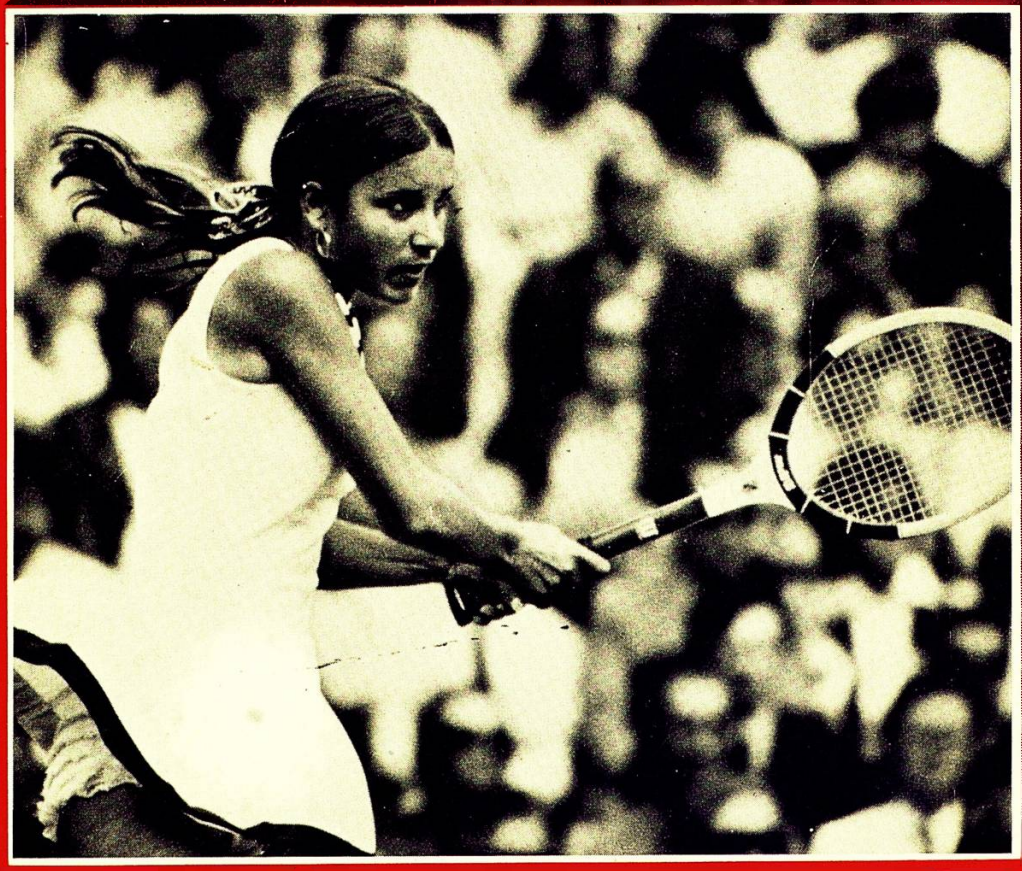
SCIENCE AT WORK



Body Maintenance

SCIENCE AT WORK

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Contents

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1 Reacting to changes

The skin as a detector

Apparatus

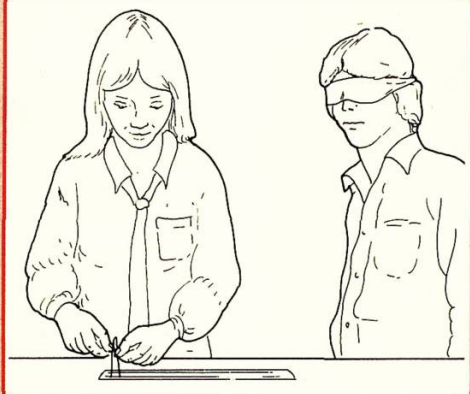
★ blindfold ★ 2 hairpins ★ ruler

You are going to find out how the **sensitivity** of the skin varies.

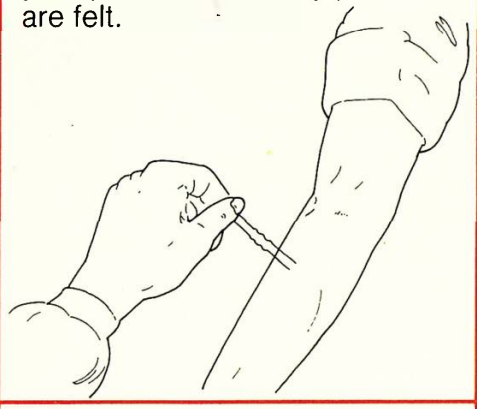
Q1 Copy this table.

Part of the body tested	Hairpin points 0.5 cm apart					Hairpin points 2 cm apart				
forearm										

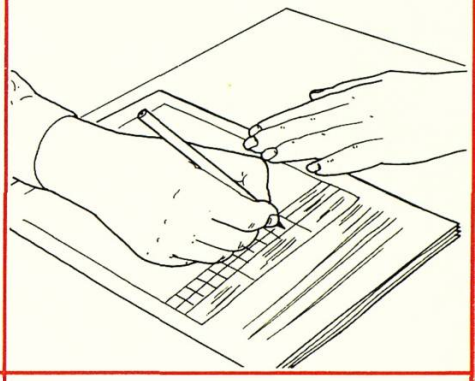
A Blindfold your partner. Bend a hairpin until the points are 0.5 cm apart.



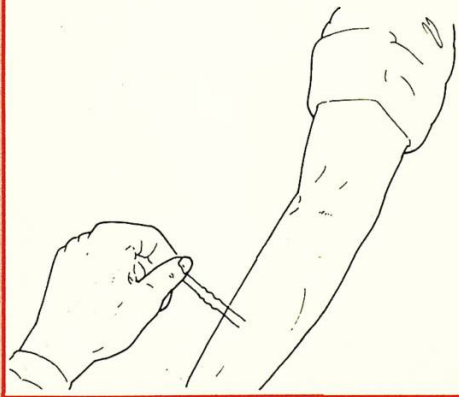
B Rest both points on the skin of your partner's forearm. Ask your partner how many points are felt.



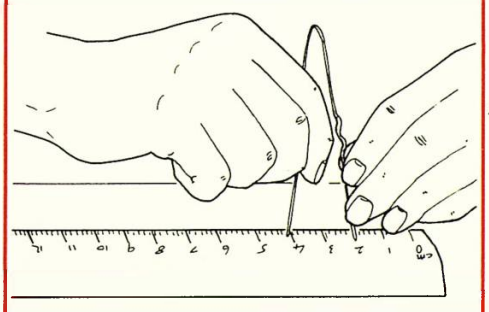
C Record the answer in your table. Put a ✓ if your partner felt 2 points. Otherwise, put a X.



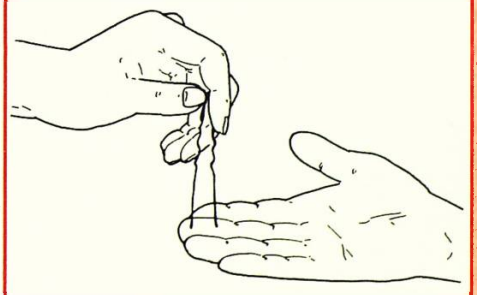
D Repeat steps B and C until you have tested 5 different places on the forearm.



E Bend the second hairpin until the points are 2 cm apart. Repeat steps B to D using the second hairpin.



F Choose 4 other parts of the body and write them in the 1st column of your table. Repeat steps B to E on each part.



Q2 Could your partner always feel both points?

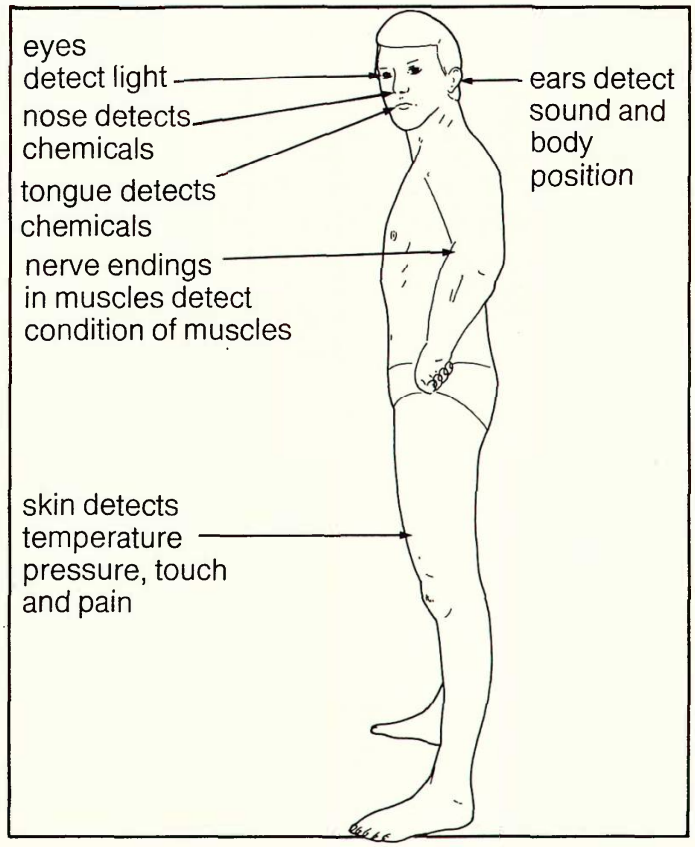
Q3 Which part of the skin was best at detecting 2 points?

Q4 Which part of the skin was least sensitive?

Q5 Why were the hairpin points set at two distances?

Information: Detecting changes

Skin covers the surface of the body. The whole skin surface is constantly being worn away and is renewed every few days. The photo shows the surface of the skin magnified 1000 times. About 70 000 skin flakes are shed each minute. A lot of house dust is made of human skin flakes.



The outside of the skin is dead but the layers beneath are alive. Near these layers are **nerve endings** that can detect temperature, pressure, touch and pain. In some parts of the skin the nerve endings are very close together—this is where the skin is most sensitive.

The skin is just one of the special parts of the body that can detect changes in the surroundings. These changes are called **stimuli.** The parts that detect stimuli are **sense organs.** They let us know what is going on and so protect us. You cannot detect all changes. Humans are not sensitive to magnetism and ultra-violet light.

Q6 What is a stimulus?

Q7 Which stimuli are detected by skin?

Timing reactions

Apparatus

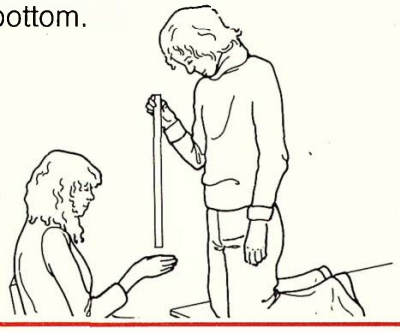
★ metre ruler ★ blindfold

You are going to find out how quickly you **react** and if your **reactions** can be speeded up.

Q8 Copy this table.

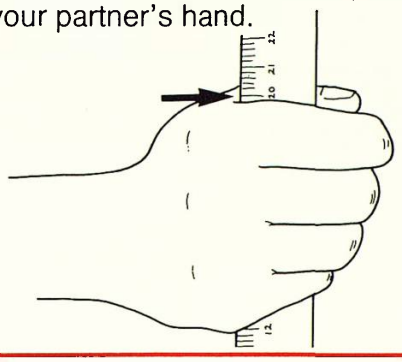
	Ruler not touching hand					Ruler touching hand					Partner blindfolded				
	Trial number:					Trial number:					Trial number:				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Number on ruler at catching point															

A Hold the ruler just above your partner's hand. Have the zero end of the ruler at the bottom.



B Without telling your partner let go of the ruler. Your partner must catch it as quickly as possible.

C When caught, record the number on the ruler at the top of your partner's hand.



D Repeat steps A to C five times.

E Repeat steps A to D but have the ruler just touching your partner's hand.

F Repeat steps A to D but blindfold your partner. You must call as you drop the ruler.

The quicker you react the lower the number on the ruler.

Q9 Did reaction time get less with practice?

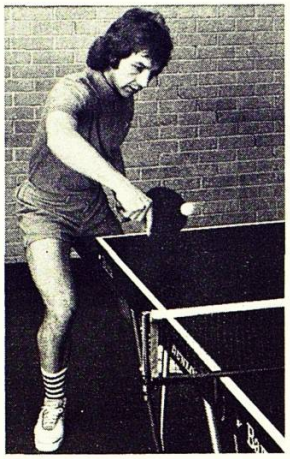
Q10 When your partner was touching the ruler how did this affect the reaction time?

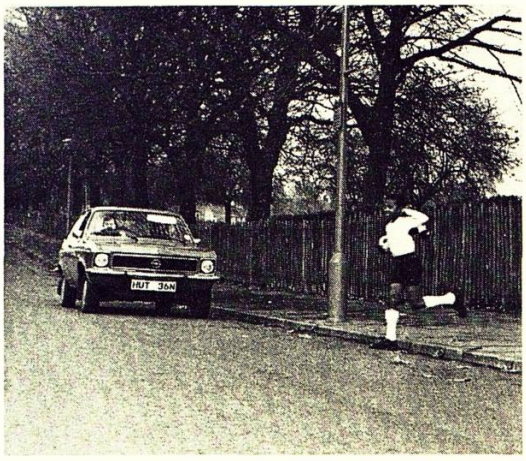
Q11 How did blindfolding affect the results?

Q12 Which sense organs are used in this investigation?

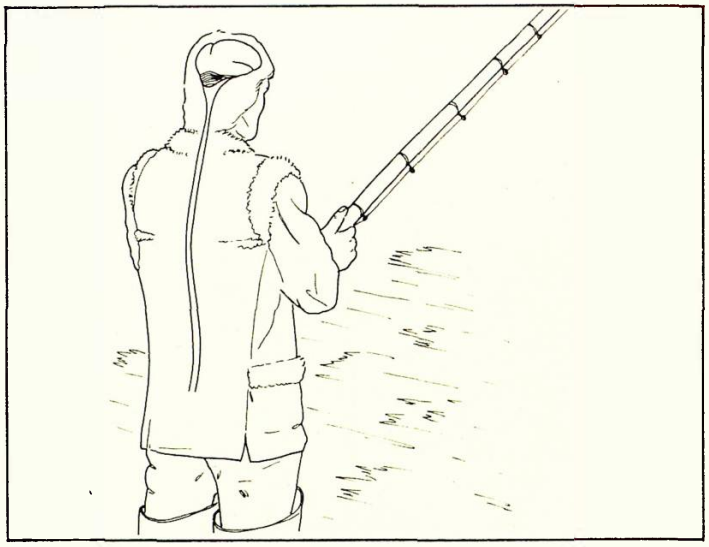
Information: Fast reactions and the nervous system

There are many occasions when you need to react quickly and cope with things you do not expect. The photographs show some of these occasions.

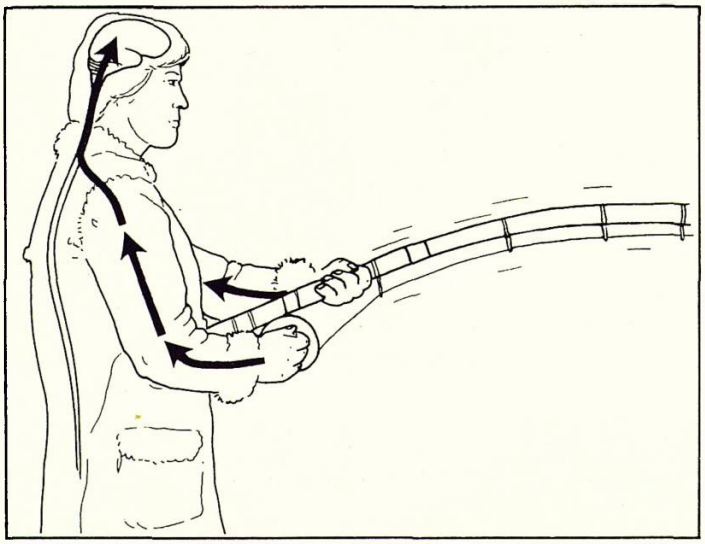


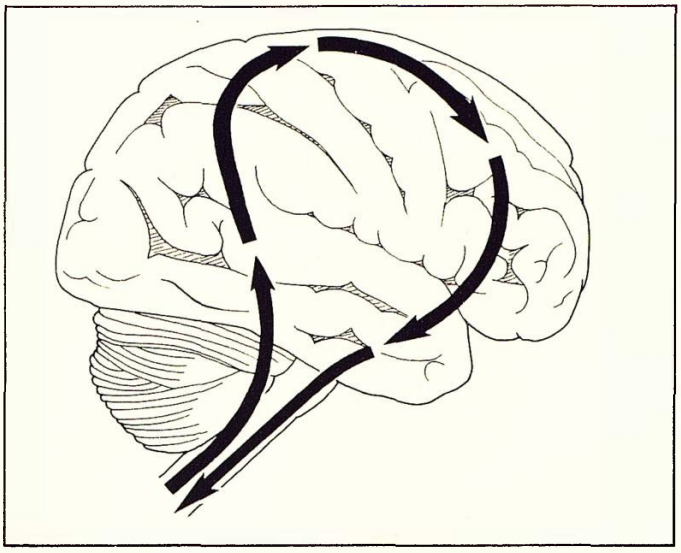


Quick reactions are brought about by your **nervous system.** The nervous system is all the sense organs, the nerves and the brain. We can show how it works in the case of an angler catching a fish.

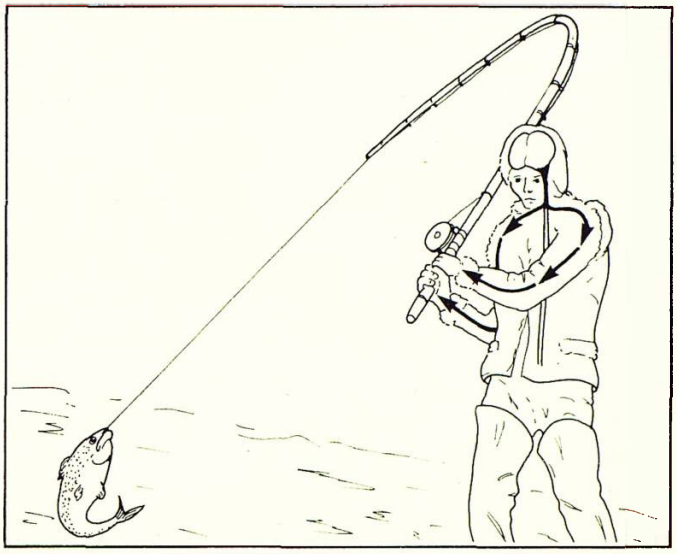


A fish is hooked on the line. The rod starts to move. Sense organs in the muscles and the skin detect the movement and send messages to the brain.





The brain sorts out the signal. When the angler has decided what to do, his brain sends messages to the muscles along another nerve.



The message goes to the muscles of the arms and hands. The fish is pulled in. Each time the angler catches a fish, he will do the task better. Practice helps the brain sort things out faster.

There are many **drugs** that can change reaction times. A person who has been drinking alcohol has slow reactions and movements of the body may be clumsy. A drunken driver cannot react quickly to dangerous situations.

Q13 Make a list of times when you need to have quick reactions.

Q14 When a fish is caught on a line, which of the angler's sense organs detect the catch?

Q15 How can anyone get better at doing a task?

Q16 Why should people not 'drink and drive'?

2 Movement of the body

The strength of different muscles

Apparatus

★ bathroom scales (marked in Newtons)

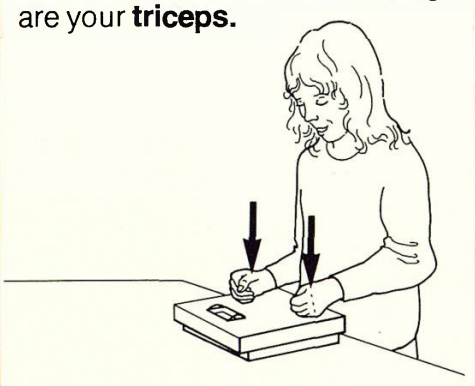
You are going to find out the strength of different muscles. A strong muscle is one which can produce a lot of **force**. The unit of force is a **Newton (N).**

Q1 Copy this table.

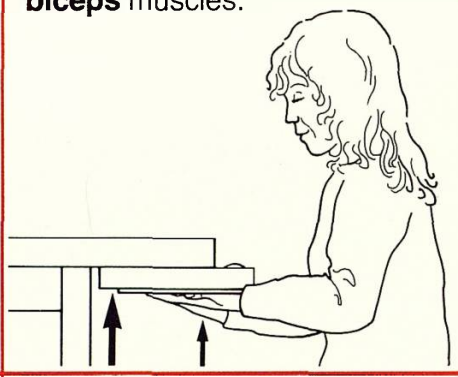
	Muscles used:				
	triceps	biceps	finger	pectorals	thigh
Reading on scales in Newtons					

A You are going to carry out each step B to F. For each step ask your partner to read the scales and record the results.

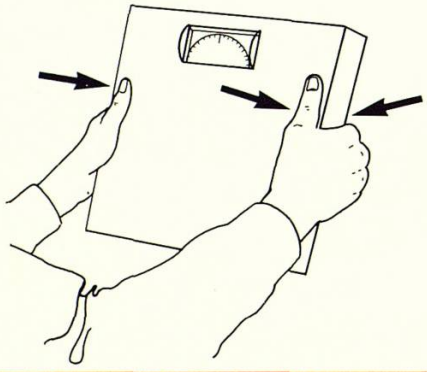
B Put the scales on a table. Push your fists down on the scales. The muscles that working are your **triceps.**



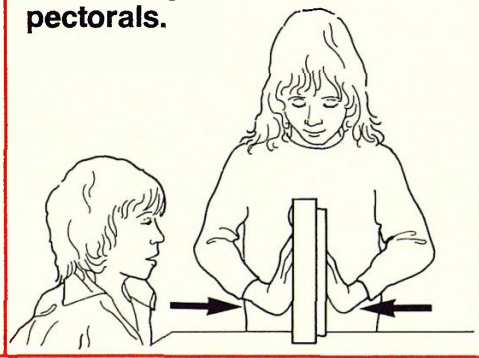
C Put the scales under the table. Push upwards on the scales. You are now testing your **biceps** muscles.



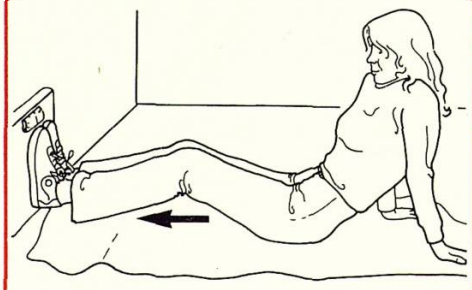
D Grip the scales in your hands. The muscles working are the ones that bend your **fingers.**



E Hold the scales between the palms of your hands. Push them together. The muscles that are working now are the **pectorals.**



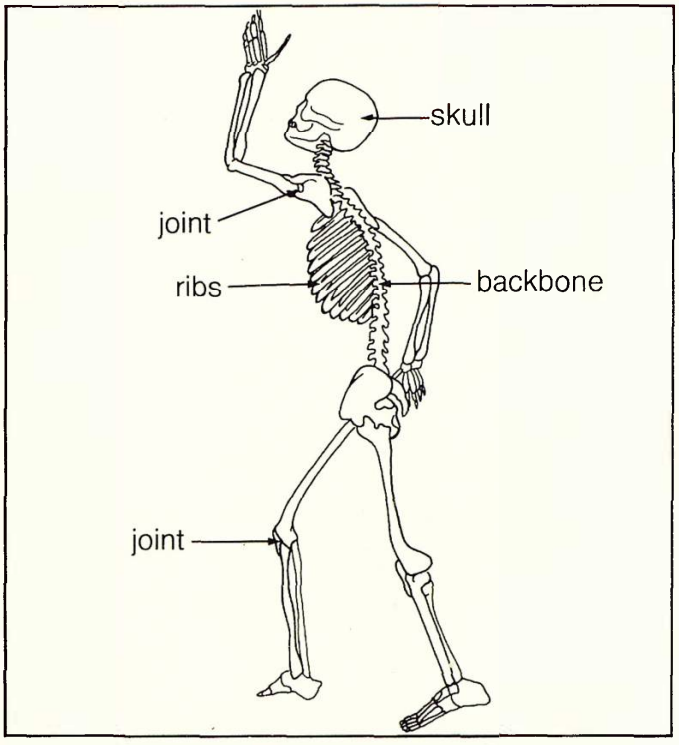
F Stand the scales up against a wall. Push against the scales with both legs. This tests the **thigh** muscles.



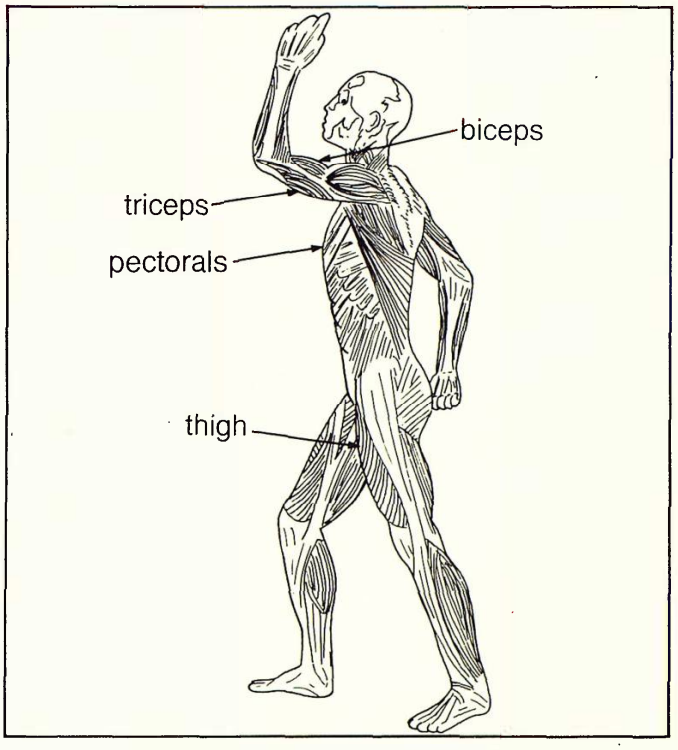
Q2 Which of the sets of muscles tested produced most force?

Q3 Look at the diagram on page 7. Find all the muscles mentioned above. Where are the pectorals?

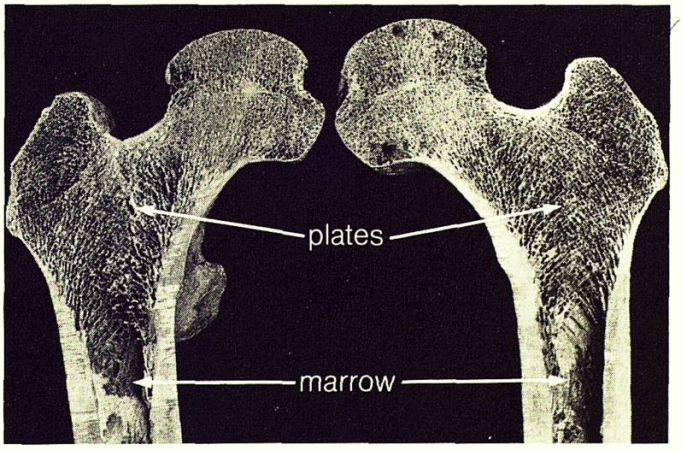
Information: Bones and muscles



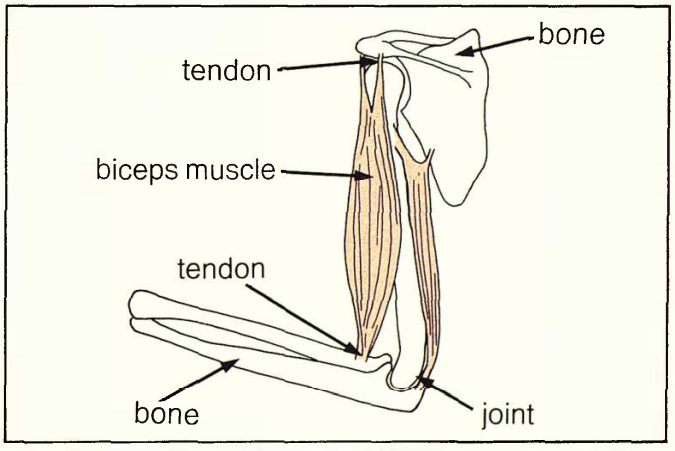
There are over 200 bones in the human **skeleton.** The skeleton supports the body and protects soft **organs** like the brain and lungs.



Bones and muscles work together to make the body move. The skeleton moves because muscles pull on bones. There are over 350 muscles in the body.



The long bones of the limbs are hollow and contain **marrow,** a jelly. Parts of the marrow make blood cells. At the ends of long bones, thin plates of bone go across the hollow. These strengthen the bone.



Muscles are fixed to bones by **tendons.** A ***joint*** moves when muscles **contract** or shorten. The muscle pulls on the tendon which pulls on the bone. A tendon is made from tough material that does not stretch.

Q4 What are the jobs of the skeleton?

Q5 What is marrow?

Q6 What do tendons do?

Muscles, work and power

Apparatus

★ metre ruler ★ supply of 10 N and 20 N sandbags ★ stop clock

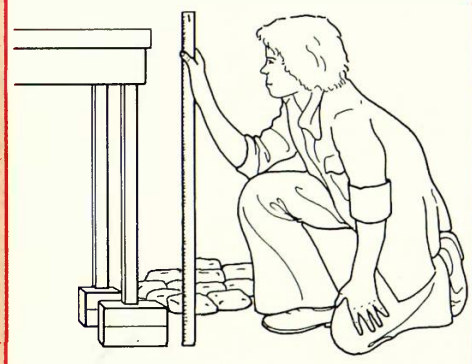
★ wooden blocks ★ heavy rucksack

You are going to find out how much work is done, and how much power is produced, when you lift sandbags.

Q7 Copy this table.

Type of sandbag (1)	Height of table (m) (2)	Number of bags lifted in 10s (3)	Work done each lift (joules) (4)	Work done during whole exercise (joules) (5)	Power produced during 1 second of exercise (watts) (6)

A Collect some 10 N sandbags. Adjust the height of the table to 1 m by using blocks. Fill in columns 1 and 2 of your table.

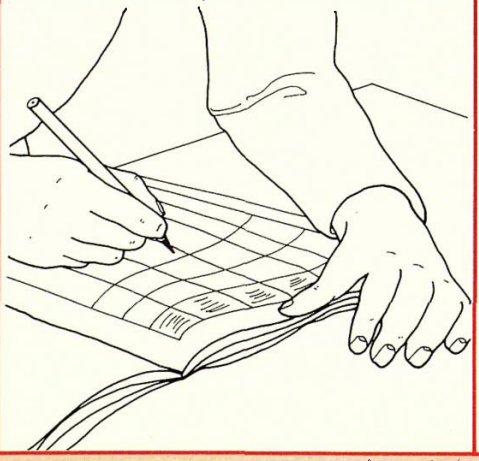


B Start the stop clock. Lift the bags as fast as you can from the floor to the table. Continue for 10 seconds.

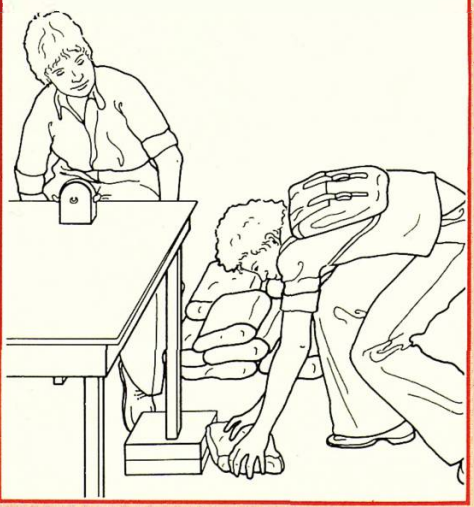
C Record the number of bags lifted in column 3 of your table.

D Collect some 20 N sandbags. Fill in the first 2 columns of your table. Repeat steps B and C.

E Rest for 10 minutes. As you rest, read page 9 and start to work out the values for columns 4, 5 and 6 of your table.



F Put on the rucksack and repeat steps A to D.



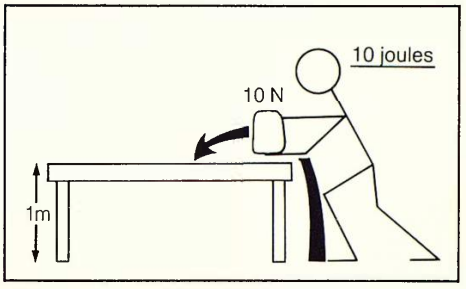
To find out how much work the muscles have done, and how much power the muscles produced, you need to calculate as shown below.

Work needs energy. Work is measured in units called **joules.**

Work = force × distance
(joules) (Newtons) (metres)

Each time you lifted one 10 N sandbag to a bench 1 metre high:

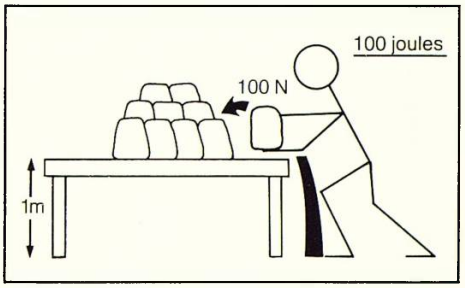
Your work = 10 N × 1 m = 10 joules.



Q8 Complete column 4 of your table by multiplying the numbers in columns 1 and 2.

If you lifted ten 10 N sandbags during the exercise you did ten times as much work.

Your work = 10 × 10 N × 1 m = 100 joules.



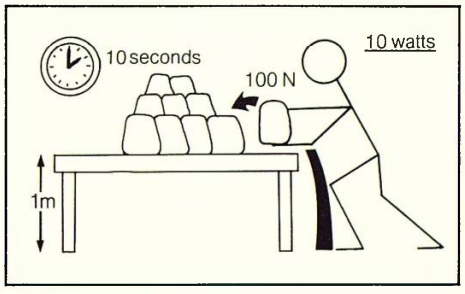
Q9 Complete column 5 of your table by multiplying the numbers in columns 3 and 4.

Power is the amount of work done in a certain time. Power is measured in units called **watts**.

1 watt of power is produced when you do 1 joule of work in 1 second.

If in 10 seconds you do 100 joules of work, then in 1 second you would do $\frac{100}{10}$ joules of work:

So the power is $\frac{100}{10}$ watts = 10 watts.



Q10 Complete column 6 of your table by dividing the value in column 5 by 10 (because you worked for 10 seconds).

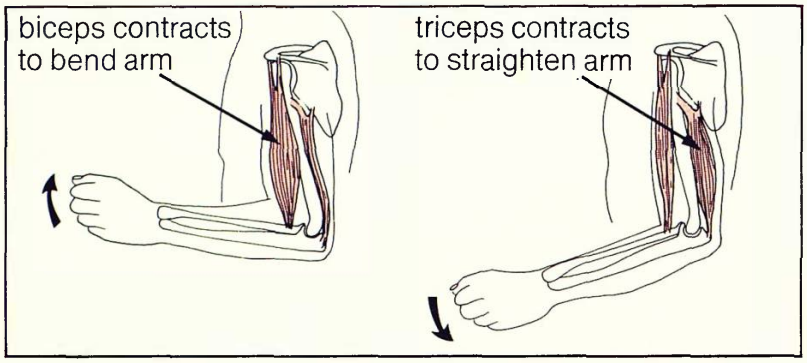
Q11 Did your body do more or less work when you lifted 20 N rather than 10 N bags?

Q12 How much power was produced in one second when you lifted 10 N sandbags (without the rucksack)?

Q13 The rucksack made your body carry more weight. Does this mean you did more work when carrying out the same task?

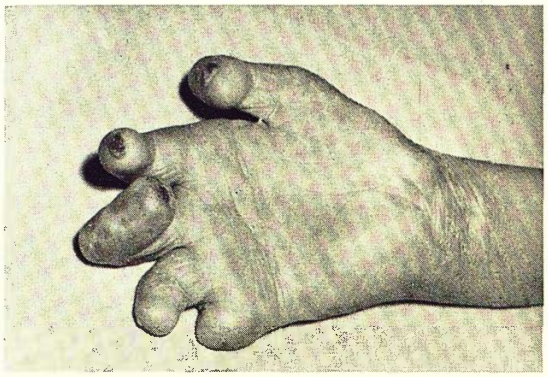
Q14 Why is it important not to be overweight?

Information: Working muscles

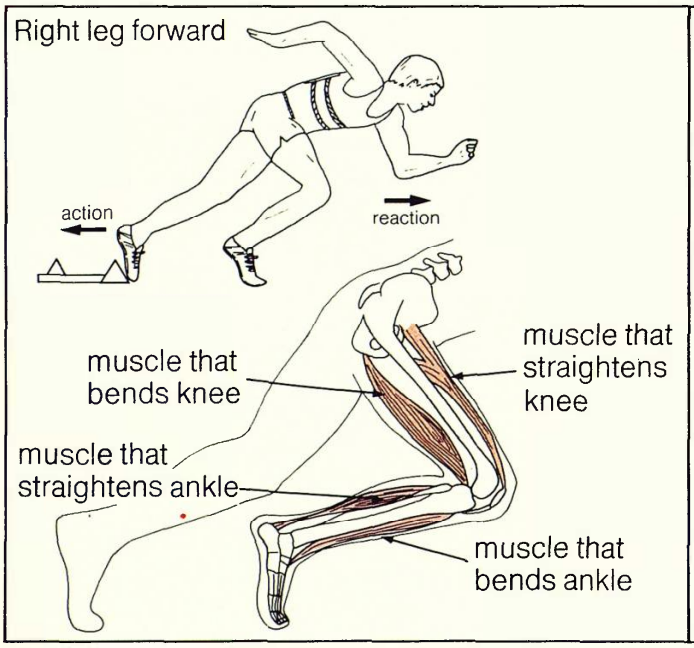


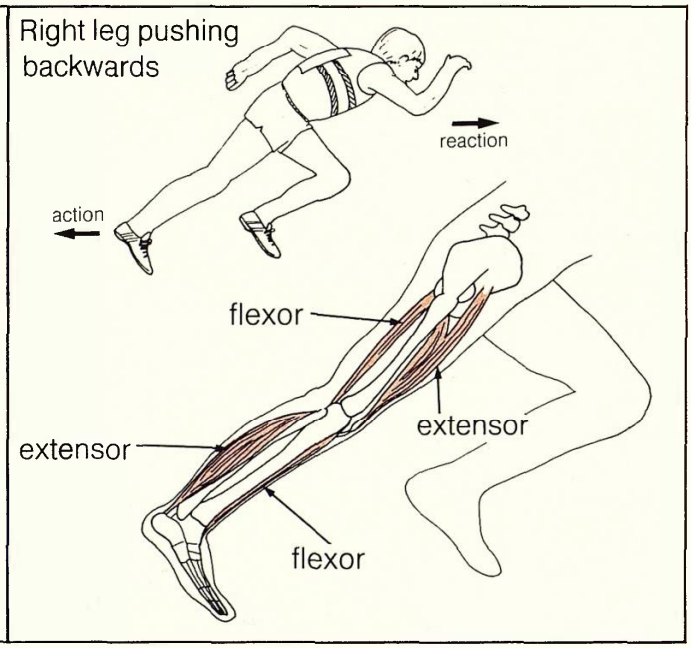
To bend a limb one muscle must pull on two bones. Muscles are arranged in pairs. Usually one bends or **flexes** a joint; the other straightens or **extends** the joint. Such pairs of muscles are called **antagonistic,** meaning one does the opposite of the other.

The movement of the muscles is controlled by the nervous system. People can learn to control their muscles to do delicate tasks. The fine control of muscles can be lost in many diseases of the nerves such as **leprosy.** In this illness fingers and toes become curled up making movement very difficult. Also, the leprosy sufferer loses all feelings from the hands and feet and may seriously damage these parts without knowing it.



The more use muscles get, the better they will work. Regular exercise strengthens muscles. Some athletes have taken drugs that build up their muscles.



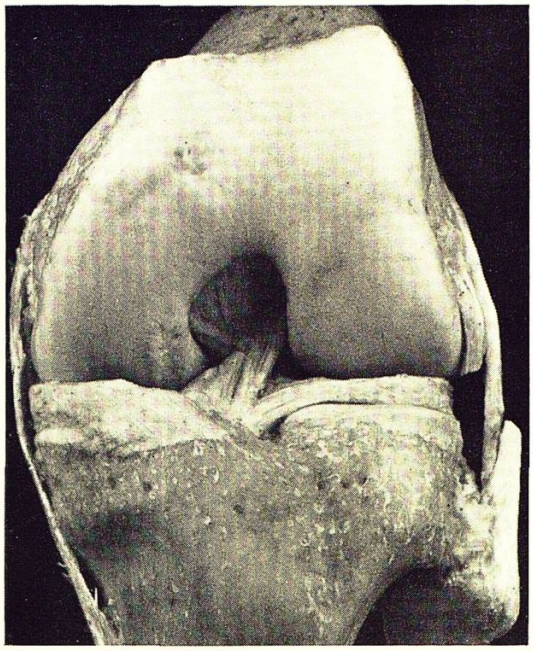


Anything can move forwards only by pushing backwards against its surroundings. The harder you push backwards, the faster you will move forwards. For this reason, sprinters use blocks to give them a better start. The diagrams above show how the leg muscles work during the first two strides of a race.

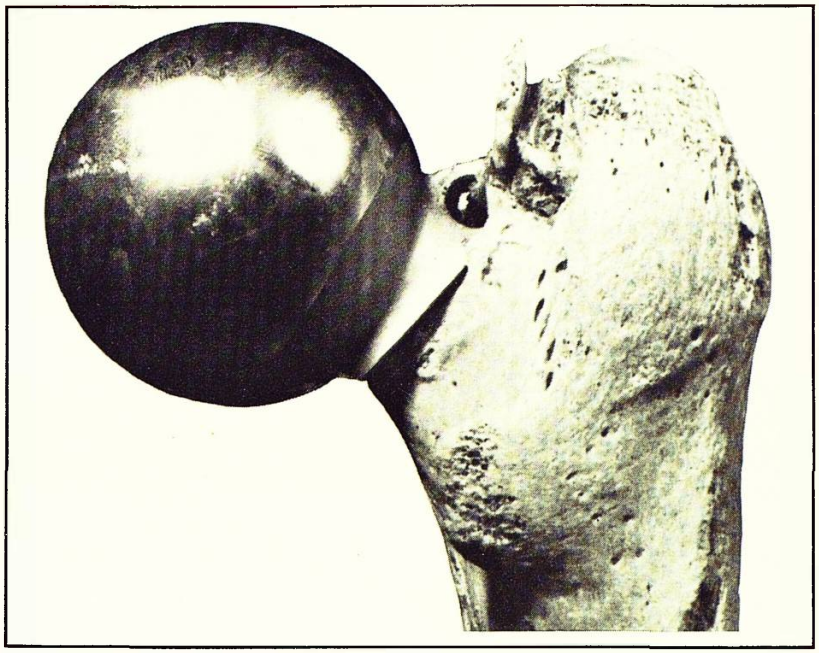
Q15 What are antagonistic muscles?

Q16 What is leprosy?

Information: Damage to the body

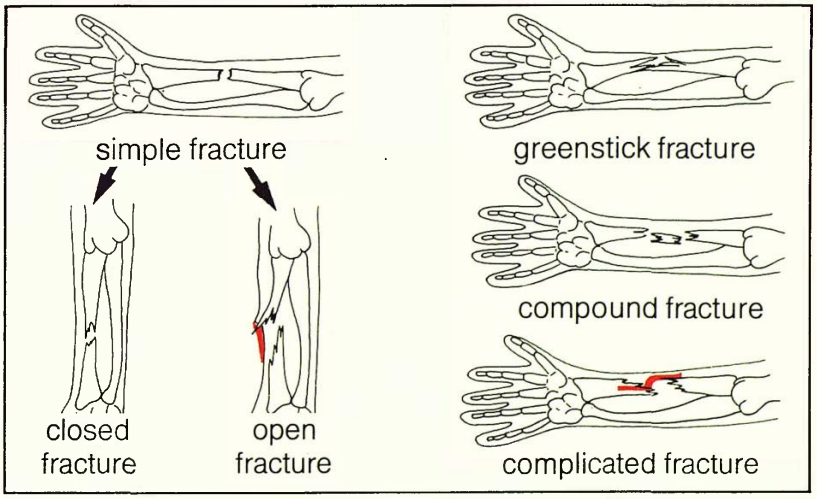


If you fall awkwardly, you may tear the **ligaments** that join bones together. This is called **spraining** a joint. If a bone comes out of place, it is **dislocated** and the ligaments may also be torn. The dislocated bone must be helped back into position by a doctor. If the ligaments are to heal, the joint must be rested.



At a joint, the ends of the two bones are covered with a smooth layer of **cartilage** (gristle). This helps the joint move easily. In old people, the cartilage may be worn so that joints are painful to move. The ends of some worn bones can be replaced by surgeons. The photo shows a replacement part for the top of the thigh bone.

Bones can be broken or **fractured.** When a bone breaks cleanly into two, it is a **simple** fracture. If the skin is not damaged it is a **closed,** simple fracture. If the skin is damaged by the broken bone, it is an **open,** simple fracture. When a bone breaks on one side only, it is a **greenstick** fracture. If there is more than one break in a bone, the fracture is **compound**. If the broken ends of the bone tear into blood vessels or nerves, then it is a **complicated** fracture.



Q17 How are bones joined together?

Q18 What is the job of cartilage?

Q19 What is the difference between a simple and a greenstick fracture?

Help for broken limbs

Apparatus

★ triangular bandage ★ safety pin ★ soft padding

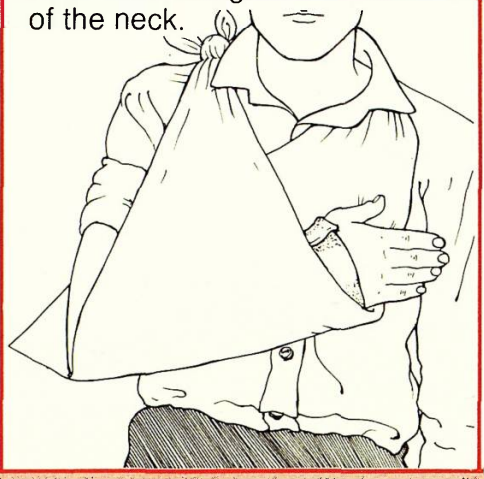
★ 4 long, broad bandgages

You are going to find out how to make a sling for a broken forearm and help a person with a broken leg.

Sling for right forearm

A **Gently** put the soft padding around your partner's forearm. Then gently put on the triangular bandage.

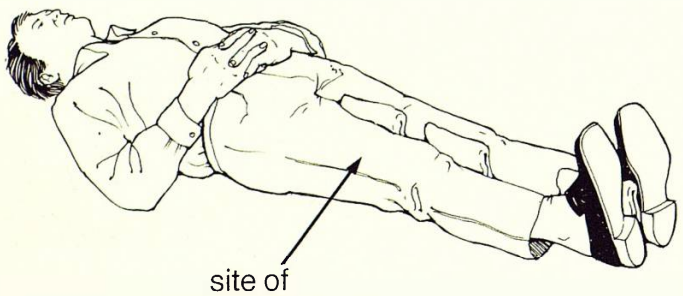
B Lift the lower tip and knot the two ends together at the side of the neck.



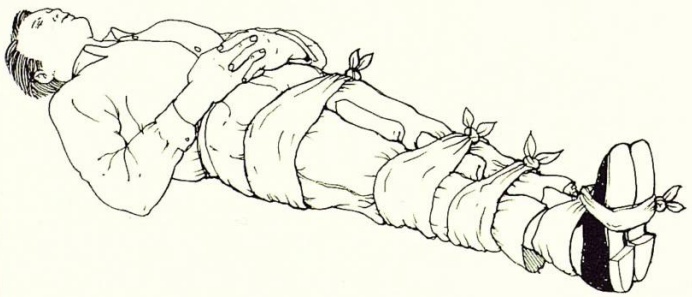
C Fix the loose point at the elbow with a safety pin.

Help for broken right femur

D Gently move the left leg towards the broken right leg. Carefully put soft padding between thighs, knees and ankles.



E Gently ease the long bandages under the legs. Tie around the ankles and feet, lower legs, knees and hips. Tie the knots on the uninjured side.

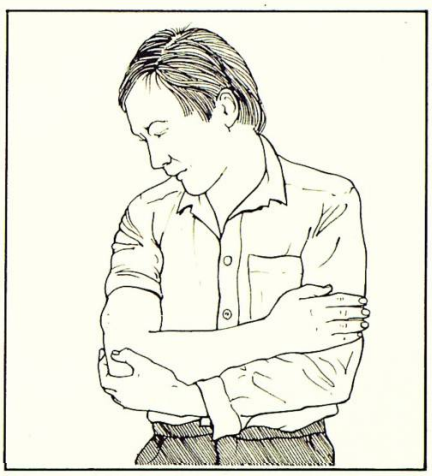


Q20 Why must you move the person's limbs carefully?

Q21 Why did you tie the knots away from the 'broken' bone?

Information: Mending broken bones

Some people think that if a person can move an arm or a leg, then it is not broken. This is not true.

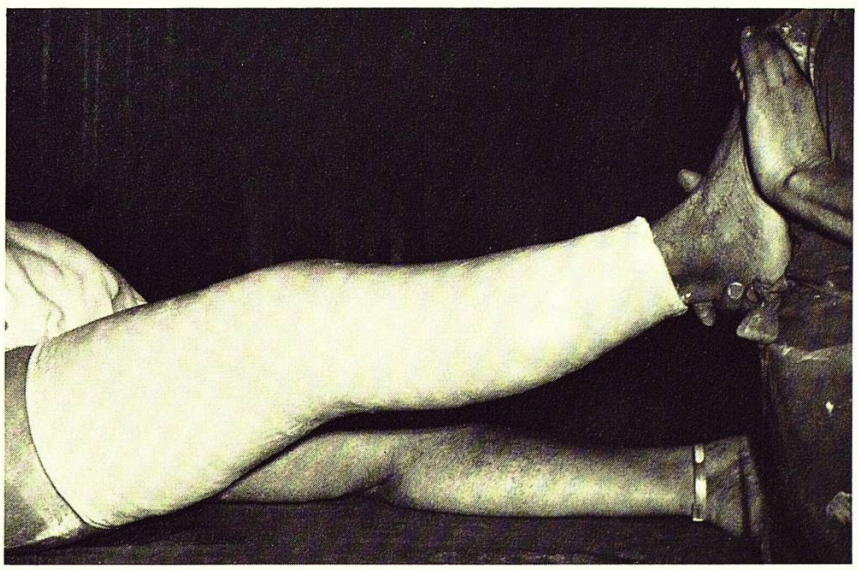


If you come across someone who seems to have a broken limb, send for medical help. Do not move the injured limb.

Someone with a broken bone may have:
P*ain*
U*nusual shape to the limb*
L*ost the use of the limb*
S*wollen and tender flesh near the break*
E*xtra movement in the limb*

For the signs of a fracture, remember—**P.U.L.S.E!**

Doctors check for breaks using **X-rays.** Like light, these rays cause changes in photographic plates. When an X-ray hits such a plate, the plate goes black. X-rays pass through the soft parts of the body but not through bone. Where the parts of the body are soft, the X-ray will look black or grey. Where there is bone, the X-ray will look white.



Broken bones heal themselves, but the broken parts of the bones have to be put into place. This is **setting** the bones. The parts are kept still by putting the broken limb in **plaster** for some time.

Q22 What must you do if you think a person has a broken limb?

Q23 Why do doctors use X-rays?

Q24 What kind of fracture is shown in the X-ray?

Q25 Why are fractured bones set?

3 Food and energy

Food as a fuel

Apparatus

★ Bunsen burner ★ heatproof mat ★ mounted needle ★ boiling tube

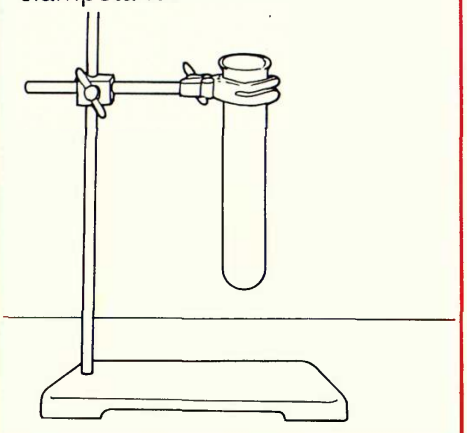
★ thermometer ★ clampstand ★ 50 cm^3 measuring cylinder ★ 2 peanuts

You are going to find out how energy can be released from peanuts and used to heat water.

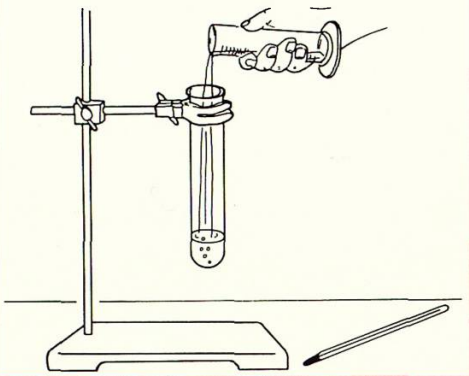
Q1 Copy this table.

Peanut number	Temperature of water at start (°C)	Temperature of water at end (°C)	Temperature change (°C)

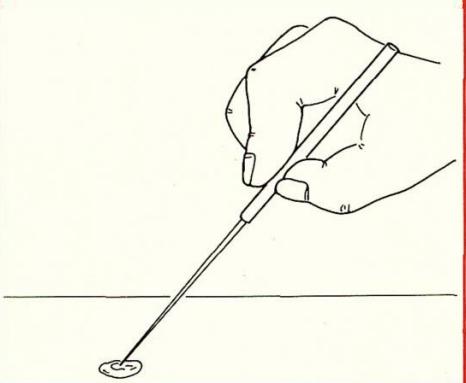
A Fix the boiling tube in a clampstand.



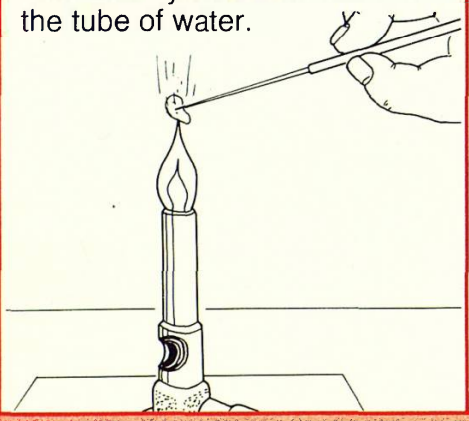
B Pour 25 cm water into the boiling tube. Take the temperature of the water and record it in the second column of your table.



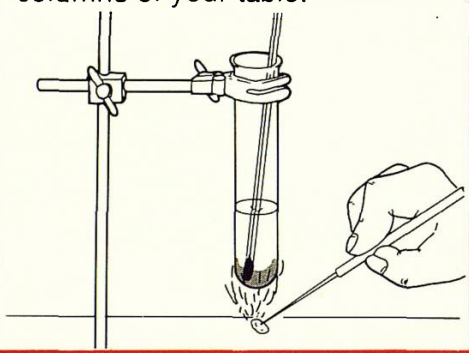
C Fix the first peanut on to a mounted needle.



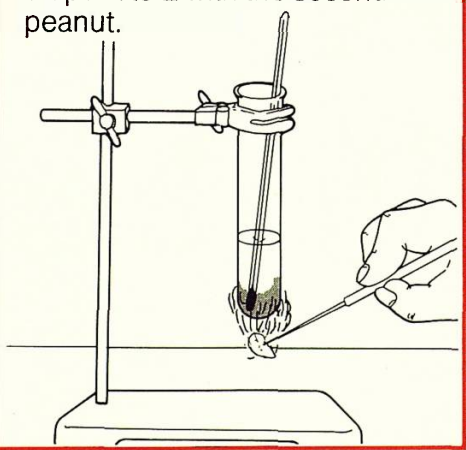
D Hold the peanut in a Bunsen flame until the nut starts to burn. Immediately hold the nut under the tube of water.



E When the nut stops burning, record the temperature of the water in the third column of your table. Fill in the first and fourth columns of your table.



F Using fresh water repeat steps A to E with the second peanut.



Q2 What happened to the water temperature when a burning peanut was held beneath it?

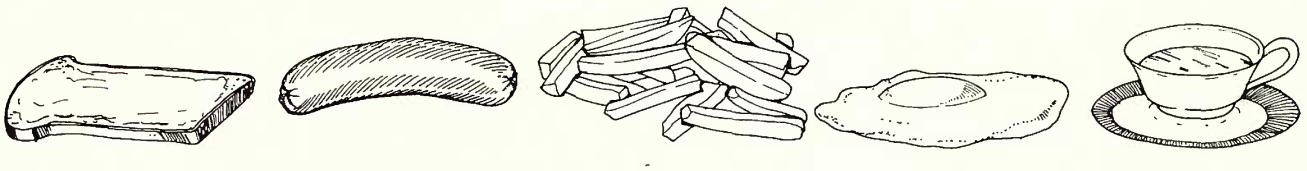
Q3 Did both peanuts change the temperature by the same amount? If not, why was this?

Information: The amount of energy in foods

Energy, like work, is measured in units called **joules.**
1000 joules is 1 kilojoule (kJ). 1 000 000 joules is 1 megajoule (MJ).

In your body, the chemical energy of your food is changed into energy that will keep your body warm and make it work.

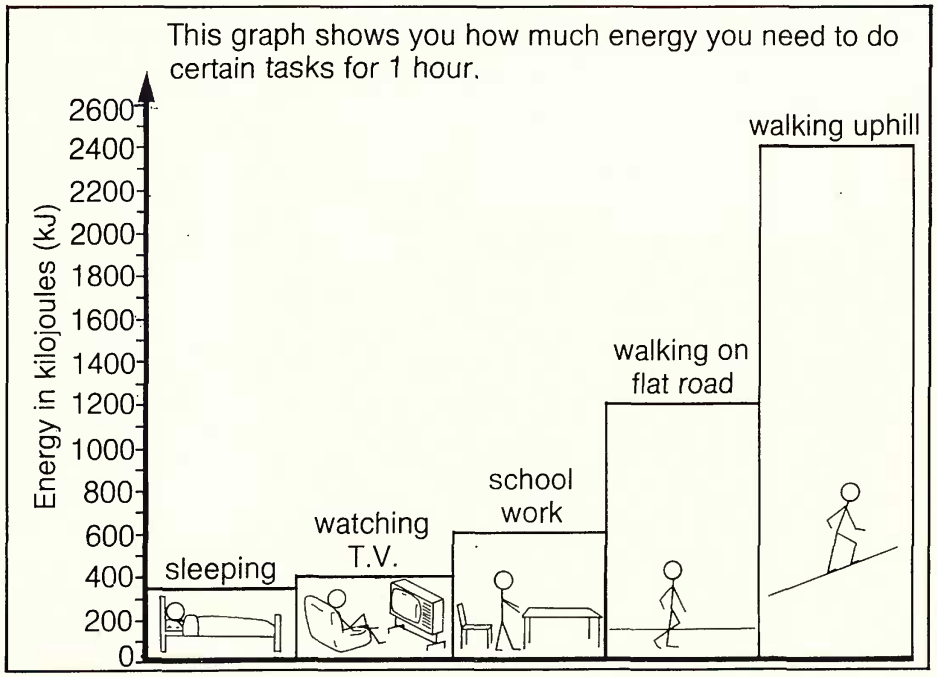
If you have a meal of fried egg, sausage, chips, bread and butter and tea, you will be taking in the amounts of energy shown below.



bread and butter	sausage	chips	fried egg	cup of tea with milk
600 kJ	500 kJ	1000 kJ	150 kJ	650 kJ

Q4 Which part of the meal gives you most energy?

Q5 What is the total amount of energy you would get from this meal?



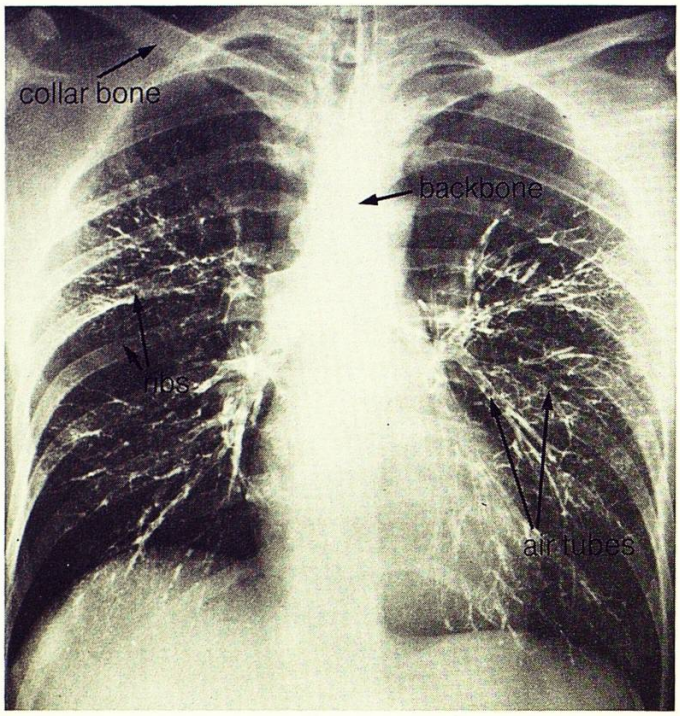
Q6 If you had eaten the meal above,
a) for how long could you sleep?
b) for how long could you do school work?
c) for how long could you walk uphill?

Q7 A very active person did not eat enough energy-giving foods. What will happen to the person?

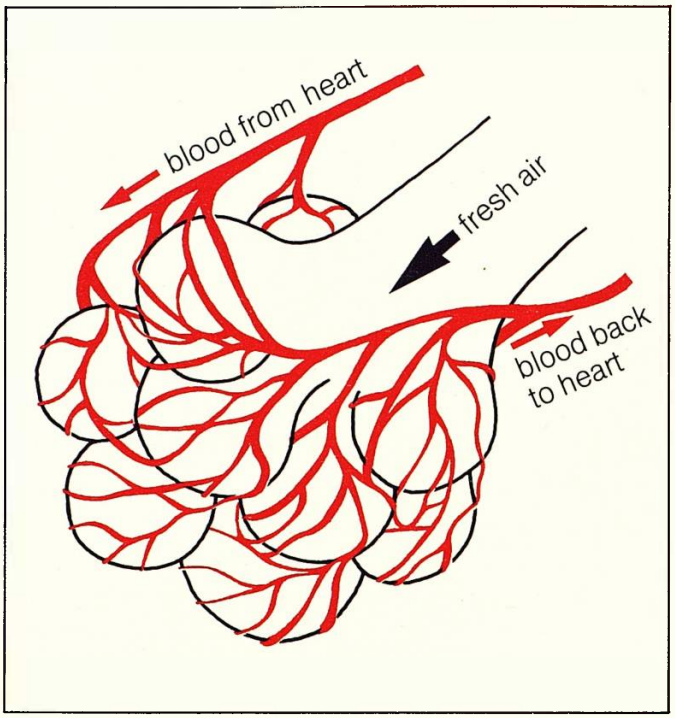
Q8 What may happen to your body if you eat more food than you need?

Information: Releasing energy

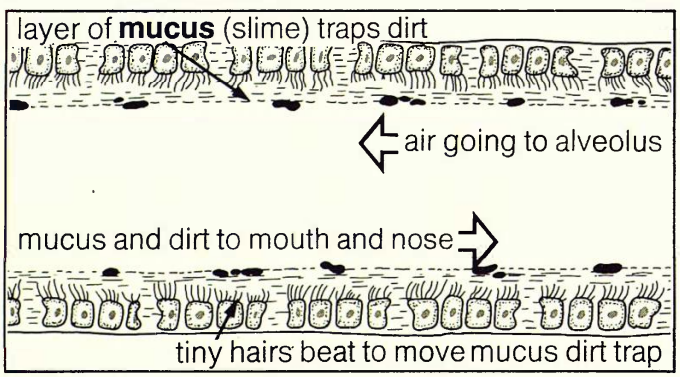
In the cells of the body **food** is burned by a process called **respiration.** This uses some of the **oxygen** from the air we breathe in. Energy is released (set free) from the food and **carbon dioxide** is made. Air we breathe out contains more carbon dioxide than the air we breathe in.



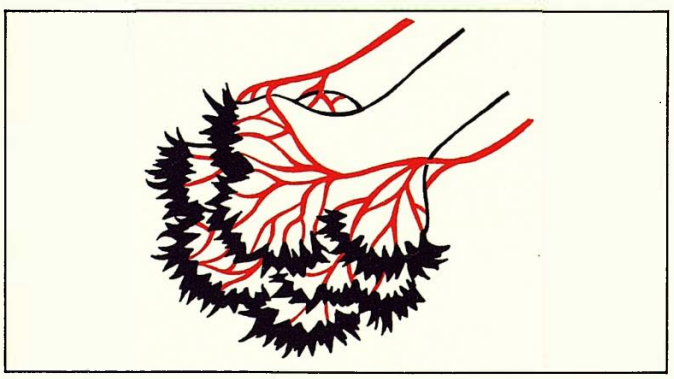
When we breathe in, air passes down the **windpipe.** This divides into two main branches. One branch goes into each **lung.** Each branch divides again and again into smaller branches. The branches can be seen on an X-ray photo of a person who had breathed in a special smoke. At the end of each fine tube is a tiny cluster of 'balloons'.



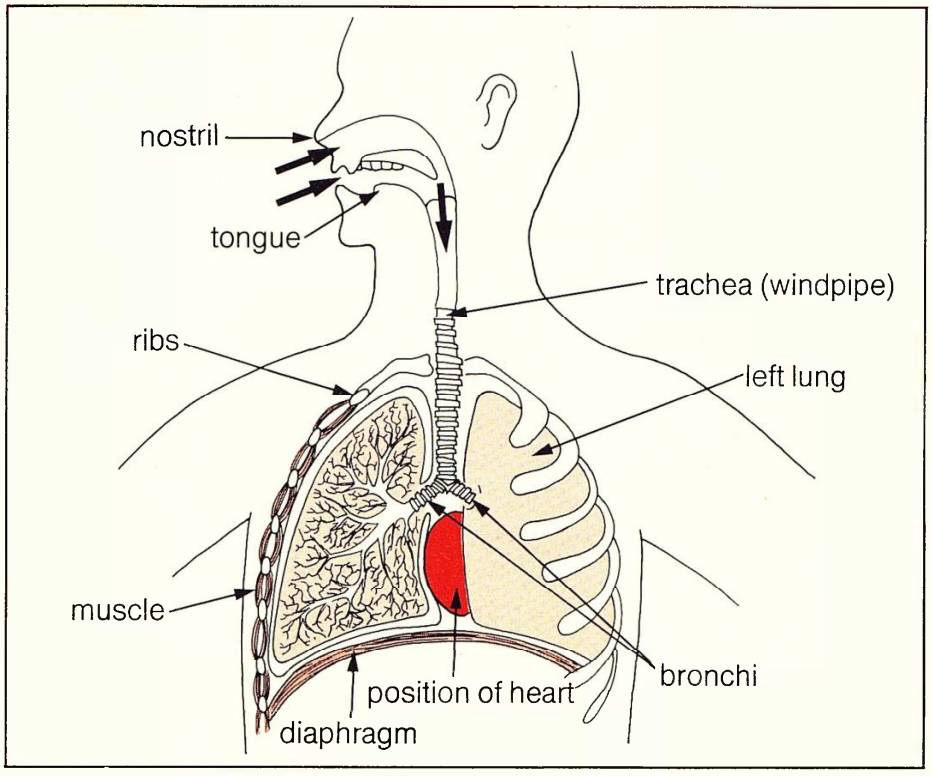
Each 'balloon' is called an **alveolus.** Each one is smaller than the point of a pin. Oxygen from the breathed in air goes across the wall of the alveolus and into the blood. The waste carbon dioxide comes out of the blood and into the alveolus.



Dirt, as well as air, goes into the lungs—but the alveoli must be kept clean if they are to work properly. Most of the breathing tube system is lined with a moving dirt trap.

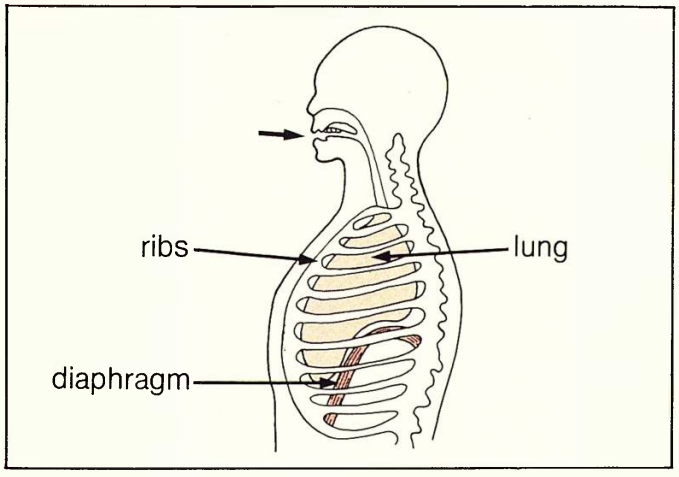


The cleaning system cannot cope with cigarette smoke. A chemical in the smoke stops the tiny hairs beating. The dirt piles up and you cough to remove the blockage. Sometimes this bursts alveoli, so there is less lung left for breathing.



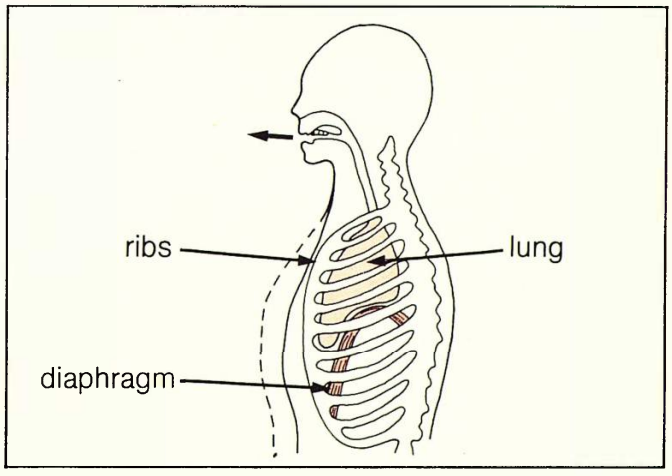
This diagram shows the parts of the body that are used in breathing.

Breathing in



When you breathe in, the **ribs** are lifted and the **diaphragm** flattens. The chest gets bigger. Air is sucked in down the windpipe

Breathing out



When you breathe out, the ribs are lowered. The diaphragm arches upwards. The air is squeezed out of the lungs.

Q9 Which gas does the body use?

Q10 What is an alveolus?

Q11 What could happen to the lungs if you smoke?

Q12 What happens to the ribs when you breathe in?

Q13 What happens to the diaphragm when you breathe out?

4 Artificial resuscitation

Helping others to breathe

Apparatus

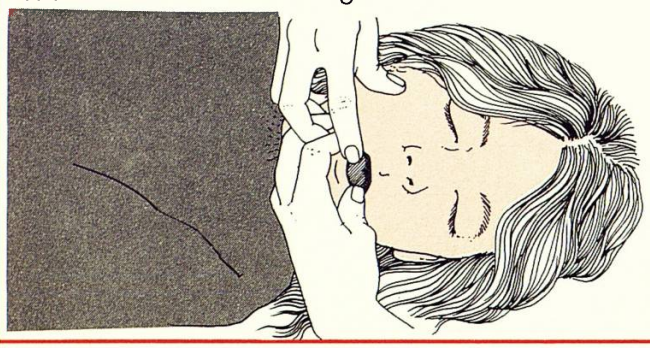
★ artificial resuscitation model

You are going to find out how to help an **asphyxiated** (suffocated) person to breathe.

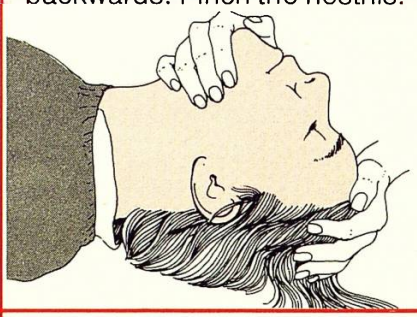
You may only try this method on a model. It is very dangerous to practice it on a person who is breathing normally.

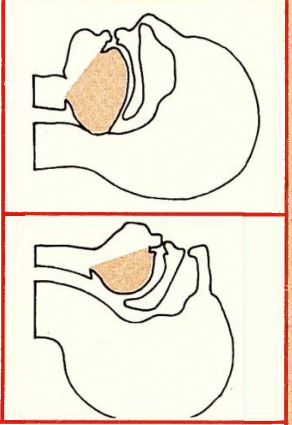
Mouth-to-mouth resuscitation

A Check the mouth for blockages. Take out false teeth etc. Loosen clothing.

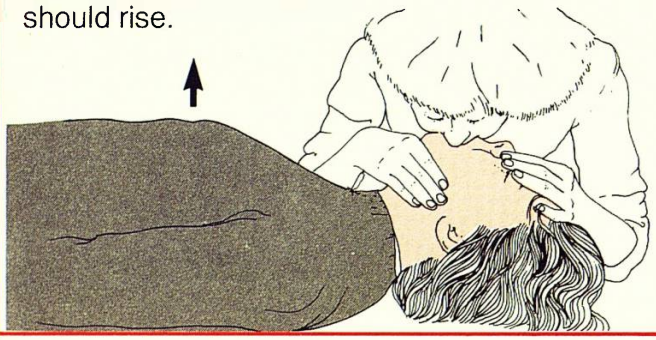


B Grip the lower jaw and forehead. Push the head backwards. Pinch the nostrils.



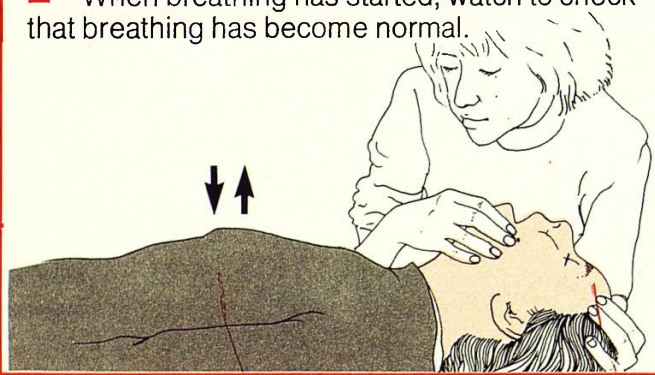


C Take a deep breath. Put your lips round the model's mouth and blow. The model's chest should rise.

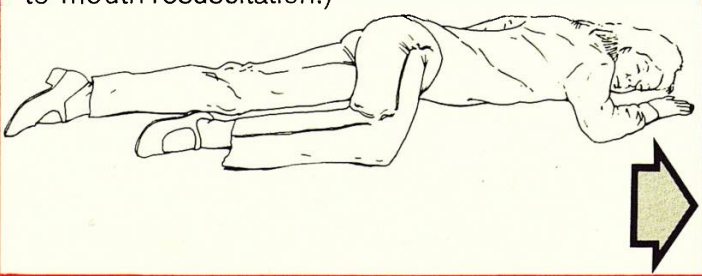


D Stop blowing. Watch for the model's chest to fall. Repeat the blowing at your normal rate of breathing.

E When breathing has started, watch to check that breathing has become normal.



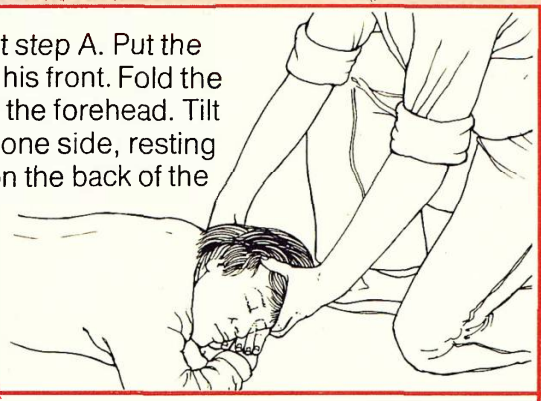
F Then carefully roll the casualty over into the recovery position. You may use a partner for this step. (If the face is injured you cannot use mouth-to-mouth resuscitation.)



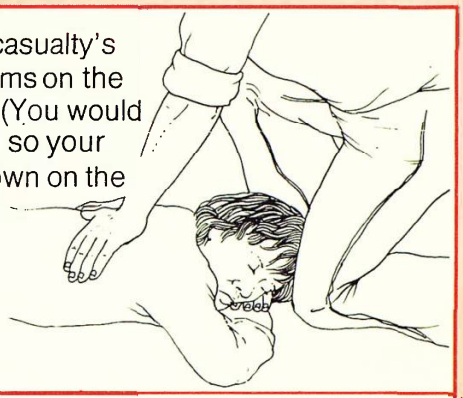
A method to use if the face is injured

You may practice this method with a partner. You must **not** press hard on your partner's back.

G Repeat step A. Put the casualty on his front. Fold the arms under the forehead. Tilt the head to one side, resting the cheek on the back of the hands.

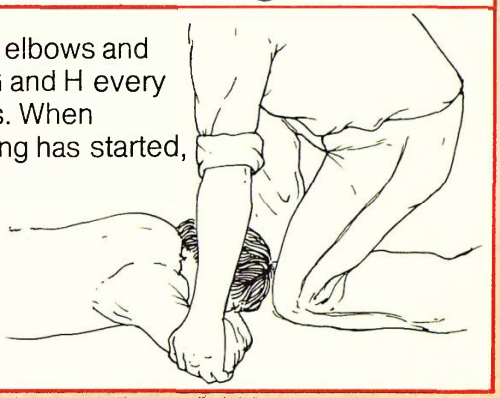


H Kneel at the casualty's head. Put your palms on the shoulder blades. (You would then rock forward so your weight pushes down on the chest.)



I Lean back pulling the casualty's elbows upwards.

J Lower the elbows and repeat steps G and H every 4 to 5 seconds. When normal breathing has started, repeat step F.



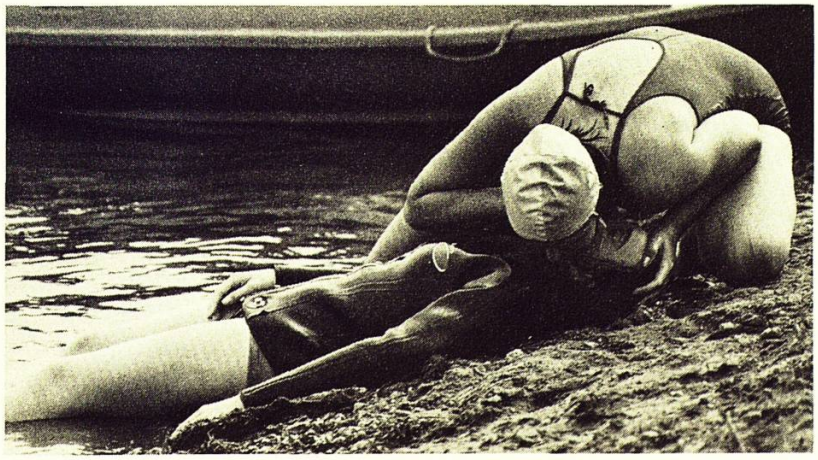
Q1 Why did you check the mouth for blockages?

Q2 How often did you blow into the model's mouth?

Q3 When can you not use the mouth-to-mouth method?

Q4 When normal breathing starts, what must you do?

Information: Checking a casualty's breathing



The following are signs that mean breathing has stopped:
The chest is not rising and falling.
The casualty's lips look blue.
The heart beat is weak.

Q5 A casualty was pulled out of a swimming pool. What signs would you look for?

5 Body heat

Taking the temperature

Apparatus

★ clinical thermometer ★ beaker of disinfectant ★ cotton wool ★ stop clock

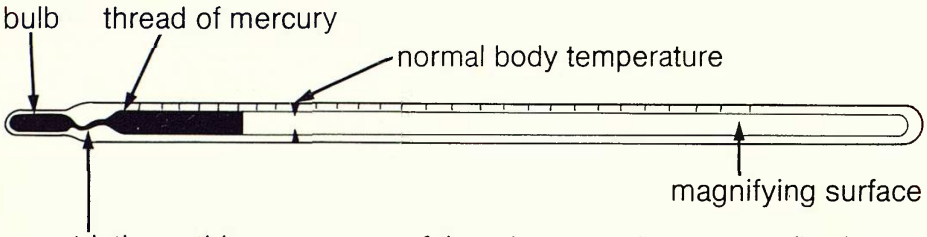
★ ice cube

You are going to take the temperature of different parts of your body.

Q1 Copy this table.

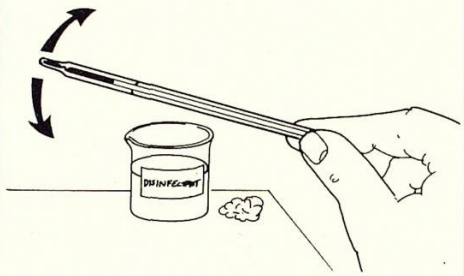
	Part of the body:					
	Mouth	Mouth after ice cube	Armpit	Behind knee	Fingertips	Ear lobe
Temperature (°C)						

A Look at your clinical thermometer. Make sure you can see the thread of mercury and read the scale. Use the drawing to help you.

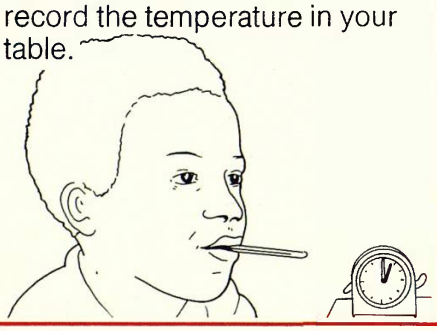


constriction – this narrow part of the tube stops the mercury flowing back before the reading has been taken.

B Dip the thermometer in disinfectant. Wipe with cotton wool. Carefully shake the thermometer.

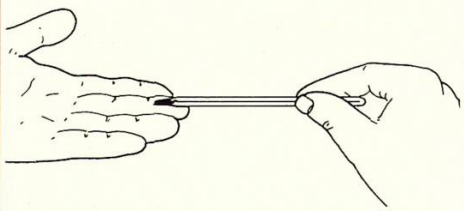


C Put the thermometer under your tongue. Wait 3 minutes. Remove the thermometer and record the temperature in your table.



D Put the ice cube in your mouth. When it has melted repeat steps B and C.

E Repeat steps B and C but put the thermometer on the other parts of your body.



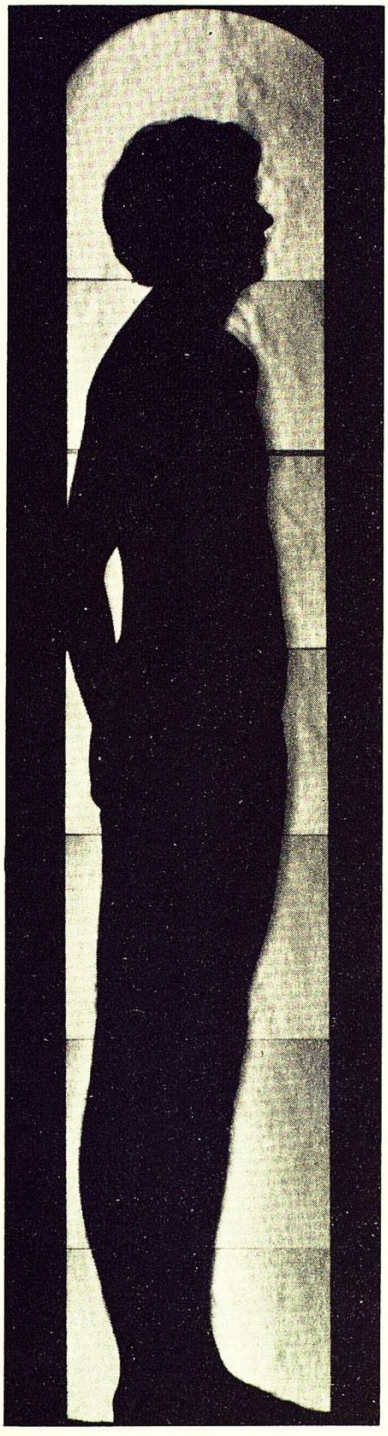
F Compare your results with those from the rest of the class.

Q2 Was everyone's mouth temperature the same? If not, what were the lowest and highest?

Q3 Why must you not take your mouth temperature after drinking iced water?

Q4 Which was the coolest part of your body?

Information: Controlling body temperature



The average body temperature is 37 °C. The skin of a naked person is usually warmer than the surrounding air. The surface of the body warms up the air. The warmed air rises as shown by this photo. In cool places the body may be clothed to stop too much heat being lost.

The human body must be kept at around 37 °C if it is to work properly. If your temperature drops you will become drowsy. Some Channel swimmers cover their bodies with grease to keep heat in. A few get so cold they have to give up their swim as they are falling asleep. In very hot countries the human body could over-heat dangerously. Extra heat is lost by **sweating.** The body is warmed by **shivering.** The native people of hot countries tend to be tall. They have a large body surface from which to lose heat. People from cool climates have shorter bodies with less surface for heat loss.

Q5 Why must the body temperature be kept at around 37 °C?

Q6 What are the ways we keep the body temperature steady:
a) in warm places?
b) in cold places?

6 The heart as a pump

Counting pulse beats

Apparatus

★ stop clock

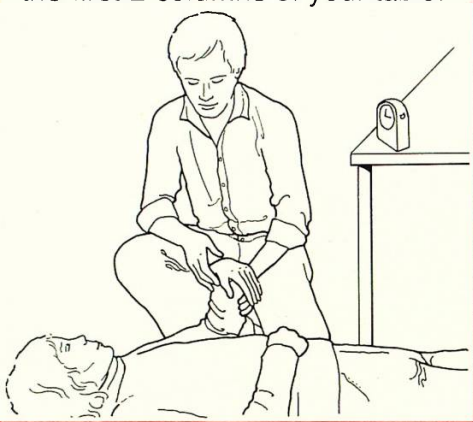
You are going to find out how the rate of the heart beat changes with body position. To do this you will count a partner's **pulse.**

Q1 Copy this table.

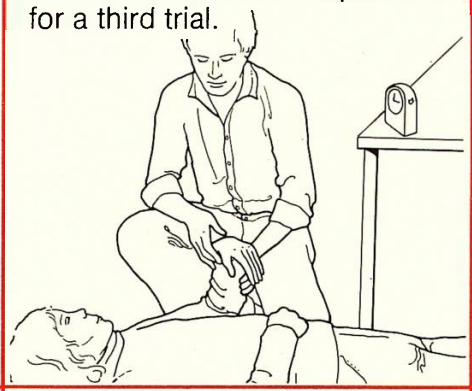
Position of body	Number of pulse beats in 30 seconds: 1st trial (a)	2nd trial (b)	3rd trial (c)	Average trials $\left(\frac{a+b+c}{3}\right)$

A Find a pulse at your partner's wrist, neck or ankle. Do not press down on the pulse. Your partner must then lie down for 3 minutes.

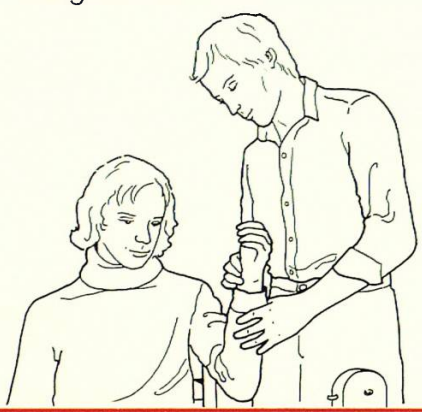
B Count the number of pulse beats in 30 seconds. Complete the first 2 columns of your table.



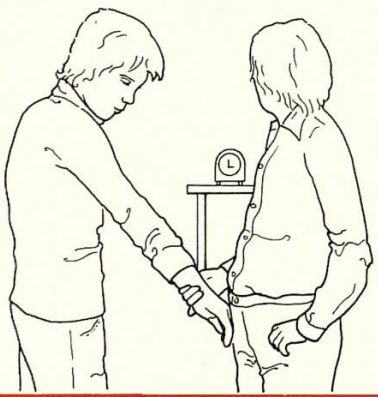
C Wait 30 seconds. Again count the number of pulse beats in 30 seconds. Record the number in the table. Repeat this for a third trial.



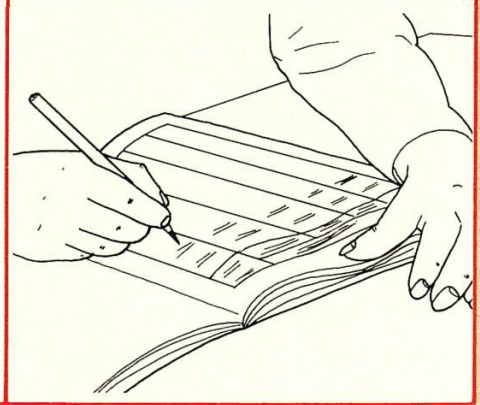
D Repeat steps B and C but after your partner has been sitting for 3 minutes.



E Repeat steps B and C but after your partner has been standing for 3 minutes.



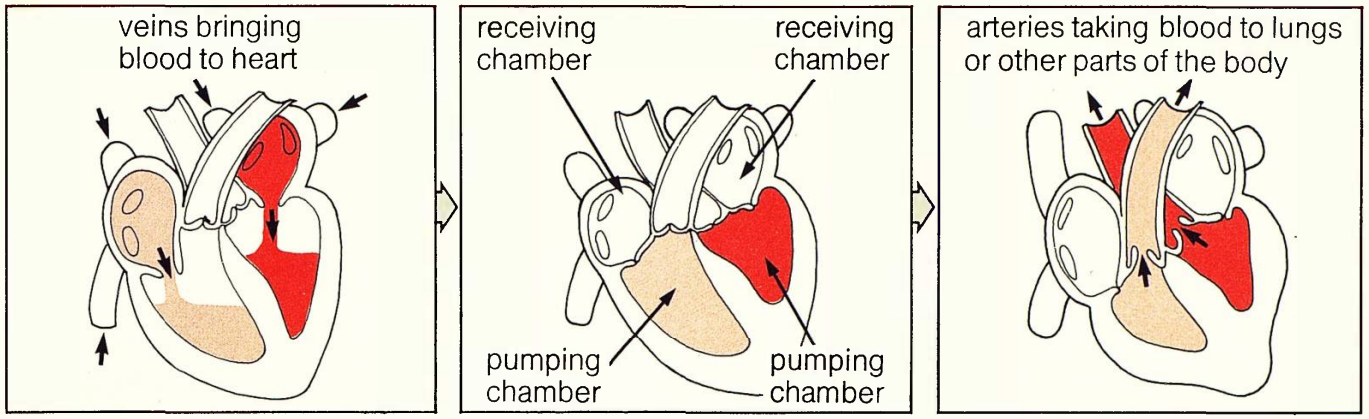
F Work out the average number of pulse beats for 30 seconds for each body position.



Q2 In which body position was the number of pulse beats:
a) lowest,
b) highest?

Q3 Why should the pulse beat change?

Information: Fitness



Blood is carried around the body in tubes known as **arteries, veins** and **capillaries.** Blood is pumped through the arteries by the heart. Where an artery passes over a bone, the movement of blood through it can be felt. This is a pulse. The blood flows through different parts of the body in capillaries and back to the heart through the veins. The heart is made up from two pumps. One pump sends the blood to the lungs to get oxygen. When the blood returns to the heart, the second pump forces it out to all parts of the body. The two pumps each beat together about 72 times a minute every day of your life.

Blood carries oxygen and food to all the cells of the body. If the heart does not work fast enough, the cells do not get enough oxygen for respiration. The food will not be 'burned' properly and a substance called **lactic acid** is made. If lactic acid builds up, the muscles stop working properly. This is why a runner who is not fit may have to stagger across the finishing line.

Some fit athletes have hearts that pump as slowly as 40 times a minute. Athletes **train** and this makes the heart work harder. The heart gets bigger and rests longer between beats. When the athlete is at rest, the trained heart beats more slowly than normal—but is still working properly. A slow heart rate is one sign of **fitness.**

Q4 What is a pulse?

Q5 When does the body make lactic acid?

Q6 Why do some athletes have slow heart rates?

Finding out if you are fit

Apparatus

★ stop clock ★ box or stool 50 cm high

You are going to find out how fit you are.

Q7 Copy this table.

1. Time of exercise in seconds	240	
2. Multiply by 100	24000	A
3. 1st pulse count in 30 seconds		
4. 2nd pulse count in 30 seconds		
5. 3rd pulse count in 30 seconds		
6. Total of 3 pulse counts		
7. Multiply by 2		B

Working out the fitness index

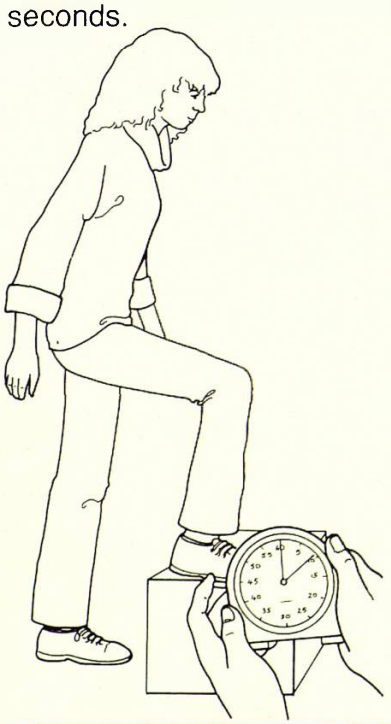
Divide number A by number B

Fitness index = $\frac{A}{B}$ = 24000

My fitness index =

over 90	- the best!
81 - 90	- excellent
71 - 80	- good
61 - 70	- fair
51 - 60	- poor
below 51	- oh dear!

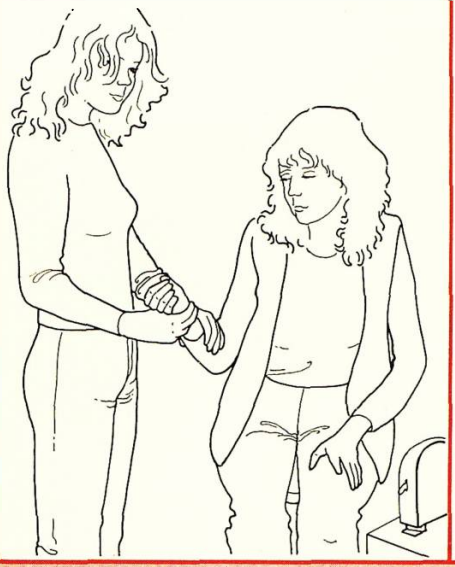
A Step up on to a box or stool and down again. Step up and down at a speed of 5 times in 10 seconds.



B Make sure you straighten your legs and stand up each time you step on and off the box. Carry on for 4 minutes.

C Rest for one minute. Get your partner to count your pulse beats for 30 seconds. Record the number in the third line of your table.

D Rest for a further 30 seconds. Your partner must then take your pulse again for 30 seconds. Record the number.



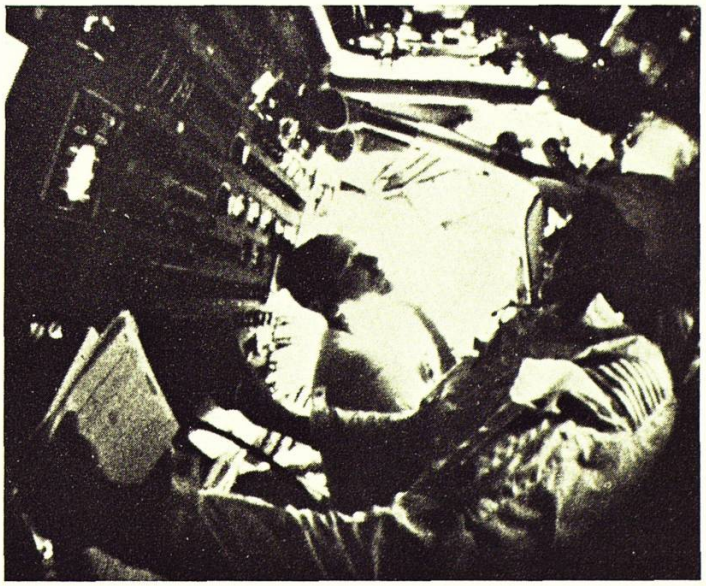
E Repeat Step D.

F Work out your fitness index.

Q8 How fit are you?

Information: The importance of exercise

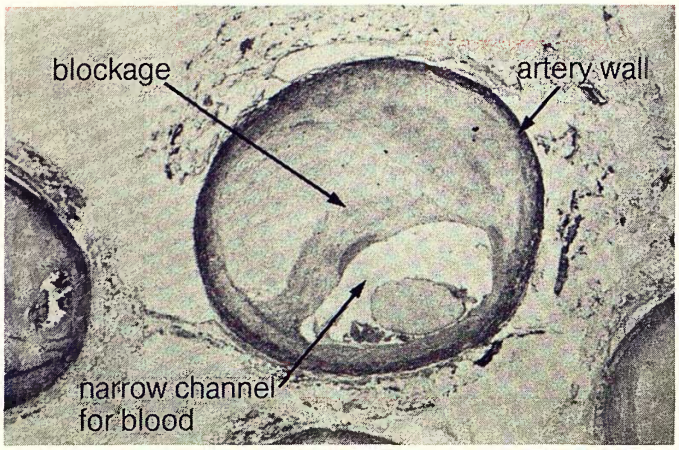
Regular exercise is needed to keep muscles and bones healthy. In space, very little force is needed to move the body. Such lack of effort can have unusual effects. This was discovered in a study of astronauts in the 1960s. During a 14-day space flight they lost up to 15 per cent of their **bone mass.** (The weight of their bones went down). By the time Skylab was launched in 1973, the astronauts had a special bicycle on which to exercise. On lengthy flights astronauts spend up to 1½ hours a day on the bicycle. This stops them losing bone mass and keeps their muscles in good condition.



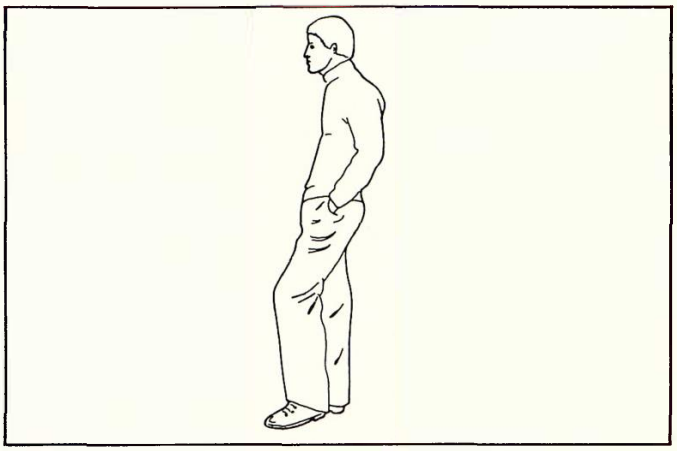
Q9 How much bone mass did astronauts lose during a 14-day flight?

Q10 How do astronauts keep fit during long space trips?

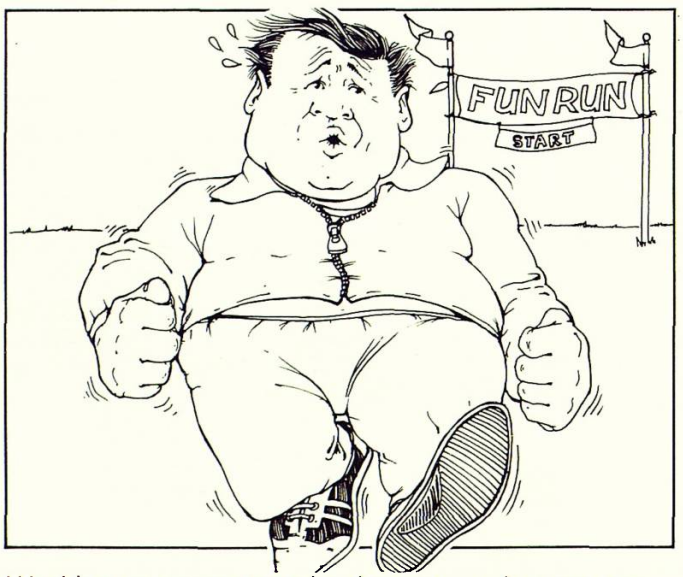
The heart as a pump



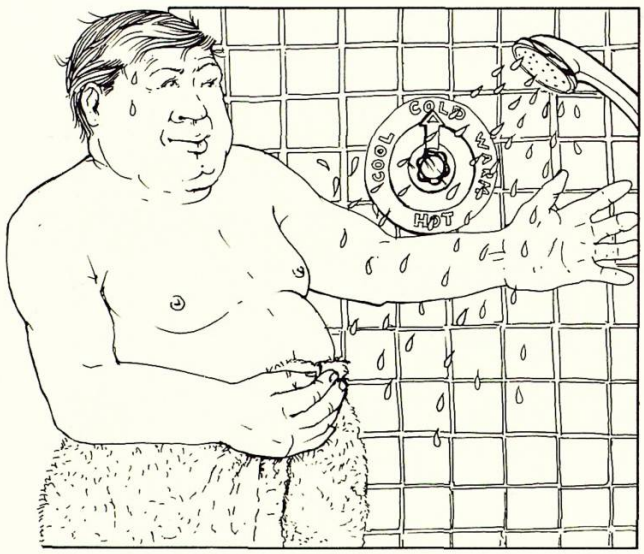
The tiny blood vessels in the body may close if blood is not pushed through them by exercise. If a large vessel gets clogged by fat, the blood can pass the blockage by going through smaller vessels. If these are closed, the detour cannot take place. This can lead to heart attacks.



If the joints are not exercised the tendons get shorter. It gets hard to twist and turn the body. Rounded shoulders and stooping back make it hard to breathe properly.



Working up a sweat can be dangerous. As a person gets hotter, more blood moves to the skin surface. Your muscles do not get enough blood for them to work. The heart may be strained. Running or cycling until you can go no further can be **fatal** for a person who is normally not very active.



Cold showers do not keep people fit. They are refreshing, but if the body is put in very cold water, the blood vessels narrow. This can happen to the blood vessels of the heart and it may stop working properly.

Q11 What might block a large blood vessel?

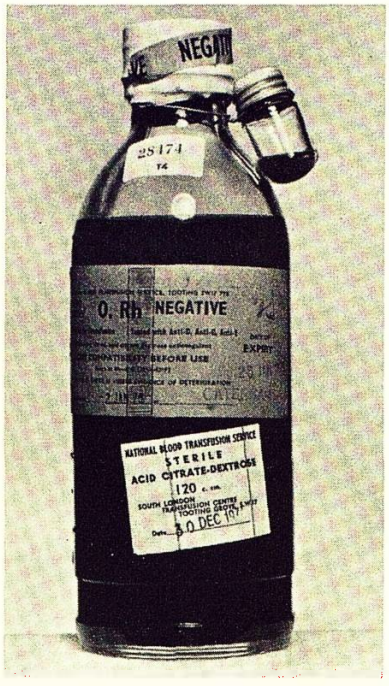
Q12 Why is it important to have exercise and good posture?

Q13 Why is it dangerous for an unfit person to do heavy exercise?

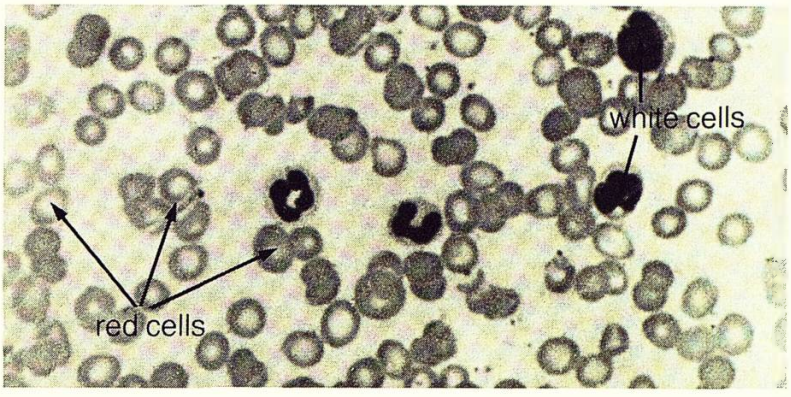
Q14 Why should you have a warm shower after exercise?

7 Blood

Information: What is blood?

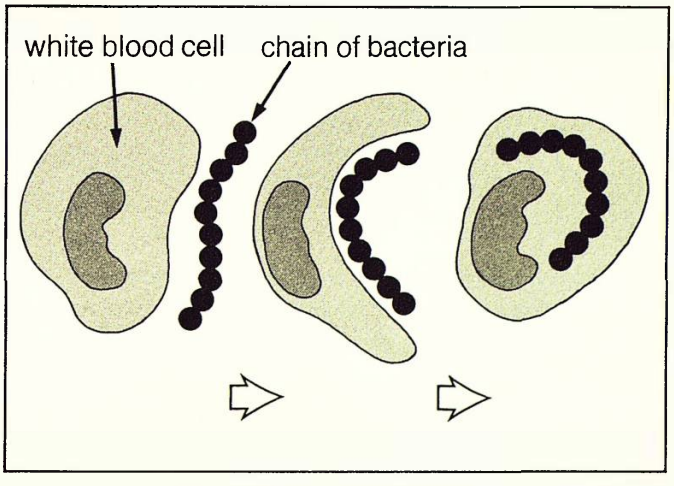


In an adult male there are between 5 and 6 litres of blood. If blood is removed from the body and left in a bottle, it separates into two parts. The straw coloured liquid on top is **plasma.** The deep red part that settles at the bottom is the **blood cells.**



The cells can be seen when they are magnified. There are two main kinds of cells—**red blood cells** and **white blood cells.** The red colour is caused by a protein called **haemoglobin.** White cells can be seen only after being stained.

In a drop of blood the size of a pin-head, there are 5 million red cells. A red cell lives for 120 days. After this time it is broken down and replaced by a new cell. In an adult the marrow (jelly) in the large bones makes red cells. If you do not make enough red cells you are **anaemic.** A blood count is when a tiny sample of blood is placed on a **counting chamber.** The cells are then counted using a microscope.



There is one white cell to every 200 red cells. White cells help to defend the body against disease. If bacteria enter the blood the white cells eat the bacteria. Red cells carry oxygen. Plasma carries many dissolved substances such as food. The blood is the main **transport system** of the body.

Q1 What is plasma?

Q2 What are the two main types of blood cells?

Q3 How long does a red blood cell live?

Q4 What is the job of a white blood cell?

Looking at blood cells

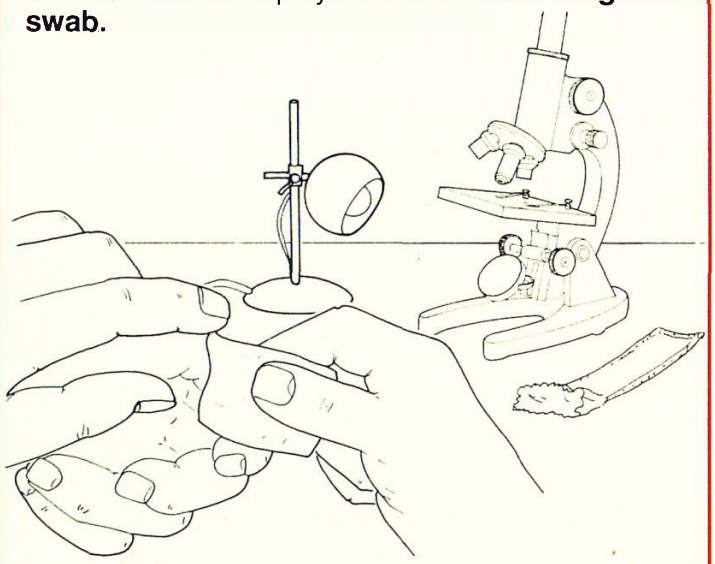
Apparatus

★ microscope ★ 2 clean slides ★ bottle of Leishman's stain ★ dropper
★ sterile lancet ★ 2 surgical swabs ★ sticking plaster ★ stop clock ★ bench lamp

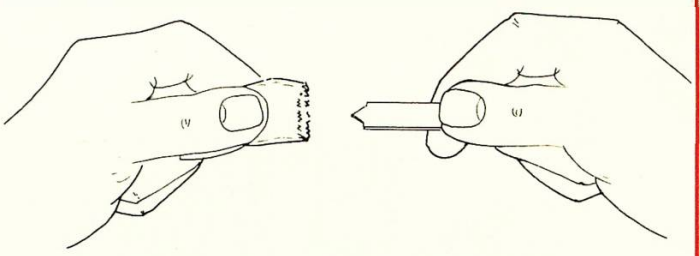
You are going to make a blood smear and look at blood cells.

Your teacher must take the blood sample for you. You must follow all your teacher's instructions very carefully.

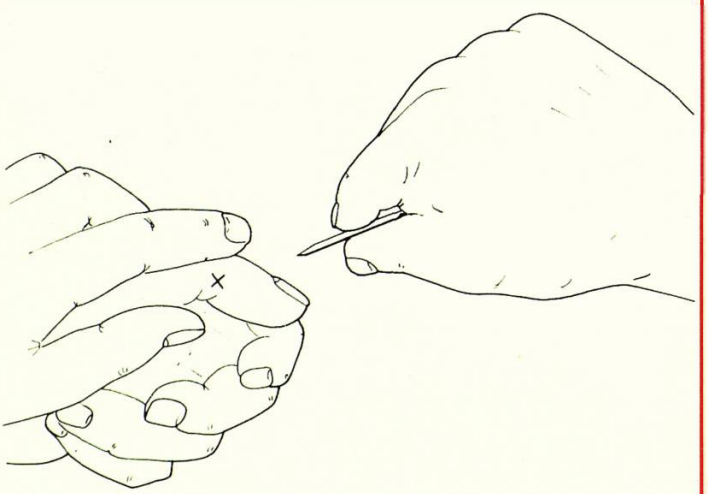
A Set up the microscope and lamp ready for use. Your teacher will wipe your thumb with a **surgical swab.**



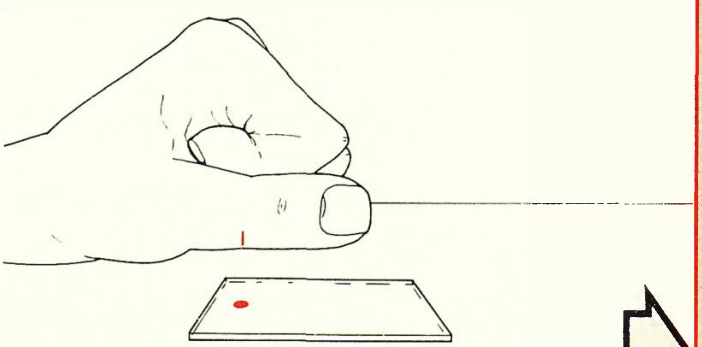
B You teacher will take a **sterile lancet** from its packet. The pointed tip must not touch anything but your cleaned thumb.



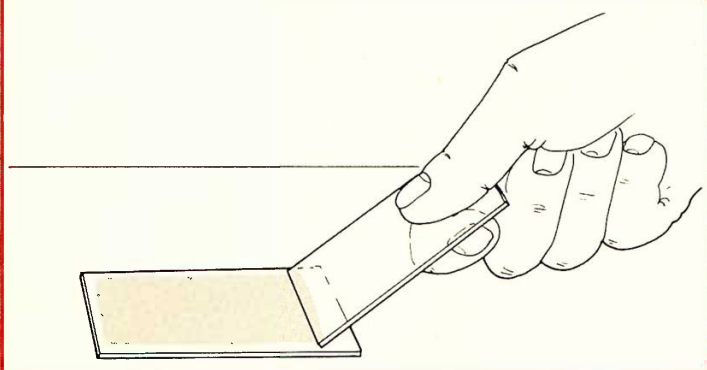
C Your teacher will pierce the cleaned skin of your thumb with the lancet.



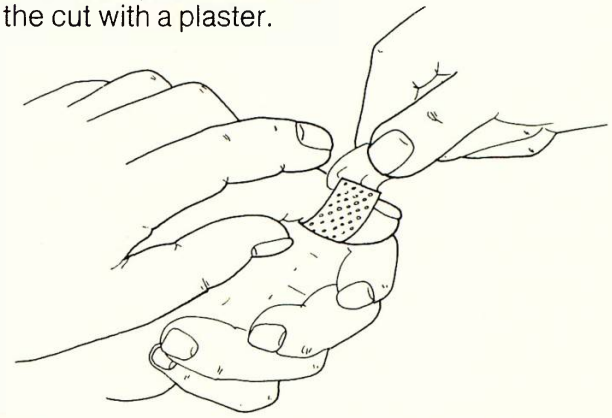
D Put one drop of blood on the end of a slide. Do not let your cut thumb touch anything.



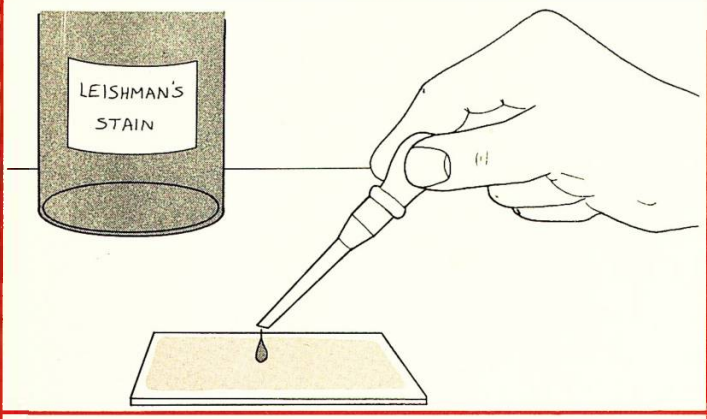
E Quickly pull the edge of a second slide through the drop to make a thin smear. Leave it to dry.



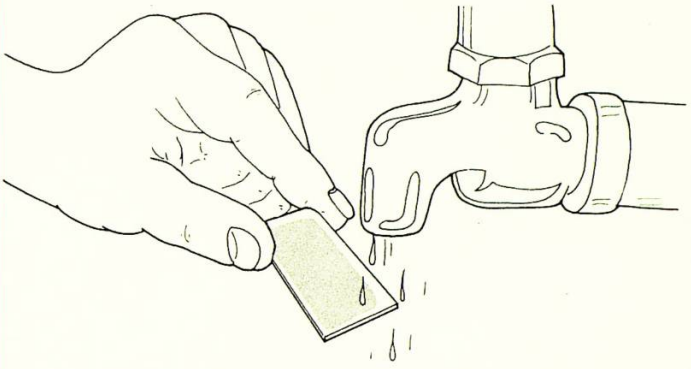
F Using a second swab, your teacher will wipe the cut on your thumb. Your teacher will then cover the cut with a plaster.



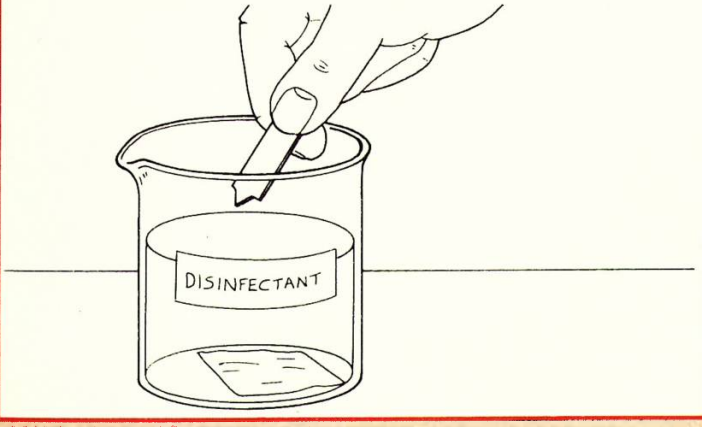
G Put 2 drops of stain on to the blood smear. Tip the slide to spread the stain over the smear.



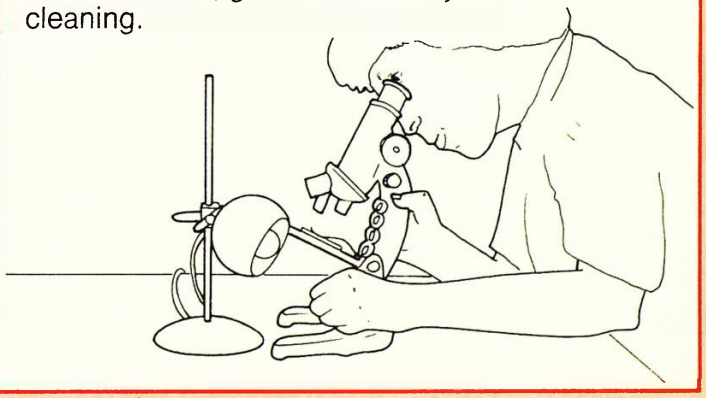
H Leave for 2 minutes. Wash off the stain by holding the slide under a gentle running tap for 1 minute. Leave to dry.



I Your teacher will dispose of the swabs, lancet and second slide.



J Look at the blood smear under the microscope. Try to find blood cells like those pictured on page 27. At the end, give the slide to your teacher for cleaning.



Q5 Which cells are the most numerous?

Q6 Which cells are the largest?

Q7 Explain why each of the following must be used:
a) surgical swabs,
b) sterile lancet,
c) a sticking plaster.

Blood grouping

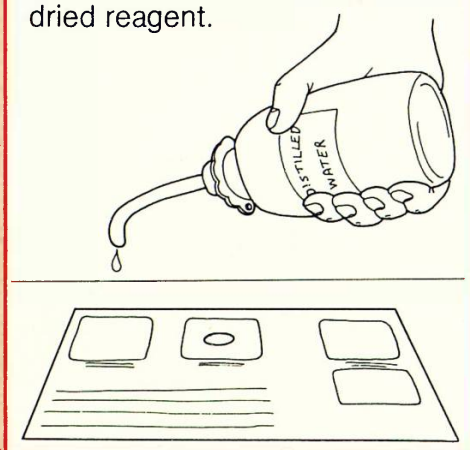
Apparatus

★ blood grouping card ★ 2 surgical swabs ★ sterile lancet
★ 4 clean mixing sticks ★ distilled water ★ sticking plaster

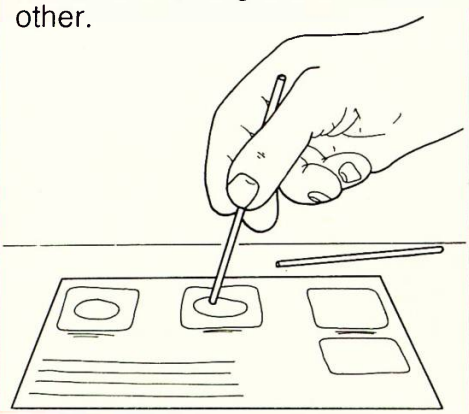
You are going to find out your blood group.

Your teacher must take the blood sample for you. You must follow all your teacher's instructions very carefully.

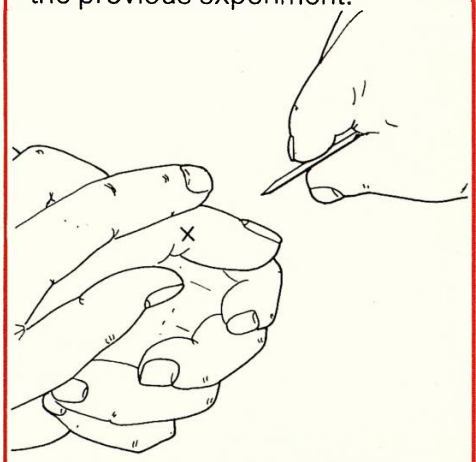
A Put the blood grouping card on the bench. Put one drop of distilled water on each square of dried reagent.



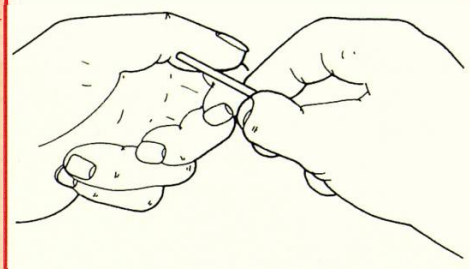
B Use a different mixing stick for each square. Stir each reagent with the water. Take care not to mix the reagents with each other.



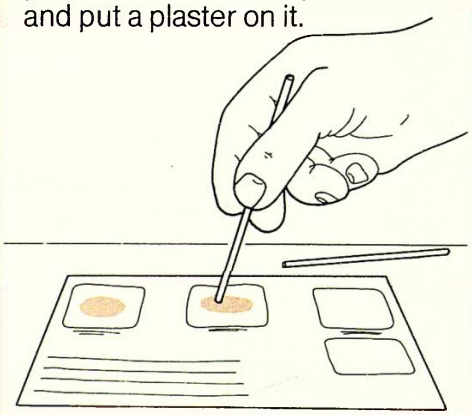
C Ask your teacher to take your blood sample for you as in the previous experiment.



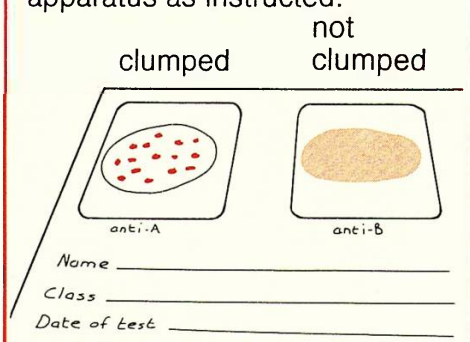
D Take a clean mixing stick. Put one drop of blood on the first square of the card. Use another clean stick to put a second drop of blood on the other square.



E With the correct sticks, mix the blood and reagents. Leave 1–2 minutes. While waiting, ask your teacher to clean your thumb and put a plaster on it.



F Look at your squares. Make a note of the squares in which the cells have or have not stuck together. Dispose of dirty apparatus as instructed.



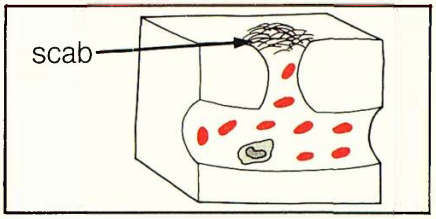
When the red blood cells stick together, this is called **clumping.**
Clumping in square anti-A means you are blood group A.
Clumping in square anti-B means you are blood group B.
Clumping in both anti-A and anti-B means you are blood group AB.
No clumping in either anti-A or anti-B means you are blood group O.

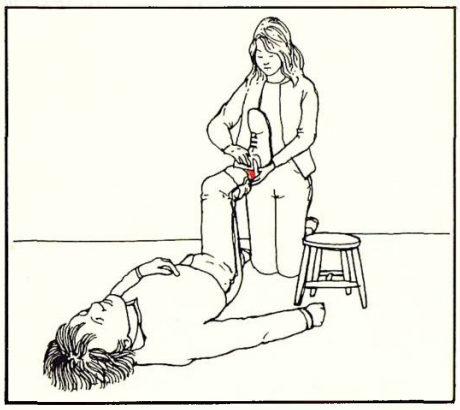
Q8 What is your blood group?

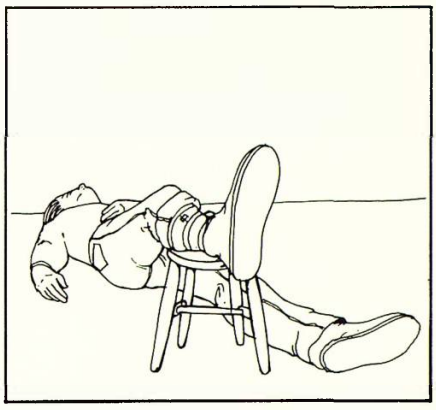
Q9 What other blood groups were found in your class?

Information: Wounds and bleeding

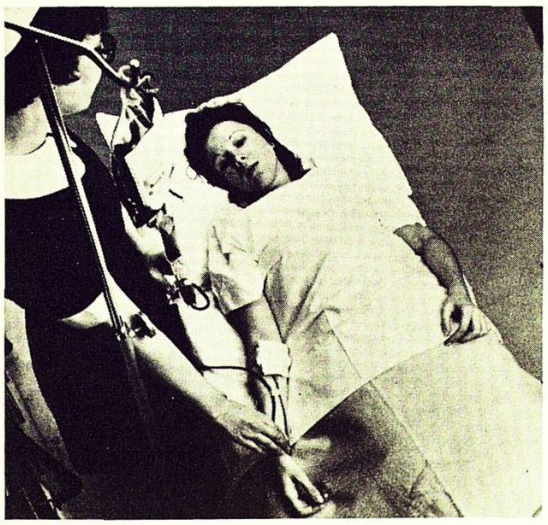
Plasma contains proteins. If the fine blood vessels are cut, one of these proteins, **fibrinogen** changes. The fibrinogen makes threads of **fibrin.** Many threads form a net which traps the blood cells. This seals the wound and hardens to form a **scab.** Beneath the scab the new skin grows and the wound is healed.







If you find someone with severe bleeding, lay the casualty down. Hold a clean pad (eg. handkerchief) on the wound. Press gently unless there is glass or metal in the wound. Raise the wounded part. Loosen tight clothing. Get help.



If a casualty loses a lot of blood, they must be given more blood in a **blood transfusion.** If a transfusion is to be successful, the correct blood group should be given. Blood grouping depends on the presence or absence of chemicals on the surface of the red blood cells. These chemicals are called **antigen A** and **antigen B.** Blood cannot be kept for a long time so blood donors are always needed.

Q10 What would you do if you found someone with a serious arm wound?

Q11 Why are blood donors always needed?

8 Accidents

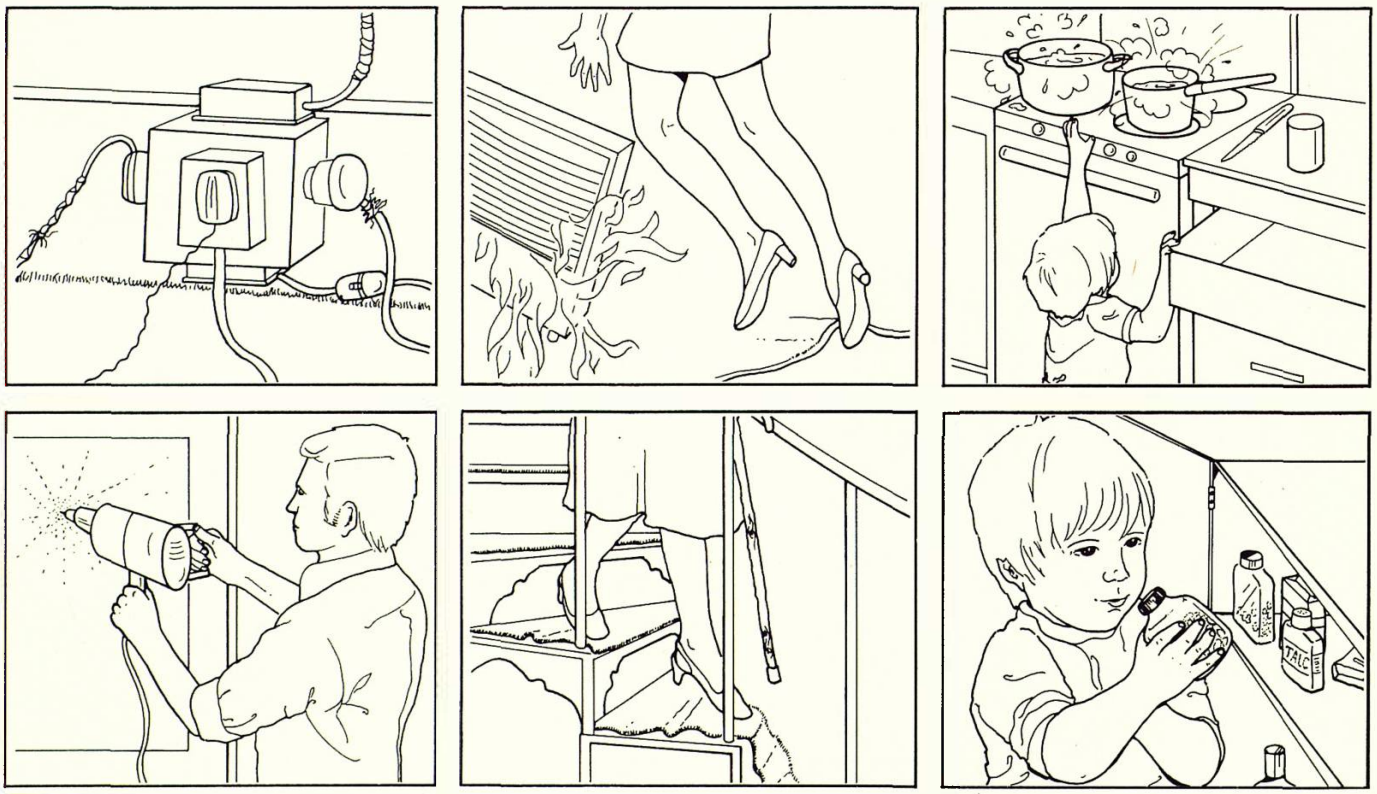
The home is where most accidents happen. The table shows the causes of death in home accidents in 1976.

Cause of death	Age group in years:					Total	**Percentage of total**
	0–4	5–14	15–44	45–64	65+		
Falls	40	15	103	332	3406	3896	**61**
Poisoning	17	14	276	230	173	710	**11**
Burns and scalds	83	49	86	141	460	819	**13**
Suffocation and choking	171	26	123	98	118	536	**8**
Other causes	61	18	84	84	199	446	**7**
Total	372	122	672	885	4356	6407	**100**
Percentage of total	**6**	**2**	**10**	**14**	**68**	**100**	

Q1 What was the cause of most deaths in the home in 1976?

Q2 What age group is most likely to have home accidents?

Each of the pictures below shows a scene that could lead to an accident.



Q3 What is the danger in each scene?

Q4 How would you deal with each accident if it happened?

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