Science@School Book 6G

Changing Circuits

Activity worksheets

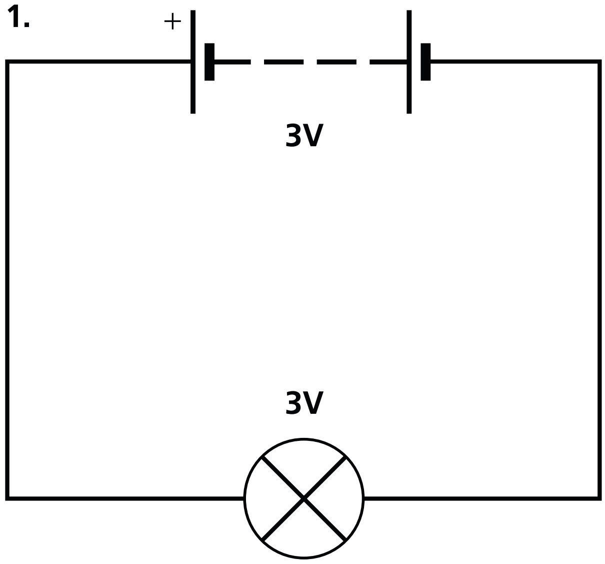
Peter Riley

1 Teacher's sheet: comprehension

See **pages 4 and 5** of *Changing circuits*

Answers

1.



2. **Circuits.**
3. **A battery.**
4. **Terminals.**
5. **The positive terminal.**
6. **(i) To show how wires, batteries and bulbs are connected together;**
   (ii) Because not all batteries and light bulbs look the same.

Complementary work

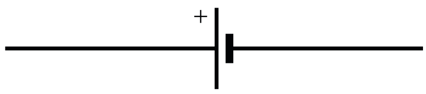
If the children have studied *4F Simple electricity* earlier in their science course they may have done some work on circuit boards. If they have, you may like to remind them of it now. They may have also seen a circuit board that you obtained from an electrician. You could show them the circuit board again and explain that it is constructed using complicated circuit diagrams.

Teaching notes

There is often confusion associated with the word battery. The cylindrical device which supplies electricity is commonly called a battery. Strictly speaking, it is really a single dry cell. It may also simply be called a cell.

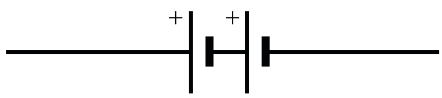
Two or more cells joined together make a battery. You may wish to point this out to the children so that they are aware of the common use of the word battery and the scientific use of the word cell. In the pupil book, the common use of the word battery is used.

In the suggested introductory activity on page 8, the children make a drawing of a circuit which features a battery, switch and bulb. For simplicity, the battery should be made from one cell. This is represented by the symbol:

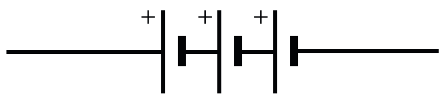


You may like to use the following information when discussing the use of the words cell and battery.

When two cells are joined together they from a two-celled battery which could be represented by this symbol:



When three cells are joined together they from a three-celled battery which could be represented by this symbol:



Generally, for convenience, when more than one cell is used the following symbol is employed, and this is the one children should learn:

This is the symbol used in the book, but it may help the children to know of the alternative ways of representing cells. This may help them to remember the cell symbol.

1

Teacher's sheet: activity

Based on **pages 4 and 5** of *Changing circuits*

Introducing the activity

(a) Use this activity after the children have read pages 4 and 5 in the pupil book. Show the children the range of equipment you will be using and draw the symbol for each one on the board as you introduce it (see note (i)).

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through task 1.

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Go through task 3, then let the children try it.

(e) Go through task 4, then let the children try it.

(f) Go through task 5, then let the children try it (see note (iii)).

(g) Let the children try task 6.

Completing the activity

(h) Let the children try task 7.

(i) When the children have made their circuits, ask them if there were parts of the circuit diagrams which were easy to follow and parts which were difficult to follow.

Conclusion

The equipment in electrical circuits can be represented by symbols. The symbols can be linked together in a circuit diagram to show the structure of the circuit. A circuit can be assembled from a circuit diagram.

Teaching notes

(i) It is very important to spend time making sure the children can relate each piece of electrical equipment to a symbol. You could extend the opening activity by letting the children make their own posters of the symbols so that they can use them in circuit work here and in other activities.

(ii) The children could look at the circuit diagram, make a list of the equipment they need and then collect it. When the children have made their circuit and shown it to you, ask them to switch it on. If it does not work, ask the children to check the connections as they sometimes come loose easily.

(iii) Make sure that the children keep their circuits simple. They should have two to three batteries, or cells, a switch and either two bulbs or a buzzer. They should not try to link a motor, buzzer or bulb together, as they will find that some items work while others do not. This is due to the amount of electricity each item needs in order to operate.

Teacher's sheet: comprehension

See **pages 6 and 7** of *Changing circuits*

Answers

1. **(i) The right hand bulb would be on, the left hand bulb would be off; (ii) Both bulbs would be on.**
2. **When all parts of the circuit make at least one loop.**
3. **The current does not flow.**
4. **The contacts are pushed together and the bulb lights up.**
5. **The contacts spring apart and the bulb goes out.**
6. **The circuit just shows you how the components are linked up and not what they do.**

Complementary work

If the children have studied *4F Simple electricity* earlier in their course, you may like to remind them of their work on switches in Unit 6. In the activity in that unit they made a switch by sticking two strips of aluminium foil to a piece of card and folding the card to make the two pieces of foil contact. You could now challenge the children to make another switch from simple materials such as aluminium foil, card and paperclips. They should test their switch in a circuit with one battery and one bulb.

Teaching notes

It is possible to make a circuit without using a switch. This is done by simply joining wires together. However, this causes the wires and battery to wear, and can also be dangerous if a strong current is being used. A switch provides a way of opening or closing a circuit which does not wear down the wires or battery. As the switch is also made from insulating materials, it helps to keep fingers away from wires and reduces the chance of someone receiving an electric shock. You may wish to add that mains switches should never be handled with wet hands as the water may enter the switch and cause the current to flow from the wire to the fingers.

At this level, the switch in the circuit diagram is always shown open and the point is made in the text that the symbols just show the pieces of equipment in the circuit and not what the equipment is doing. This is an important point as sometimes children draw a diagram showing that a bulb is alight or that a motor is moving. At a higher level, a switch may be shown closed, with the acute line moved down to rest horizontally on the two contacts. The children do not need to know about this symbol at this stage. They should concentrate instead on linking the symbols to items of equipment.

Teacher's sheet: activity

Based on **pages 6 and 7** of *Changing circuits*

Introducing the activity

(a) You may like to introduce the activity by showing the children a range of switches that they may use in their circuit work. You could show them a toggle switch, a push switch and a rocker switch. Tell the children that no matter how the switch is designed, it has just one purpose – to control the flow of electricity.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Go through task 3, then let the children try it (see note (iii)).

(e) Go through task 4, then let the children try it (see note (iv)).

(f) Go through task 5, then let the children try it (see note (v)).

(g) Go through task 6, then let the children try it.

(h) Go through task 7 with the children, then let them try it.

(i) Let the children try tasks 8 and 9.

Completing the activity

(j) Let the children compare their answers to steps 8 and 9.

Conclusion

A switch either lets a current of electricity flow or it stops the flow of electricity. Switches can be arranged in different ways in a circuit. When the switches are arranged in line (in series), both must be closed to make the electricity flow round the circuit. When the switches are arranged side-by-side (in parallel), either one can be closed to make the current of electricity flow. Two-way switches can make a current flow in two directions through a circuit. Two-way switches are often found at the top and bottom of a staircase.

Teaching notes

(i) You may like the children to look at the circuit diagram, make a list of the items they need and then collect them.

(ii) If the children do not get the bulb to light when both switches are closed, ask them to check all the connections in the circuit. In the excitement of making circuits children often fail to secure connections firmly.

(iii) The children can use the same equipment from step one but will need another piece of wire.

(iv) If the bulb fails to light when either switch is used the children need to check the connections.

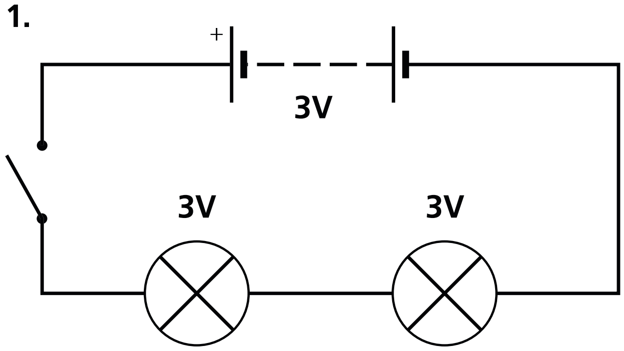
(v) When the paperclip under the central drawing pin is swung left or right it should make contact with another drawing pin.

Teacher's sheet: comprehension

See **pages 8 and 9** of *Changing circuits*

Answers

1.



2. **(i) Add one or more batteries;**
   (ii) Take away a battery.

3. **Short, thick wires.**

4. **It would shine more dimly.**

5. **A filament.**

6. **(i) They are in a line; (ii) They would shine more dimly. The two bulbs would have to share the voltage with the third bulb.**

Complementary work

(a) The children could make a survey of the kinds of lights used in schools. They should be told that fluorescent lights are more economical than filament lights, and they may use this information to draw conclusions about the widespread use of fluorescent lights in school.

(b) The children can use secondary sources to find out about energy efficient light bulbs and how they are made.

Teaching notes

Household light bulbs contain a wire coil called a filament which is surrounded by a gas called argon. This gas is present in the air in very small amounts. In a light bulb, it is used instead of air because oxygen in the air would cause the filament to burn out.

The glass in a light bulb may be clear, to give a bright, clear light, or it may be translucent. Translucent bulbs are called pearl bulbs. They give a softer, more diffuse light than clear bulbs.

Some strip lights, such as those used in kitchens or for lighting under cupboards, have a filament, but the large strip lights used in ceilings in kitchens, garages, schools and offices do not use a filament. When one of these strip lights is switched on, a current of electricity flows through a gas in the tube. As the current passes through the tube, part of it changes to ultraviolet light. This strikes the lining of the tube and makes it glow. The material in the lining is fluorescent. Fluorescent material only glows when it receives ultraviolet light, so the moment you switch off a fluorescent lamp, it stops glowing. Sometimes strip lights of this type are called fluorescent lights.

All electrical devices offer some resistance to the current passing through them. Filaments offer a high resistance to the current, so the current has to work hard and is 'used up' in order to get through the wire. As it is used up, light and heat are produced. The children do not need to know about resistance at this level, but it is a useful concept when comparing series and parallel circuits in Unit 5.

Teacher's sheet: activity

Based on **pages 8 and 9** of *Changing circuits*

Introducing the activity

(a) You could begin by reminding the children that scientists do not only work out new experiments, but they also repeat the experiments of other scientists in order to test their work. In the pupil book, information was given about how the brightness of a bulb can be controlled. In this activity the children have to devise experiments to test this information.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then let the children try task 1 (see note (i)).

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Go through task 3, then let the children try it (see note (iii)).

(e) Let the children try task 4 (see note (iv)).

(f) Go through task 5, then let the children try it (see note (v)).

(g) Let the children try task 6 (see note (vi)).

(h) Let the children try task 7.

Completing the activity

(i) Let the children compare their results.

Conclusion

When the number of batteries in a circuit is increased, the brightness of a bulb in the circuit also increases. When the number of batteries in a circuit is decreased, the brightness of the bulb decreases.

When the number of bulbs in a circuit is increased, the brightness of the bulbs decrease. When the number of bulbs in the circuit is decreased, the brightness of the bulbs increases.

Teaching notes

(i) Many children find it easier to plan their experiment if they can see the equipment they are going to use.

(ii) The following three circuits should be drawn: one battery, switch and bulb; two batteries, switch and bulb; three batteries switch and bulb. It may be helpful here for the children to draw in each of the batteries they use. When they are wiring up their batteries, they should be able to connect positive to negative terminals easily.

(iii) Check each circuit as the children finish making it. Look at how the terminals of the batteries are wired together. Make sure that none of the circuits have a positive terminal wired to a positive terminal or a negative terminal wired to a negative terminal.

(iv) You may ask the children to devise a table in which to record their results in this task and in task 7.

(v) In this plan, the number of batteries should remain the same in all circuits but the number of bulbs should change. The circuits may have either one, two or three batteries. In the first circuit there should be a switch and a bulb, in the second circuit a switch and two bulbs and in the third circuit a switch and three bulbs.

(vi) Make sure that the bulbs are arranged in series.

Teacher's sheet: comprehension

See **pages 10 and 11** of *Changing circuits*

Answers

1. **A = rod-shaped magnet, B = salty water, C = metal dish, D = copper wire.**
2. **To make the spindle turn.**
3. **It rotates around the magnet.**
4. **It changes D into a magnet.**
5. **It pushes D away.**
6. **(i) Volts; (ii) D would move slowly with the 1.5V battery supplying power. D would move quickly with the 4.5V battery supplying power.**

Complementary work

The children could use secondary sources to find out about electric motors which power vehicles at an airport, inside a factory and electric cars.

Teaching notes

Small electric motors are usually enclosed in a metal casing so nothing can get in the way of the moving parts. There are two parts to the motor in the casing. One part is made from a pair of magnets, and between them is a coil of copper wire. When electricity flows through the coil, the current turns it into a magnet.

The north pole of the coil is repelled by the north pole of one magnet and attracted by the south pole of the other magnet. At the same time, the south pole of the coil is attracted to the north pole of one magnet and repelled by the south pole of the other. These forces of attraction and repulsion turn the coil on its spindle.

There is a special connection in the motor which links the coil to the wires which supply the motor with electricity. When the coil has turned so its poles are facing the opposite poles of the magnets, the connection switches the flow of the electricity so it flows the opposite way through the coil. This makes the poles of the coil change over so that they are again pushed and pulled by the poles of the surrounding magnets, making the coil move again. The coil and connection are set up so the constant changing of the current in the coil keeps it spinning in one direction. This allows the motor to generate a powerful enough force to turn a wheel.

Teacher's sheet: activity

Based on **pages 10 and 11** of *Changing circuits*

Introducing the activity

(a) Use this activity after you have done activity 3. It calls upon knowledge and understanding from Unit 3. Tell the children that, in order to try and understand what they see, scientists use information they have already learned. In this activity the children get an opportunity to show what they have learned so far about electricity in circuits.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, go through task 1, then let the children try it (see note (i)).

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Let the children try task 3.

(e) Go through tasks 4 and 5, then let the children try them (see note (iii)).

(f) Let the children try task 6.

(g) Go through task 7, then let the children try it (see note (iv)).

Completing the activity

(h) Let the children compare their results.

Conclusion

In circuit A the motor spun round very quickly, and the paper made a high pitched humming note. In circuit B the motor spun round more slowly, it made a lower pitched humming note and the filament of the lamp just glowed. In circuit C the motor spun more slowly still and made an even lower pitched humming note. The filaments of the two bulbs either glowed very dimly or not at all. The reason for these changes was due to the extra resistance of the bulbs in the series circuit.

The motor spun fastest in circuit A because there were no bulbs, and slowest in circuit C because there were two bulbs. When a second battery was added to each circuit, the motor spun more quickly, the bulb in circuit B shone more brightly and the bulbs in circuit C shone too. The reason for these changes is due to the increased voltage from the extra battery.

Teaching notes

(i) The piece of paper should be about a centimetre wide and about four centimetres long. It may be useful to test the motor and paper before the lesson. It should make a high pitched buzzing noise when moving quickly.

(ii) If the children seem to be having difficulty, remind them of how the filaments used up the electricity in the previous unit.

(iii) The children should not be allowed to use too many batteries as the motor in the circuit might burn out.

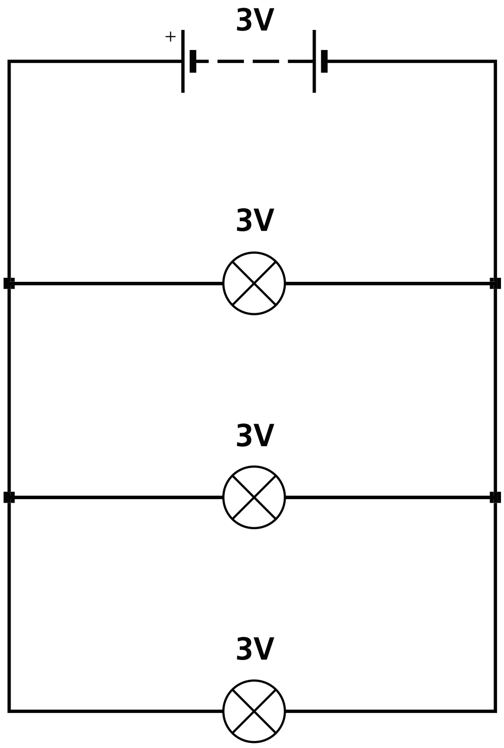
(iv) If the children are having difficulty, remind them how increasing the number of batteries increases the voltage, or push, on the current.

Teacher's sheet: comprehension

See **pages 12 and 13** of *Changing circuits*

Answers

1.



2. **A junction.**

3. **We connect them side by side.**

4. **They are not affected, they keep working.**

5. **They would keep shining.**

6. **(i) At home and at school; (ii) In the circuit with one bulb. The circuit in the picture uses more power, so the batteries would run out faster.**

Complementary work

Challenge the children to make a parallel circuit which features a bulb, a motor and a buzzer.

Teaching notes

Almost all electrical devices offer some resistance to the flow of current through them. The current has to work against the resistance and in so doing some energy is lost as heat energy. In a filament, the wire is designed so that the bulb also loses energy in the form of light.

When two bulbs are arranged in series, the resistance of one bulb is added to the resistance of the other. This makes it increasingly difficult for the current to get through, and as a consequence both bulbs glow more dimly than if they were each in a circuit with their own battery.

The voltage of a battery is the measure of the push that it gives to the current. When two batteries are connected in series, their voltages are added together and give a more powerful push to the current. This explains why the bulbs in a series circuit glow more brightly when another battery is added to the circuit.

When two bulbs are connected in parallel, each one offers its own resistance to the batteries. The resistances of the two bulbs are not added together to oppose the voltage. This means that each one glows as brightly as if it was in a circuit with its own battery.

5 Teacher's sheet: activity

Based on **pages 12 and 13** of *Changing circuits*

Introducing the work

(a) If you did the introduction to this unit on page 11 of this *Teacher's Guide*, you may like to remind the class of it now so that they are familiar with the terms series and parallel. Tell the children they are going to investigate some circuits with bulbs and a buzzer.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form. Go through tasks 1 and 2, then let the children try them (see note (i)).

(c) Go through tasks 3 and 4, then let the children try them (see note (ii)).

(d) Go through task 5, then let the children try it.

(e) Let the children try task 6 (see note (iii)).

(f) Let the children try task 7.

(g) Go through tasks 8 and 9, then let the children try them.

Completing the activity

(h) Let the children compare their results.

(i) As the children have discovered that two bulbs and a buzzer work together, they may like to make a scary face or monster out of cardboard and place it over their circuit. The two bulbs can be its eyes and the buzzer can be its voice.

Conclusion

When three 3V bulbs are arranged in series with two 1.5V batteries they glow dimly because batteries to the value of 9V are needed to match the bulbs. When the three bulbs are arranged in parallel they glow brightly with just two 1.5V batteries because each bulb draws 3V directly from the batteries. When a buzzer and bulb are arranged in parallel, the buzzer sounds and the bulb glows brightly. When two bulbs and a buzzer are arranged in parallel, the two bulbs glow as brightly and the buzzer sounds as loud as in the circuit with one bulb. This is because you can add as many components as you like in parallel without affecting the working of any of the existing components. All that will happen is that the more components there are, the quicker the batteries will run down.

Teaching notes

(i) While the children are making their circuits check that they are arranging the batteries in the correct way – negative terminal to positive terminal and not two positive or two negative terminals together. Also check that the children are making firm connections between the wires and the other components of the circuit.

(iii) The children may need help in joining the bulbs in parallel. The way they make their circuits will depend on what you use to connect the wires. If, for example, you use crocodile clips, one crocodile clip can be snapped onto another to make a joint.

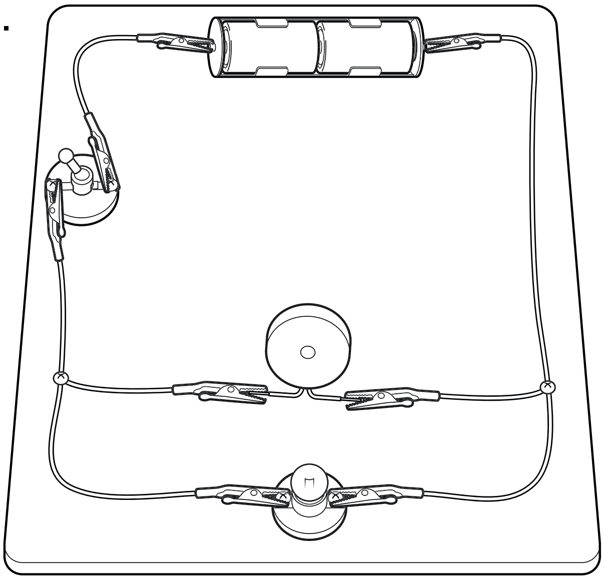
(iii) The children may need reminding about the symbol for a buzzer. The children will also need to know that a buzzer will only work if it is connected the correct way round – that is, the red wire to the positive terminal of the battery, the black wire to the negative terminal.

Teacher's sheet: comprehension

See **pages 14 and 15** of *Changing circuits*

Answers

1.



2. **A motor.**

3. **The compass moves. The wire behaves as a magnet.**

4. **Wrap a coil of wire around a nail and pass a current of electricity through the coil.**

5. **The water begins to bubble.**

6. **(i) The key would become coated in copper; (ii) The positive terminal.**

Complementary work

(a) The children can use secondary sources to find out about the use of electromagnets.

(b) You may also like to use this unit with Unit 6 in *6D Changing materials* where instructions for performing an investigation on electroplating are provided.

Teaching notes

In this unit the use of electricity to provide sound and light is featured, but more unfamiliar uses are also introduced. The children may know about the flow of electricity through liquids from warnings about drying their hands before using a light switch.

In this unit electricity is shown to travel through salty water. When electricity passes through the salt water it breaks the water up into the two substances from which it is made – hydrogen and oxygen. These gases escape from the liquid in the bubbles. When the copper and key are set up as the diagram shows, copper dissolves in the water and then settles again on the surface of the key.

Electricity and magnetism are closely related phenomena. When a current passes through a wire it creates a magnetic field around the wire. If the wire is coiled, an object with a much stronger magnetic field, called a solenoid, is created. The power of the coiled wire, or solenoid, is further increased by placing a steel or iron nail inside it.

6

Teacher's sheet: activity

Based on **pages 14 and 15** of *Changing circuits*

Introducing the activity

(a) Use this activity after the children have studied the unit in the pupil book. Remind the children that electricity and magnetism are linked, and tell them that they are going to investigate this relationship.

Using the sheet

(b) Give the children the sheet, let them write their names and form on it, then go through task 1 (see note (i)).

(c) Let the children try task 1.

(d) Go through task 2, then let the children try it (see note (ii)).

(e) Go through tasks 3, 4 and 5, then let the children try them (see note (iii)).

(f) Go through task 4, then let the children try it (see note (iii)).

(g) Go through task 6, then let the children try it.

(h) Let the children try task 7 (see note (iv)).

(i) Let the children try task 8.

Completing the activity

(j) Let the children compare their results.

(k) Ask the children how they think the electromagnets would perform if three batteries were used instead of two, then let them test their prediction.

Conclusion

The number of coils in an electromagnet affects its power. As the number of coils increases, the power of the electromagnet increases.

When a third battery is used in the circuit the power of the electromagnet increases.

Teaching notes

(i) Some children may have coiled the wire tightly so that it does not need any further support. Some children may need to use sticky tape to hold their coil in place.

(ii) When the children assemble the circuit check to see if the batteries are lined up correctly.

(iii) The children should find that the paperclip does not stick to the nail in task 3 but it does in task 4, when the current is switched on. The children could also confirm that the coil and nail are behaving like a magnet by placing a compass near the nail then noticing that the compass needle swings when the current is turned on.

(iv) In the plan, look for the idea that the strength of the electromagnet can be measured by counting the number of paperclips it can hold. Look also for electromagnets with different numbers of coils.

Teacher's sheet: comprehension

See **pages 16 and 17** of *Changing circuits*

Answers

1. **(i) The wire is bent and thicker than in A; (ii) The wire is broken and there is debris on the bottom of the case beneath the gap.**
2. **The current flow speeds up.**
3. **(i) It gets warm; (ii) It may cause a fire.**
4. **It will keep melting and the circuit will never work.**
5. **Kettle, toaster, TV, computer, radio.**
6. **Not always. If the other wires in the circuit are thinner than the fuse they may heat up first when the circuit is overloaded and cause a fire.**

Complementary work

You could arrange for someone to visit the school to talk about the dangers of electricity. This person could be an electrician, an engineer, a paramedic, a nurse or a doctor.

Teaching notes

There are two kinds of fuses, fuses for houses and other buildings and fuses for plugs. Household and building fuses are also known as fuse boxes, and are shown in the circuit diagram on page 21 of the pupil book. There are two types of these fuses, fuse wires and cartridge fuses.

If fuse wires are used, a 5 amp fuse is needed for the lighting circuit, a 15 amp fuse is needed on circuits which supply an appliance working at up to 3 kilowatts and a 30 amp fuse is needed on a circuit supplying an appliance working at up to 13 kilowatts, such as a cooker.

If cartridge fuses are used in a building, a 5 amp fuse is used for a lighting circuit, a 15 amp fuse is used for appliances up to 3 kilowatts, a 20 amp fuse for a water heater, a 30 amp fuse for some cookers and showers and a 45 amp fuse for cookers which have a power greater than 13 kilowatts.

There are two fuses for plugs. 3 amp cartridge fuses are used for appliances below 700 watts and 13 amp cartridge fuses are used for appliances above 700 watts.

Children may become confused if too many electrical terms are introduced, and it is best to keep their use to a minimum. For simplicity, volts measure the push of the current made by the power supply, amps measure the size of the current flowing through a wire, and watts measure the power of an appliance. The power is the rate at which an appliance changes one form of energy to another. For example, a 40 watt bulb changes electrical energy into light energy more slowly than a 100 watt bulb and so shines less brightly.

Teacher's sheet: activity

Based on **pages 16 and 17** of *Changing circuits*

Introducing the activity

(a) Use this activity after the children have studied the unit in the pupil book. Remind the children that tampering with electrical devices is very dangerous and should never be done. Tell the children that they can look at fuses in this activity because they are not connected to any device which can be wired to the mains.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Go through task 3, then let the children try it.

(e) Go through task 4, then let the children try it.

(f) Let the children try task 5, then ask them to try task 6.

Completing the activity

(g) Let the children compare their results.

Conclusion

The thinnest fuse wire can carry a current up to 3A. The medium-sized fuse wire can carry a current up to 15A. The thickest fuse wire can carry a current up to 30A. The thicker wires can carry more current because there is more room for the current to flow through them.

A fuse is a glass cylinder with metal caps at each end. There is a label which shows the size of current which can pass through the fuse. A wire passing from one end of the fuse to the other may be seen.

The fuse is held in the plug with metal spring clips.

The fuse needed for an iron is 13A, a CD player needs a 3A fuse, the vacuum cleaner needs a 13A fuse, the hair dryer needs a 3A fuse, the toaster needs a 13A fuse, the table lamp needs a 3A fuse (see note (iii)).

Teaching notes

(i) If the children ask about how amps are different from volts they can be told that the voltage is a measure of the push of the electricity. An amp is a unit which measures the size of the current running through a wire.

(ii) The children can simply look at or handle the wires and discover that they are different thicknesses.

(iii) Remind the children never to open electrical devices to look at a fuse or to change a fuse. This must be done by an adult who knows what to do. The purpose of the information here is to help the children understand what a fuse looks like and what it does.

8

Teacher's sheet: comprehension

See **pages 18 and 19** of *Changing circuits*

Answers

1. **(i) The heating element; (ii) A coil of wire as shown on page 18 of the pupil book.**
2. **Light.**
3. **It will have a dull orange or red glow.**
4. **It provides hot water for the taps.**
5. **A wire cage.**
6. **It blows air through the heating element so that warm air emerges from the dryer.**

Complementary work

(a) The children could use secondary sources to find out how an electric oven is made.

(b) The children could use secondary sources to find out how gas and wood are used to provide heating.

Teaching notes

If the children have studied *4F Simple electricity* they will have already met heating appliances in Unit 2. It may be useful to remind them of their work. They need to be reminded that heating appliances such as kettles, ovens and irons have a heating device called an element. This is made from a coil of wire and is enclosed in a protective case. In kettles, the element is enclosed in a water-tight case, as is the immersion heater featured in this unit. The heating element in the hob of an electric cooker is enclosed in a strong case which can take the weight of a pan without bringing the case and pan into contact with the element.

In the supporting activity in *4F Simple electricity*, the children cut out pictures of household appliances and grouped them according to the rooms in which they were found in homes. The children then had to describe the use of each heating appliance and perform a survey on the use of appliances in their home. In this survey they had to divide the day into four time periods – morning, daytime, evening and night – and find out when each item was used. From this they could find out the time period when their home needed the most power. You could review that activity here or, if the children have not studied *4F*, they could do the survey now.

8

Teacher's sheet: activity

Based on **pages 18 and 19** of *Changing circuits*

Introducing the activity

(a) Use this activity after the children have studied the unit in the pupil book. Tell the children that scientists sometimes gather information by making surveys and in this activity they are going to design and use their own survey sheet.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 with the children (see note (i)).

(c) Let the children try task 1.

(d) Go through task 2 with the children, then let the children try it (see note (ii)).

(e) Go through task 3, then let the children try it (see note (iii)).

(f) Let the children try task 4 (see note (iv)).

(g) Let the children try task 5.

(h) Go through task 6 with the children, then let them try it (see note (v)).

Completing the activity

(i) Let the children compare their results.

Conclusion

The following appliances may be used for making meals: kettle, microwave oven, oven, toaster, slow cooker, sandwich maker. The following appliances may be used to keep clean: heater in shower, immersion heater, hair dryer, washing machine and tumble dryer. The following appliances may be used to keep comfortable: electric fire, convection heater, electric blanket. The frequency with which the appliances are used will depend on the people surveyed.

Teaching notes

(i) The children should see that kettles and ovens are used for making food; showers and hair dryers are used for keeping clean; and fires and electric blankets are used for keeping comfortable.

(ii) The left hand column should have the appliances grouped into making meals, keeping clean and keeping comfortable. There should be ten further columns in which the children can place a tick if the person they are surveying uses a particular appliance. There may be a total column for each appliance and a total line at the bottom of the table for each person. There may also be a column to indicate when each item is used.

(iii) The children could survey pupils in other classes, or friends, neighbours and members of their families. The children should be reminded not to talk to strangers when making their survey.

(iv) The children should total up the number of times an appliance is used. They may also total up the number of appliances used by each person. They should comment on these totals.

(v) The children should look for similarities and differences in the results. They may also find that they have some appliances in their survey which are not found in the class survey or that the class survey has some appliances which they have not featured on their survey sheet.

Note: This activity could be used as an ICT exercise.

Teacher's sheet: comprehension

See **pages 20 and 21** of *Changing circuits*

Answers

1. **B = electricity meter, D = earth wire, E = wall light switch, F = ceiling light.**

2. **A cable.**

3. **(i) A fuse box; (ii) The fuse box should be labelled A as in the pupil book;**
   (iii) Prevents problems in one home from affecting others.

4. **It records the amount of electrical energy used in the home every second.**

5. **Live wire.**

6. **Parallel circuit.**

Complementary work

The children could use secondary sources to find out about the voltages used in other countries to provide power to home circuits.

Teaching notes

In Great Britain the plug for the mains has three pins on it. The top pin is the earth pin. Looking at the plug from the front, the pin at the lower left is the live pin and the pin at the lower right is the neutral pin. Cables attached to plugs have three wires. The wire with the green and yellow cover is the earth wire, the wire with the brown cover is the live wire and the wire with the blue cover is the neutral wire. *Do not* let children wire up a plug.

When the plug is placed in the socket, and the socket is switched on, a current of electricity flows through the live and neutral wires. The voltage is 240 volts. This is the voltage at which a wide range of electrical appliances can be used and at which people will usually survive an electrical shock (but some may not).

An earth wire gives protection if an electrical appliance develops a fault. For example, if an electric kettle with a metal casing developed a fault, the current could flow into the casing. Anyone touching the casing would receive a shock that might kill them. The earth wire is connected to the casing so that if a fault occurs, the current is taken away to the earth (or it may be connected to a copper water pipe which goes into the ground). As the current is drawn away to the earth it melts the wire in the fuse and the circuit is broken. All this happens very quickly, and makes the kettle safe to handle.

Teacher's sheet: activity

Based on **pages 20 and 21** of *Changing circuits*

Introducing the activity

(a) Tell the children that although we cannot use mains electricity for investigations, we can make a model of the wiring in a room. By doing this we can see some of the problems an electrician faces when wiring up a room (see note (i)).

Using the sheet

(b) Give out the sheet and let the children write their names and form, then go through task 1 (see note (ii)).

(c) Let the children try task 2.

(d) Go through task 3, then let the children try it (see note (iii)).

(e) Go through task 4, then let the children try it (see note (iv)).

(f) Let the children complete task 5 (see note (v)).

Completing the activity

(g) Let the children compare the circuits they have made, or their rooms.

Conclusion

A battery, wires and other components can be used to make circuits in a model room. They can provide light, sound for a door buzzer and movement for a fan. The circuits must be set up in parallel so that each one can be used on its own.

When circuits are made in model rooms, care must be taken to make sure the wires are connected securely and that switches, bulbs and other components are secured to the room walls or ceiling.

Teaching notes

(i) You may also refer to doll's houses which have electric lights in them.

(ii) Get the children to trace the path of the circuit with a finger. Make sure that they understand that some of the wires are shown behind the wall.

(iii) The children should think about the difficulties in judging how much wire to use and making the components of the circuit stick together and to the room.

You may wish to introduce the concept of cost, and say that wire is expensive so it should not form long wavy lines on the outside of the room, but go straight between components.

(iv) Some children may have difficulty thinking about other circuits to make. Here are some circuits for them to try. A door could be made in the room and a circuit with a buzzer and switch set up. A motor could be put in the ceiling to power a fan and a switch could be put on the wall, a lamp could be put outside the door with a switch on the inside of the room.

(v) Make sure that the second circuit is in parallel with the first.

Teacher's sheet: comprehension

See **pages 22 and 23** of *Changing circuits*

Answers

1. **(i) A generator; (ii) A high voltage cable; (iii) A pylon.**
2. **To keep it away from people.**
3. **It is very expensive to bury cables.**
4. **A pattern of cables that supply electricity.**
5. **(i) Air and ceramics; (ii) plastic.**
6. **This is the most efficient voltage to carry electricity long distances.**

Complementary work

(a) The children could use secondary sources to find out how electricity is generated at a power station.

(b) The children could use secondary sources to find out about the different ways in which electricity is generated.

Teaching notes

In Unit 4, the children learned that there was a link between magnetism and electricity, and this is used to make an electric motor. Magnetism is also used to make an electric current in an electrical generator. The dynamo on a bicycle is an example of a small electrical generator. It contains a coil of wire and a magnet.

A magnet has an area around it in which its magnetic force is active. This area is called the magnetic field. It is easily seen by sprinkling iron filings on paper held over a magnet. When the magnet in a generator turns, its magnetic field sweeps through the coil of wire and makes a current of electricity. The current created in a power station is at about 25,000 volts. This is passed through a transformer which raises, or steps up, the voltage to about 400,000 volts so that it can be transported economically in overhead power lines or transmission lines.

When the current comes to the end of its journey on the transmission line, it passes into another transformer which lowers, or steps down, its voltage.

Currents at high voltages are stepped down in a series of stages. The step down process takes place at a substation. For heavy industry, such as steelworks, large substations step the current down to 33,000 volts. Railways use electricity at 25,000 volts, while hospitals receive their electricity at 11,000 volts, which is stepped down again before use. Neighbourhood substations step down electricity, ready to distribute it to homes. Children must be warned to keep away from them.

10 Teacher's sheet: activity

Based on **pages 22 and 23** of *Changing circuits*

Introducing the activity

(a) You may like to begin by telling the children that when new power stations or towns are set up, engineers have to think carefully about how they will supply electrical power. Tell the children that in this activity they are going to work as engineers and run a power line from a distant power station to a house in the middle of a town.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Go through tasks 2 and 3 with the children.

(d) Go through task 4, then let the children try it (see note (ii)).

(e) Let the children try task 5.

Completing the activity

(f) Let the children compare their plans and decide which is cheapest and safest.

Conclusion

The cheapest and safest method of supplying power would be to use transmission lines from the power station, through the valley round the edge of the lake to the edge of the town.
An underground cable would then run from the edge of the town directly to the house. Placing underground power lines through the hills or under the lake would be very expensive. Building islands to support pylons in the lake, to take the power directly to the opposite side of the lake would also be possible, but expensive. Using overhead transmission lines through the town would be cheaper than an underground cable but it would not be safe enough.

Teaching notes

(i) Make sure that the children recognise all the features on the map.

(ii) Make sure that the children know that if they change the power line from overhead transmission lines to underground cable, or from underground cable to transmission lines, they simply change the symbols. They can change the method of supply as often as they like.