

Unit 4F Circuits and conductors

ABOUT THE UNIT

This unit builds on children's previous practical experience of making circuits and extends their understanding of circuits, conductors and insulators and the need for a complete circuit in order for a device to work. Children are introduced to ways in which they can vary the current in a circuit.

Experimental and investigative work focuses on:

- using ideas about circuits to construct circuits and investigate how they work
- using results to draw conclusions.

Work in this unit also offers opportunities for children to relate their knowledge about electricity to everyday contexts and to recognise and take action to avoid hazards and risks to themselves.

This unit takes approximately 10 hours.

WHERE THE UNIT FITS IN

Builds on Unit 2F 'Using electricity'

Children need to:

- know the names of devices commonly used in simple circuits
- be able to name appliances at home and in school which use either mains electricity or batteries
- understand that a device will not work unless there is a complete circuit.

Links with Units 1D, 3C and 4C and design and technology.

VOCABULARY

In this unit children will have opportunities to use:

- words and phrases relating to electrical circuits *eg battery, bulb, buzzer, motor, break, electrical conductor, electrical insulator*
- names of types of material *eg metal, plastic*
- expressions used to make generalisations
- expressions for making suggestions using 'if', 'might', 'could'.

RESOURCES

- batteries of different voltages, wires, bulbs and/or buzzers
- video or other secondary sources to show hazards of mains electricity
- samples of materials that are good conductors of electricity and those which are insulators
- collection of plugs, wires, cables used in circuits in the home
- electrical devices with switches

EXPECTATIONS

at the end of this unit

most children will:

construct simple circuits and use them to test whether materials are electrical conductors or insulators and how switches work; relate knowledge about metals and non-metals to their use in electrical appliances and systematically investigate the effect of changing components in a circuit on the brightness of bulbs

some children will not have made so much progress and will:

construct a simple working circuit, and explain why some circuits work and others do not

some children will have

explain how they matched different components for a particular circuit and describe

progressed further and will also:

what may happen if the components are not matched

LEARNING OBJECTIVES

CHILDREN SHOULD LEARN

- that a circuit needs a power source
- that a complete circuit is needed for a device to work

POSSIBLE TEACHING ACTIVITIES

- ◆ Review earlier work on circuits. Ask children to look at drawings of circuits and decide and explain which will work and which will not. Ask children to make a circuit which will work, record it by drawing, and to annotate their drawings to indicate the purpose of each part *eg the battery provides the power/electricity.*

- that circuits powered by batteries can be used for investigation and experiment, appliances connected to the mains must not

- ◆ Show children a video of the dangers of mains electricity and discuss the differences between devices which can be run on batteries and those which require mains electricity.

- that some materials are better conductors of electricity than others
- how to find out which materials allow electricity to pass through them
- to use results to draw conclusions about which materials conduct electricity

- ◆ Ask children what materials are used to make electric circuits and ask them to suggest why this is. Ask children how they could test their ideas *eg by inserting different materials into a complete circuit with a bulb, motor or a buzzer and observing whether the device will still work.* Record which materials complete the circuit and which do not. Discuss results with children and ask them to make a generalisation about the type of materials which complete the circuit. Introduce the concepts of electrical conductors and insulators.

- that metals are good conductors of electricity, most other materials are not and that metals are used for cables and wires, plastics are used to cover wires and as covers for plugs and switches

- ◆ Ask children to explore *eg using secondary sources and a collection of plugs, wires and cables used in the home* the uses of metals and plastics in relation to their properties as electrical conductors and insulators. Record where conductors and where insulators are useful.

- that a switch can be used to make or break a circuit to turn things on or off (using both batteries or mains)

- ◆ Demonstrate switches on familiar devices (mains and battery driven) and how they can be used to turn the devices on and off. Ask children to make simple switches *eg from paper clips, foil, drawing pins* and incorporate them into circuits with bulbs or buzzers. Elicit children's ideas about the function of switches, *eg it saves electricity by letting you switch off the circuit*, and how switches work.

LEARNING OUTCOMES

CHILDREN

- explain why devices in some circuits shown in drawings will work but devices in other circuits will not *eg the switch is open so there is a break in the circuit and the bulb won't light*
- identify the purpose of components in a circuit

- record in simple terms the characteristics of devices using mains electricity *eg they are large and powerful, they need a lot of electricity*

- construct a circuit to test which materials let electricity pass through
- explain that with some materials the bulb did not light because the circuit was not complete
- make a generalisation about which materials did/did not conduct electricity *eg metals let electricity pass, plastics did not, metals are good conductors of electricity and plastics are not*

- explain that metals are used *eg for cables and wires* because they are good conductors and plastics *eg for plugs* because they are insulators

- construct a circuit in which a switch turns a specific device on or off
- explain how their switch works

POINTS TO NOTE

Children will not have studied electricity since Key Stage 1 and it may be appropriate to revise the vocabulary associated with electricity and aspects of safety.

The scientifically correct term for a single battery is a 'cell'. Teachers will need to decide whether it is appropriate to introduce this to children at this stage.

At the beginning of this unit it is appropriate to show circuits in drawings rather than in conventional circuit diagrams. Some children will need to have their concept of a circuit reinforced throughout this unit. Children will find it easier to understand how circuits work if they have a number of opportunities to construct circuits and to represent these in drawings.

 **SAFETY** – Warn children of the dangers of mains electricity. Emphasise that the work they do in class is safe because they use batteries which are much less harmful.

A water circuit in which water passes through transparent tubes and makes devices *eg turbines* work can be used as an analogy for an electric circuit.

Graphite (used as pencil lead) which is a form of carbon and a non-metal is a good conductor of electricity.

Children could be challenged to construct a game or model *eg a 'steady hand' game* which works by making and breaking circuits.

Although children are not expected to know the term 'voltage,' many will be familiar with it or with the term 'volts' through using battery-powered devices.

 **SAFETY** – Mains appliances, including those brought in from home, should only be used if they have been subject to an electrical supply check.

LEARNING OBJECTIVES

CHILDREN SHOULD LEARN

- to make predictions about the effect of including additional batteries in a circuit
- that care needs to be taken when components in a circuit are changed to ensure bulbs/motors do not burn out

- how to change the brightness of bulbs and speed of a motor in a circuit
- to make suggestions about what can be investigated and predictions about what will happen
- to plan to change one factor and keep others constant
- to make comparisons indicating whether the results support the prediction made

POSSIBLE TEACHING ACTIVITIES

- ◆ Demonstrate circuits where the bulbs are very bright. Ask children to predict what would happen if an additional battery is added. If possible demonstrate this. Point out to children that bulbs and motors are designed to be used with batteries of a particular voltage and that if the voltage is exceeded the device may burn out.
- ◆ Ask children to make a simple circuit and to suggest how they might change the brightness of the bulbs *eg by changing the number of bulbs, the type of bulb, the number of batteries, the voltage of the battery*. Ask them to plan what to do and what circuits they would use. Help them to recognise the importance of changing only one thing at a time.

Review work on electricity and ask children to make annotated drawings of circuits showing how to make bulbs light up brightly without burning out. Present children with drawings of circuits and ask them to decide whether each device in the circuit will work.

LEARNING OUTCOMES

CHILDREN

- describe what is likely to happen *eg it may be brighter but it may burn out*
- describe how device and battery should be matched *eg if it's a 1.5 volt bulb it needs a 1.5 volt battery*
- suggest a way of changing the brightness of a bulb and predict what will happen *eg if we use two bulbs it won't be as bright as with one; if we use two batteries the bulb will be brighter*
- compare circuits fairly by changing one factor at a time
- make comparisons *eg with two batteries the bulb is much brighter than with one but if we used three batteries the bulb might burn out; or when we used one bulb it was quite bright, with two bulbs it was dim and with three bulbs you could hardly see them* and decide whether the prediction was right

POINTS TO NOTE

Children sometimes think that when there are two bulbs in the circuit, the electricity will reach one bulb first and this will be brighter than the second because the bulb uses up the electricity. Some children think that electricity flows from both ends of the battery.

Teachers should try to ensure they match bulbs exactly so that two equivalent bulbs in a simple circuit are of equal brightness.

This activity offers children the opportunity to carry out a whole investigation. It may be helpful to concentrate on the aspects of investigation highlighted in the learning objectives.



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