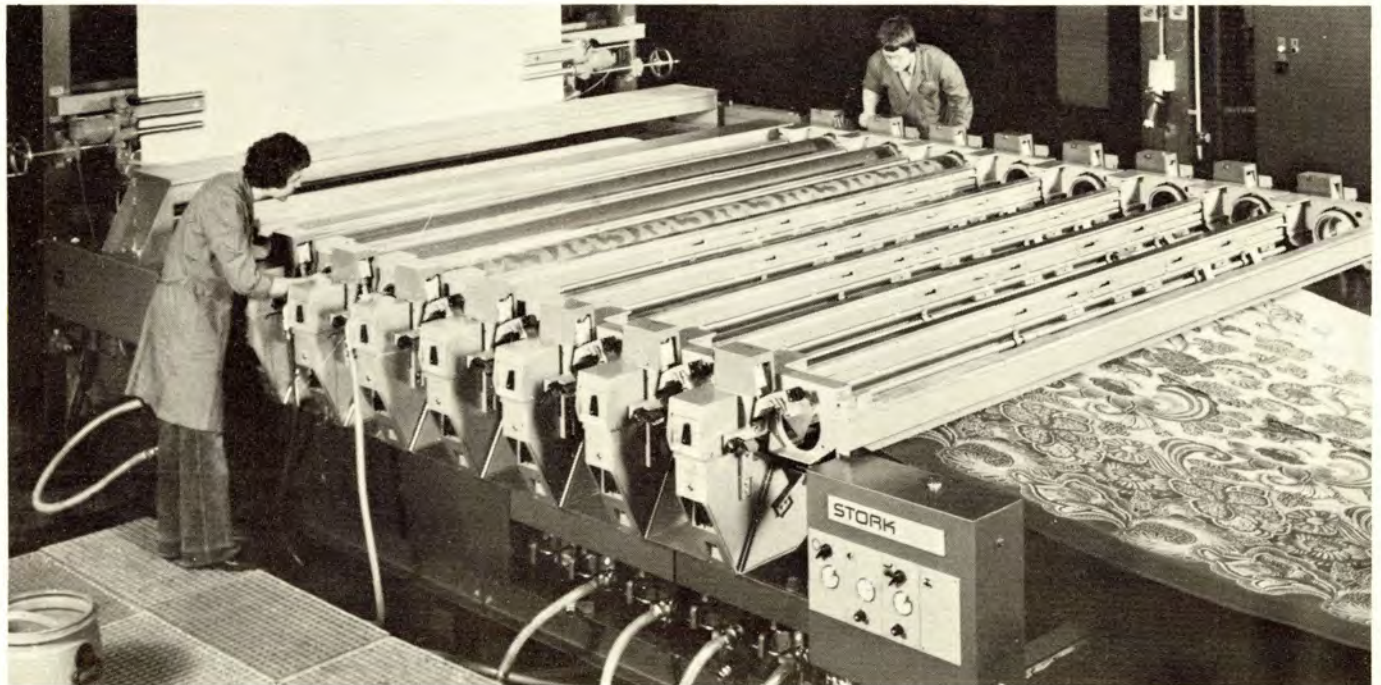
Nearly all materials, such as fabrics, wood, paper, leather, metals and plastics, can be coloured in some way. For this reason dyeing is now an important industry.



Huge, complicated machines are needed to make the dyes.



Here a dye is being tested. The dye is rolled out on to the fabric to make a pattern. This is called **printing**.



The fabric shown is over 3 metres wide. A multi-coloured pattern is being printed on to the fabric. The machine is called a **rotary screen printing machine**.

Q11 Name one machine that can be used for printing fabrics.

Q12 Make a list of everything around you that has been dyed.

AS07 12TAJ

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