Science Scheme of Work Year 6 – Exemplar Unit 7 (Changing circuits)

Unit Objectives

Pupils will learn to:

- Understand that a circuit needs a power source, and that a complete circuit is needed for a device to work
- Know that metals are electrical conductors and plastics are electrical insulators
- Know how to make bulbs in a circuit brighter
- Know how to use mains electricity safely
- Understand that electrical components can be represented by symbols, and know the symbols for the components they use
- Know how to construct circuits from a circuit diagram
- Understand what a parallel circuit is, and identify some of the differences between series and parallel circuits
- Know how the thickness of a wire in a circuit will reduce the brightness of the bulbs
- Know the effect on brightness of changing the numbers of bulbs and cells in a circuit
- Understand that a flow of electricity is called a current, and how to measure current

Teaching Resources
Exploring Science 6, Longman Active Science Class 6 Pupil Book (available from http://pearson.vrvbookshop.com/)
Scientific language
circuit, switch, battery, bulb, motor, buzzer, electrical conductor, electrical insulator, component, mains electricity, voltage, electric shock, circuit diagram, symbol, cell, series, parallel, current, ammeter, amps (A), resistance

Objectives	Teaching	Resources
Understand that a circuit needs a power source, and that a complete circuit is needed for a device to work Know that metals are electrical conductors and plastics are electrical insulators Know how to make bulbs in a circuit brighter Know how to use mains electricity safely	Ask pupils what they know about electricity. Show pupils a circuit made with one cell and two bulbs. Ask them how they could make the bulbs brighter (use a different cell that has a higher voltage, use more cells, or remove one of the bulbs). Ask what would need to be added to the circuit to turn the lights on and off, and ask why this works. Show pupils a circuit with a cell and a bulb, with a gap in the circuit. Show them a selection of different items, and ask which ones would make the bulb light up if they were put in the gap. Elicit the idea that metals conduct electricity, and can be used to complete a circuit. Demonstrate the effect of overloading a circuit by using cells with a higher total voltage than the bulb rating. Note that this will blow the bulb. Ask pupils to suggest how this could be avoided. Remind pupils of the hazards of mains electricity before starting any practical work. Provide pupils with components and wires, and cells with different voltages, if available, and ask them to construct circuits to match given descriptions. Ask pupils to draw their circuits. If pupils are likely to take a long time doing their drawings, either just visually check each circuit, or suggest that they draw a few of them. However spending time drawing pictures of their circuits will help them to understand the need for circuit symbols in the next topic. ⚠ Do not use rechargeable cells for circuit work as they can get very hot if short-circuited, and may even explode. Briefly discuss with pupils what burglar alarms are, and how often they might work. If necessary, elicit the idea of a pressure switch under a carpet by asking them what they stand on when they go through their front door. Ask for suggestions about making a switch. Remind pupils that the switch must only close when someone treads on it, so they will need some way of keeping the two halves of the switch apart for the rest of the time and talk about how others may detect that the switch has been closed. Provide pupils with materials to build their switch and a circuit with a buzzer, and ask them to work in groups to design and build their burglar	*Exploring Science Pupil Book 6* *Longman Active Science Class 6 Pupil Book, Unit 13 'Discovering Electricity'* *Circuit with once cell and two bulbs; selection of different materials, e.g. plastic, metal, wood* *Component, wires, cells of different voltages* *Cells; wires; bulbs; buzzers; switches.*

	alarm. They should record their ideas and reasoning as they go along. Provide the following hints if necessary: ● What will you use to make a noise? ● How will you provide electricity? ● The two parts of your switch must only touch if someone presses them together. How will you stop the two parts touching the rest of the time? ● What properties do your materials need to have? ● Do you need to use electrical conductors and insulators? ● Do any of your materials need to be springy? ● How will you put your materials together? ● How will you stop your alarm from making a noise when you go in and out of the house? Encourage pupils to consider how to prevent the alarm from sounding when they step on the switch. This can be achieved by including another, normal switch in the circuit which must be closed before the alarm will work at all. When pupils have built their alarms, ask them to evaluate their work and suggest improvements. The then present their designs in the form of posters with labelled diagrams explaining what they did and the reasoning for their designs. *What might be the problem if a bulb in a circuit does not light?* Encourage pupils to consider all possibilities (possible answers: the bulb is broken, there is a gap in the circuit, the battery is flat/not working). Ask pupils to consider the odd one out: metal, plastic, wood (possible answers: metal is the only one that conducts electricity, wood is the only one not usually used in a circuit).	
Understand that electrical components can be represented by symbols, and know the symbols for the components they use Know how to construct circuits from a circuit	Write a maths question on the board in words, and ask pupils how they would represent it in symbols. Ask them to suggest why symbols are used, and for other examples of symbols in use (e.g. road signs). Elicit that symbols are quicker and easier to write/draw, and can be understood by people who do not speak the same language (which is often important	*Exploring Science Pupil Book 6* *Cells; wires; bulbs; buzzers; switches* *Cell; 12 wires; 5 bulbs; switch*

diagram Understand what a parallel circuit is, and identify some of the differences between series and parallel circuits	in science and engineering). Ask pupils to design their own symbols for the electrical components they have used in school, then compare pupils' designs with the conventional symbols. Show pupils a circuit and ask them to draw a circuit diagram to represent it. Encourage pupils to show the cell the correct way round, with the components in the correct order around the circuit. Show the whole class several circuits one after the other, allowing time for drawing between each, or, alternatively, set out several different circuits around the room and ask groups of pupils to move from one to the next as they finish their diagrams. Provide pupils with circuit diagrams and ask them to build the circuits shown. ⚠ Do not use rechargeable cells for circuit work as they can get very hot if short-circuited, and may even explode. Once pupils have practised building circuits, show them a series circuit with several bulbs in it. Remind them that adding more bulbs makes the bulbs dimmer, and removing one bulb from its holder will make all bulbs go off because there is now a gap in the circuit. Explain that this is called a series circuit where electricity goes through each component in turn. Show pupils how to construct a parallel circuit with several bulbs, and ask them to find out what happens if more bulbs are added (the bulbs will stay as bright or get slightly brighter) or if one bulb is removed (bulbs in other branches stay on). They could also investigate the effect of putting switches in different places in the circuit (a switch only controls the 'branch' of the circuit that it is in). Provide a set of circuit drawings and diagrams that include deliberate mistakes. In groups, pupils discuss the drawings and list the mistakes before reporting back to the class. Alternatively the diagrams can be copied onto OHP slides or displayed on a digital projector and be used as the basis for a class discussion.	

Know how the thickness of a wire in a circuit will reduce the brightness of the bulbs Know the effect on brightness of changing the numbers of bulbs and cells in a circuit Understand that a flow of electricity is called a current, and how to measure current	Remind pupils that changing the number of cells and/or bulbs in a circuit can change the brightness of the bulbs. Show a range of diagrams of parallel circuits, and ask pupils to comment on the brightness of the bulbs. A simple way to work out the relative brightness is to divide the number of cells in the circuit by the number of bulbs (this assumes that all cells are the same and all bulbs are the same). Explain that in this lesson, pupils are going to investigate the effects of different lengths, thicknesses or materials of wire in a circuit. Fuse wire or resistance wire (available from equipment manufacturers) is needed for this investigation. Try out the investigation first, to find a combination of cells, bulbs and wires that provide a detectable difference in brightness when the length or thickness of the wire is changed. Investigating the effect of different lengths of wire is the easiest form of this investigation, as it may be difficult to obtain wires of several different thicknesses or different materials. Note that it is only the wire between the crocodile clips that is relevant, as this is the only part of the wire that the current will flow through. It is not necessary to cut different lengths of wire for this investigation – the length of wire can be adjusted by changing the amount of wire between the crocodile clips. Pupils could use two lengths of wire next to each other to represent a wire twice as thick, but some pupils may have difficulty with this idea. Pupils carry out their investigations and then record their results. ⚠ Note that thin fuse wire may get very hot if the current is too high or the wire is very short. Ask pupils to use ammeters to measure the current in a circuit. This is an opportunity for pupils to consider the difference between qualitative and quantitative results, and which is best to use in investigations. Pupils measure the current in circuits of various configurations. *Why was it safe to use bare wires in the investigation? Why did the length of wire make a difference when it does not normally do so?* Ask pupils to make up questions (with answers) about circuits and conductors for other pupils in the class to answer. Pupils' knowledge and understanding of the unit can be reviewed by observing both the questions and the answers they write, and the answers they give in	*Exploring Science Pupil Book 6* *Cells; bulb; switch; connecting wires; crocodile clips; fuse wire or resistance wire* *Cells; bulbs; switch; connecting wires; ammeter*

	response to other pupils' questions. *What would life be like without electricity?* This could be used as the basis for a class discussion, or pupils could write a description or a diary or a letter to a friend about a day without electricity.	

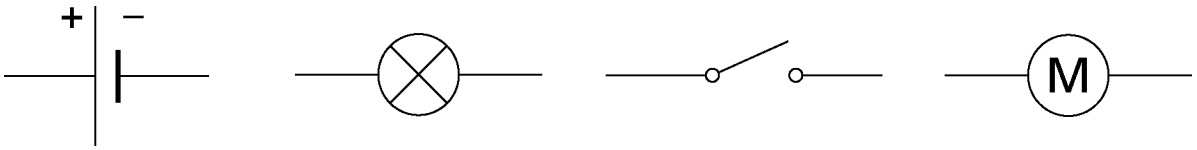
End of Unit Test

Changing circuits

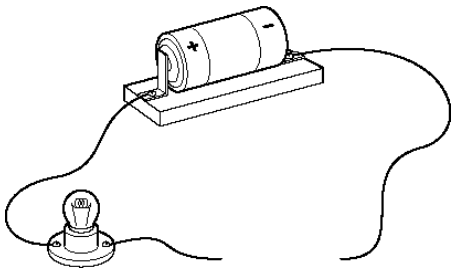
(Year 6 Unit 7)

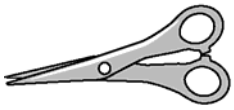
Answer the questions below.

1. What do each of these symbols show? Write the names of the symbols. (2 marks)

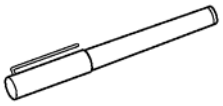


2. The bulb in this circuit is not lit. Which two materials could you put in the gap to make the bulb light up? Tick *two* boxes. (2 marks)



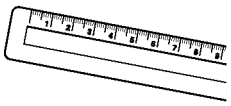


❑ metal scissors



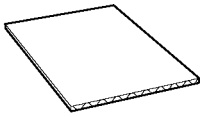
❑ plastic pen

❑ metal paper clip



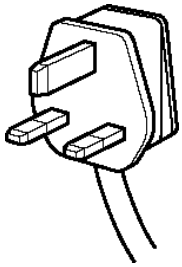
❑ wooden ruler

❑ glass

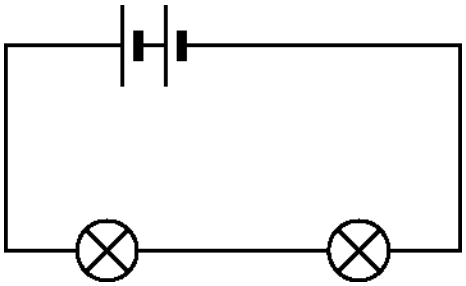


❑ cardboard

3. Why is the wire to the plug covered in plastic? (1 mark)



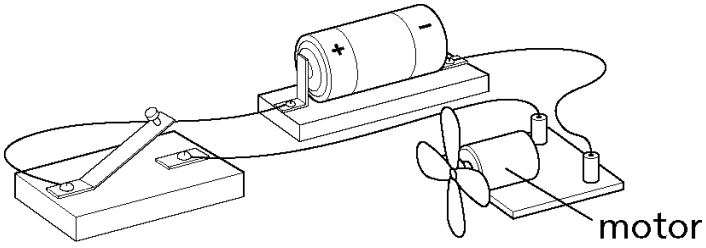
4. Pat has made this circuit.



Pat adds another bulb to the circuit. How will the brightness of the two bulbs change? (1 mark)

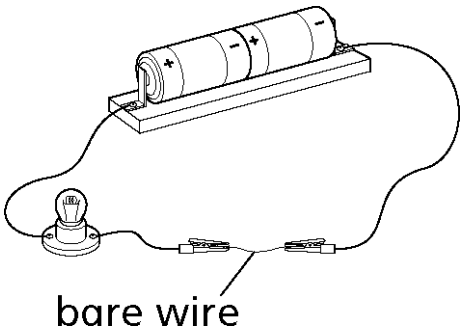
5. Aysha has built this circuit to make a fan spin.

a) Draw a circuit diagram of Aysha's circuit, using the correct symbols. (5 marks)



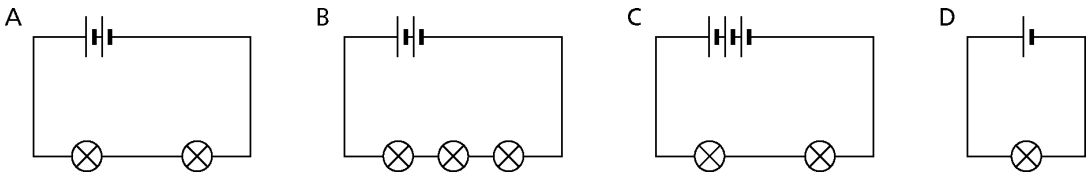
b) Write down two ways that Aysha could change her circuit to make the fan spin faster. (2 marks)

6. Jill has two pieces of bare wire. They are made from the same material, but one piece is thicker than the other. She wants to find which wire is best at conducting electricity.
She uses a circuit like this.



Write down two things that Jill must keep the same to make sure her test is fair. (2 marks)

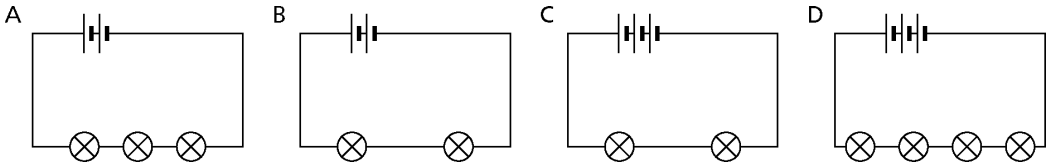
7. a)



i Which two circuits have bulbs of the same brightness?

ii Explain how you worked out your answer. (2 marks)

b)



i Write the letters for the circuits in order, starting with the one that has the brightest bulbs.

Brightest _____

_____

_____

Dimmest _____

ii Explain how you worked out your answer. (2 marks)

8. You can make bulbs in a circuit dimmer by putting a piece of fuse wire into the circuit. Adding more normal connecting wires does not make any difference to the brightness of bulbs in a circuit. Explain this observation. (1 mark)

[Total marks: 20]

Mark Scheme for End of Unit Test

Changing circuits

(Year 6 Unit 7)

This test should be set as soon as possible after pupils have finished their work on the unit. They should work independently and should need about 30 minutes to complete the test.

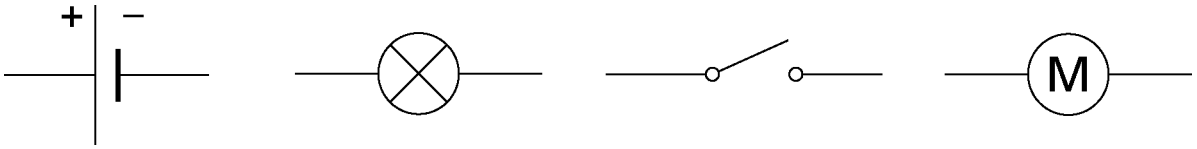
The aim of the test is to find out what pupils have learnt and understood as a result of their experience of studying the unit. The test is based on information and experiences they should have met during their work on the unit, so they should approach the test with confidence.

The teacher should be looking for marks in excess of 14 out of 20 from most pupils. More able pupils should be able to achieve 17+.

The teacher should be looking in their marking to award marks, not withhold them. The purpose at this stage is to give pupils the confidence that they can recall and understand scientific knowledge and concepts.

Marking Guide

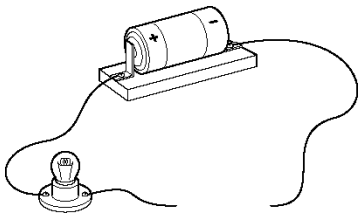
1. What do each of these symbols show? Write the names of the symbols. (2 marks)

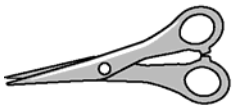


Cell (or battery) *bulb* *switch* *motor*

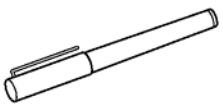
Award ½ a mark for each correct answer.

2. The bulb in this circuit is not lit. Which two materials could you put in the gap to make the bulb light up? Tick *two* boxes. (2 marks)





✓ metal scissors

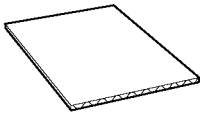


❑ plastic pen

✓ metal paper clip

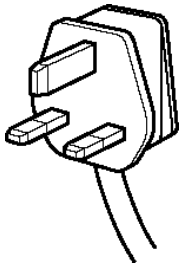
❑ wooden ruler

❑ glass



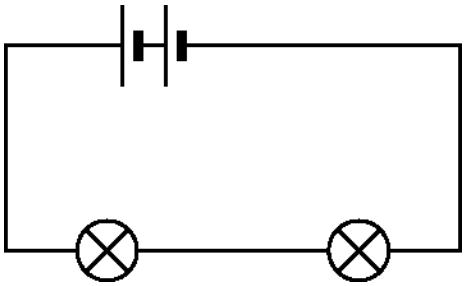
❑ cardboard

3. Why is the wire to the plug covered in plastic? (1 mark)



Plastic is an insulator / for safety.

4. Pat has made this circuit.

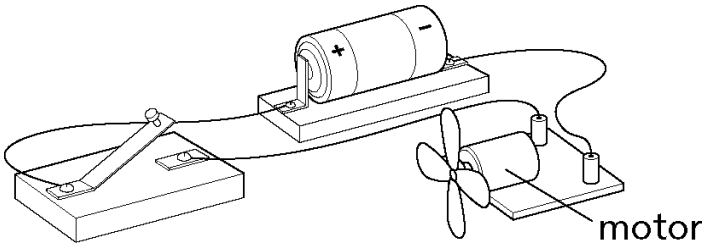


Pat adds another bulb to the circuit. How will the brightness of the two bulbs change? (1 mark)

They will get dimmer / less bright.

5. Aysha has built this circuit to make a fan spin.

a) Draw a circuit diagram of Aysha's circuit, using the correct symbols. (5 marks)

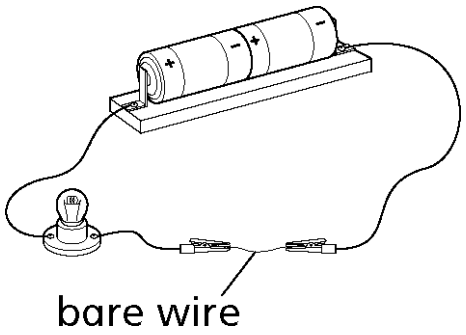


Accept a diagram where all of the symbols are correct and in the right order around the circuit. The diagram should be neat with straight lines and no gaps.

b) Write down two ways that Aysha could change her circuit to make the fan spin faster. (2 marks)

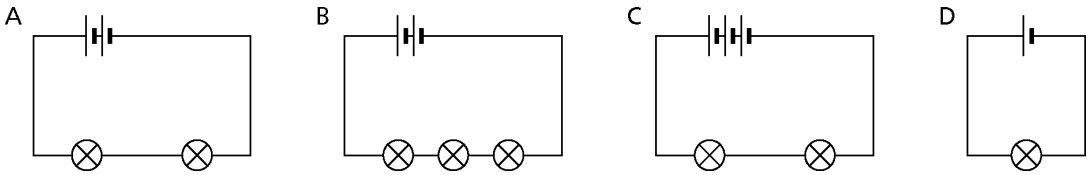
Remove the bulb; use an additional cell (answers in either order).

6. Jill has two pieces of bare wire. They are made from the same material, but one piece is thicker than the other. She wants to find which wire is best at conducting electricity.
She uses a circuit like this.



Write down two things that Jill must keep the same to make sure her test is fair. (2 marks)
She must use the same cells / bulbs. The length of the wire needs to be consistent.

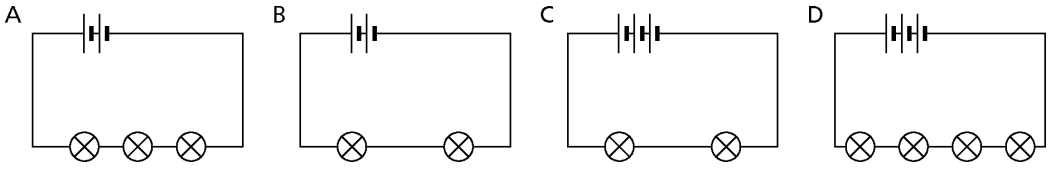
7. a)



i Which two circuits have bulbs of the same brightness?
A and D

ii Explain how you worked out your answer. (2 marks)
They have one bulb for each cell, or the ratio of cells to bulbs is the same. (Accept equivalent answers.)

b)



i Write the letters for the circuits in order, starting with the one that has the brightest bulbs.
Brightest *C*
B
D
Dimmest *A*

ii Explain how you worked out your answer. (2 marks)

Accept any explanation involving the ratio of cells to bulbs.

8. You can make bulbs in a circuit dimmer by putting a piece of fuse wire into the circuit. Adding more normal connecting wires does not make any difference to the brightness of bulbs in a circuit. Explain this observation. (1 mark)
   They are much thicker than the fuse wire, so they do not affect the flow of electricity. (Award ½ a mark for each point.)

[Total marks: 20]