5 Electrifying!

About this topic

Curriculum link: Year 6, Electricity

Topic summary: This topic builds on the Year 4 work on electricity, taking it into the scientific use of symbols for components in a circuit as well as considering the effect in more detail of changing components in a circuit. The children have the opportunity to apply their learning by creating an electronic game.

Units

5.1 Think like an electrician

5.2 All change

5.3 Build your own

Pupil video: 'Electrifying' (access on My Rising Stars)

Interactive activity: Electrifying! (My Rising Stars)

Activity resource book

Page 42: Circuit symbols

Page 43: Circuit diagrams

Page 44: Electrifying – Test

Did you know?

Fun facts to introduce the new topic. Challenge the children to find more.

- **Electricity can be generated when you rub a balloon on your hair or on a nylon jumper.**
- **Electricity travels at the speed of light – more than 300,000 km/second!**
- **A bolt of lightning can measure up to three million (3,000,000) volts and it lasts less than one second.**
- **Electricity can be made from wind, water, sunlight and even animal poo.**
- **A 600-megawatt natural gas plant can power 220,000 homes.**
- **The first power plant – owned by Thomas Edison – opened in New York City in 1882. He also invented more than 2000 new products, including almost everything needed for us to use electricity in our homes: switches, fuses, sockets and meters.**

Unit 5.1 Think like an electrician

Learning objectives

- To recall circuit symbols for a cell, battery, switch, motor and buzzer.
- To construct simple circuits using bulbs, motors, buzzers and switches.
- To recognise and explain what is needed for a circuit to work.
- To present findings and conclusions.

Success criteria

- I can make a circuit from a diagram.
- I can represent circuits with symbols.
- I can explain what is needed to make a bulb light.
- I can name some components in a circuit.
- I can correct faults in a circuit and explain how I did it.
- I can predict whether a circuit will work from a diagram.
- I can explain what the circuits I have used show.

Children might think...

- that a wire isn't a component.

Children already know...

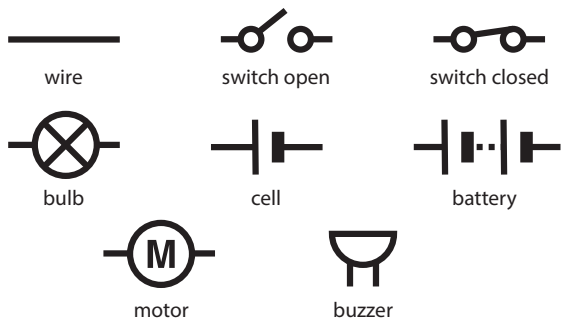
- that a complete circuit is required for a bulb to light.
- that batteries produce electricity.
- that some devices run off mains and some off batteries.
- that batteries have two ends.

Teacher knowledge

Before you start any work on circuits with the children, it is crucial that you test that all the batteries work, as well as the bulbs. A simple circuit will allow you to do this. Ensure you have plenty of spare batteries and bulbs handy as they do run out and blow respectively during lessons! Also ensure that the bulbs and batteries are rated correctly so the children don't blow too many or will not be able to see the light.

A circuit will only work if there are no gaps in it. A current will only pass around the circuit if it is complete. Any break in the circuit will reduce the current to zero throughout the whole circuit.

To make representation of circuits easier and clearer, symbols are used, such as these:



When getting the children to draw circuits, these should be completed with a ruler to make square circuits, rather than free-flowing wires. The positive end of the cell (single battery) is the longer line. A series of single batteries (cells) makes a 'battery'.

Cross-curricular lesson ideas

English: Set the children dictionary work on the meanings and derivation of names for electricity.

Mathematics: The children practise multiplication for voltage in a circuit related to the number of batteries.

Scientific language

Component: something that makes up part of a circuit such as a bulb or wire.

Cell: another name for a battery that supplies power to the circuit.

Complete: something that doesn't have any gaps in it.

Electrons: what makes up electricity: negatively charged particles.

Let's think like scientists

Use these questions to develop research skills and speaking and listening:

- **Michael Faraday made some of the first batteries and made frogs' legs twitch. What did he use and how are these similar to modern batteries?**
- **There are lots of other symbols used by electricians. What are they?**
- **There are some materials other than metals that conduct electricity. Can you find out what they are?**

Must-see topic websites

- www.kidsenergyzone.com/games/activitiesdetail63.cfm?activityid=8 is a game about changing bulbs and saving electricity and energy.
- www.primarygames.com/holidays/christmas/games/xmastreelightup/ light up the Christmas tree circuit game.
- www.bbc.co.uk/bitesize/ks2/science/physical_processes/electrical_circuits/read/1/ facts and information to support children on complete circuits and symbols.
- www.shiftingphases.com/2012/04/15/k-12-engineering-squishy-circuits-tips-and-tricks/ great for fun circuits, made with playdough.

Simple circuits

Quick challenges

- Place a range of components on a tray that the children will recognise from Year 4. Cover with a tea towel. Show the children the components, count to five and then cover them again. Can they say what was there? Take one away (without them seeing) and see if they can spot what is missing.
- Quick sorting activity for battery and mains operated objects to revise prior learning. Discuss the pros and cons of battery versus mains. Include safety in this discussion.

Main activities

Whole class learning: Draw a very convoluted circuit on the board. It should include three wires, two bulbs and two batteries in series, and make sure you mark the colours of the wires, but don't mark on the size or the direction of the batteries, other than visually (i.e. no numbers or + or – signs). Discuss whether the children think it will light the bulbs. Provide resources to make the circuit on the board.

Pair up: Set the children to make the circuit that you drew on the board. Can they follow it clearly? Is it easy to work out the different components? Discuss whether it lit up and which way round the batteries should be. Ask the children what they found difficult about trying to follow the drawing on the board.

Whole class learning: Explain that scientists all use symbols. Quickly draw your circuit on the board again with symbols. Can the children work out what the components are from the symbols, knowing what they know now?

Pair up: Provide the component pictures and the symbols on cards for the children to match, or as a matching exercise with drawing lines to join them (see Activity resource book, page 42).

Children can then make their own circuit and draw it using the symbols. They can use any components they like from the bag as long as they can draw the symbols and the circuit.

Pair up: Give the children whiteboards and a selection of circuit components. One member of the pair draws a circuit using symbols and the other must build it.

Class consolidation: Discuss whether there are any gaps in the diagrams that they have drawn. Should there be? If there is a gap, will it work? Put a series of circuits on the board for the children to make from symbols. Flash up the symbols on the board and ask children to call out the name of the component.

You will need

- Whiteboard or other for display
- Bag or electrical resources, e.g. 6 wires of different colours, 3 batteries (1.5 V), 1 battery (3V or similar), 3 bulbs, a buzzer, a motor, a switch, etc. for each group/pair
- Pack of symbols cards and pictures of components for each pair/group
- 'Circuit symbols' (Activity resource book, page 42)

Support and extend

- **Support:** Simplify the symbols for the children to identify to those that are commonly used.
- **Extend:** Provide some real charts for electricians. Can they see symbols on them that they recognise?

It's faulty

Quick challenges

- Revisit the symbols from last session with a quick quiz about what they mean. You can use the flashcards from the Activity resource book, page 42.
- Show some components and ask children to draw the symbols on whiteboards and hold them up.
- Look up what electricity is and where the word 'electron' comes from.

Main activities

Get into groups: Provide the children with bags of circuits to test their electrician problem-solving skills. Each group will need a bag with broken circuits to try, so the circuits could be set up as a circus. Explain that they will have to be systematic with how they test in order to work scientifically. The children will need to draw the broken circuit and to draw the correct one and explain how they fixed it.

Bags/circuits to fix would include:

- a simple circuit with a flat battery.
- a simple circuit with a broken bulb.
- a circuit with two batteries but one the wrong way round.
- a circuit with the wrong voltage bulb in, so it is not bright enough.
- a simple circuit with a wire not connected.
- a simple circuit with the bulb not screwed into the holder properly.
- a circuit with one battery and four bulbs.

Class consolidation: Go through the answers and the reasons for each solution, so the children know what was wrong and not only how to fix it, but why it worked.

You could also provide circuit diagrams with mistakes in for the children to solve the problems, or explain if they will work or not.

You will need

Circuits as listed above plus spares for the children to fix the circuits, e.g.:

- Simple circuit with a flat battery = flat battery, 1 bulb, 2 wires
- Simple circuit with a broken bulb = 1 battery, blown bulb, 2 wires
- One with two batteries but one the wrong way round = 2 batteries connected wrong way round, 2 wires, 1 bulb
- One with the wrong voltage bulb so it is not bright enough = 1.5V battery, 6V bulb, 2 wires
- Simple circuit with a wire not connected (or a broken wire) = 2 wires, 1 battery, 1 bulb
- Simple circuit with the bulb not screwed into the holder properly = bulb loose in holder, 2 wires, 1 battery
- One with one battery and four bulbs = 4 bulbs, 1 battery, 5 wires
- 'Circuit diagrams' (Activity resource book, page 43)

Support and extend

- **Support:** Provide some prompts for children, e.g. is it complete? Are all the components correctly joined, etc.?
- **Extend:** Provide motors or buzzers instead of bulbs in the circuits as it is harder to spot flat batteries.

Unit 5.2 All change

Learning objectives

- To recognise from a diagram whether a circuit will work.
- To represent circuits with symbols.
- To plan how to investigate an idea by managing variables.
- To change components in a circuit and explain the patterns of change produced.

Success criteria

- I can draw diagrams of circuits that others can make.
- I can change components in a circuit.
- I can plan an investigation that will produce useful evidence.
- I can design a circuit to test an idea.

Children might think...

- that if a bulb isn't working, it is a flat battery, but sometimes it is the voltage of the bulb compared to the battery that is wrong, or the blub that is blown.

Children already know...

- that batteries produce electricity.
- that an electric current passes through a circuit.
- that metals are good conductors.
- that a complete circuit is needed for the component in the circuit to work.

Teacher knowledge

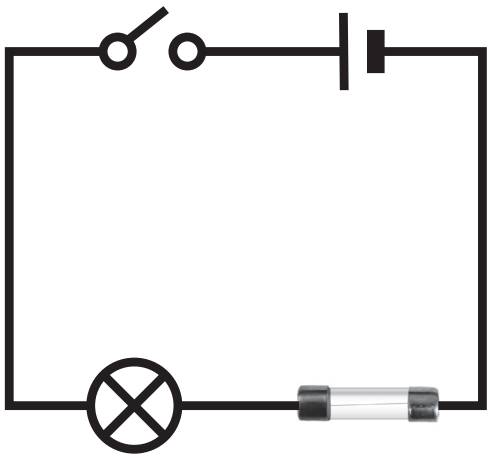
A fuse inside a plug contains a thin length of wire which is designed to melt if the current is too high. In normal use, a current passes because the wire is a conductor.

A number of fuses will be required for this activity. A few of the fuses should have blown.

Use 1A quick blow fuses as working fuses. Use 250mA quick blow fuses as the blown fuses. To melt the fuse wire, connect the fuse directly across the terminals of a battery. This will need to be done in advance.

Suggested circuit

The fuse blows because it has too much electricity going through it. As in Year 4, changing the components of a circuit changes how they respond. More batteries makes bulbs brighter, or blow, or motors turn faster; or turning batteries round makes them turn the other way. The children should explore these systematically.



Cross-curricular lesson ideas

Drama: Direct the children to role play being electricity in a wire.

Literacy: The children write a diary entry – a day in the life of electricity in a circuit.

Scientific language

Fuse: a safety device that will melt and make a break in a circuit if there is too much electricity.

Blow: what happens when a bulb has too much electricity going through it.

Filament: the very thin wire, like that in a fuse, that is inside a bulb.

Cell: a single battery.

Battery: a series of cells.

'Cell' and 'battery' are science terms, but everyday terminology has changed their meaning.

Let's think like scientists

Use these questions to develop research skills and speaking and listening:

- **Houses have 'fuse boards'. They used to have wire like in a normal fuse. How do they work now? (Don't play with these. Research only.)**
- **Why do you have different sized fuses?**
- **Do cars have fuses? Why?**

Must-see topic websites

- www.bbc.co.uk/schools/scienceclips/ages/10_11/changing_circuits_fs.shtml a game about changing circuits.
- www.nuffieldfoundation.org/practical-physics/how-fuses-work shows a circuit to be able to test fuse wire.

Blow!

Quick challenges

- Show a video of making a piece of fuse wire blow. Discuss what is happening to make it melt.
- Demonstrate what is inside a plug – go through safety that children should not do this at home. Show them where the fuse is.

Main activities

Whole class learning: Show children a table lamp or similar device that does not work when plugged in and switched on. Tell them you think the fuse in the plug has melted (blown). Ask children to design a circuit that would test whether or not the fuse has melted.

Pair up: The children then draw the circuit using circuit symbols and test a number of cartridge fuses to find out which have blown. They should note the numbers of each of the fuses and record whether the fuse works or has melted. www.furryelephant.com/player.php?subject=physics&jumpTo=ee/10Ms63 has a game for this

Whole class learning: Show the children the thickness of some fuse wire. Predict which one will melt first and try to explain why. You could do some drama about this to explain why the wire gets hot and then glows, and melts. Also helps to explain how the fuse works by making a break in the circuit.

Pair up: Show the children an oversized bulb and look at the filament inside. What does it remind them of? What happens if you turn it on? Why does it glow? What will happen if there is too much electricity?

Get into groups/class consolidation: Children produce a drama or play to show how electricity in a circuit behaves, i.e. flowing round it, making a bulb light up and what happens if the fuse breaks or the bulb blows.

You will need

- 1.5 V batteries
- 1.25 V bulbs in holders
- Switches
- Leads
- Connectors
- Selection of numbered fuses, some blown, some not
- A table lamp or similar that doesn't work

Support and extend

- **Support:** You may need to help the children with ideas for the drama.
- **Extend:** Higher attaining children present their drama to the class with explanations.

How bright?

Quick challenges

- Remind children of the investigation they performed in Year 4 about the brightness of bulbs. They either changed the number of cells or the number of bulbs in a circuit – use a quick demonstration of the circuit to remind them. Ask them what happened when the number of bulbs increased.
- Show a picture of an underground train. Explain that the train uses electricity to drive motors. Ask for suggestions as to how the speed of the train can be changed.

Main activities

Whole class learning: Start by asking the children about how to make bulbs brighter and how to be scientific about it. Model a very unfair test, changing batteries, wires and bulbs 'willy nilly' and then say that you can't see how to tell which is the brightest. Discuss how to be scientific about the way of testing. Also, how will they measure the brightness of the bulb? If you have dataloggers these could be used, or devise a way of seeing through a certain number of pieces of paper. The children may have their own ideas.

Get into groups: The children work in small groups to plan how they will investigate what happens to a bulb, a motor and a buzzer if the voltage is increased. Remind them that the proper name for one battery is a cell and each cell has a voltage of 1.5 V. Ask what voltages can be obtained from up to five cells.

When they have planned their investigation, the children should draw circuit diagrams of the circuits they will use and carry out their investigation. They should also consider how best to present their results, e.g. bar chart, table, line graph, photographs, etc.

Class consolidation: The children share what they have found out and the way they chose to present the data.

You will need

- Batteries
- Bulbs
- Buzzers
- Motors
- Wires
- Paper and pencils or pens

Support and extend

- **Support:** Provide pre-drawn tables for recording data, or off a crib sheet with ideas on how to measure brightness, or motor speed (sticking a strip of paper across the motor to make the blades longer and easier to see rotating and count the rotations – easier than bulbs).
- **Extend:** The children draw line graphs of the their results independently.

Unit 5.3 Build your own

Learning objectives

- To design and build a circuit that matches a design brief.
- To explain how the circuit works in detail.
- To represent circuits scientifically.
- To consider the impact of various ways of making electricity on the environment.
- To consider alternative forms of electricity production.
- To use results to make predictions and suggest further tests to conduct.

Success criteria

- I can design my own product from a brief.
- I can evaluate how well my product works.
- I can explain how it works with scientific language and effectively presented data.
- I can explain how alternative forms of energy could help save our planet.
- I can research to find out information.

Children might think...

- that electricity is always best from renewable sources.
- that solar power is only from the Sun.

Children already know...

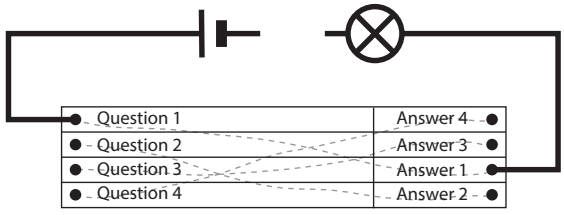
- that a complete circuit is needed for a device to work.
- that increasing batteries increases the output of components in a circuit.
- that components need to be matched to ensure the best output.

Teacher knowledge

There are some very simple activities that the children can use to apply their learning. The simplest games, in the first section, are focused on completing a circuit by correctly locating two points on a board.

The children will need to consider what they need to use for the conduction of the electricity – cooking foil works well as it can be flexible but thin, and shows up less than extra wires on the back of card.

There are several game formats that the children can use, such as question and answer activities, and matching activities. One possible design would be to glue the template onto the lid of an A4 paper box. Push paper fasteners through the outer end of each question and answer box. Link the question to the correct answer underneath the box lid with solid copper core wire. The rest of the circuit contains a 1.5 V cell, a bulb and leads with flying ends to touch onto the paper fasteners, such as below:



Many games rely on a steady hand to join up two correct points, but there are others that the children may know or can research online.

Cross-curricular lesson ideas

Numeracy: The children solve equations involving brackets and powers.

Literacy: Ask the children to write a definition of common grammatical terms.

Other: There is an opportunity for children to make up questions and provide answers about any topic within any subject area.

Scientific language

Renewable: can be used again or generated again.

Solar: generated from light.

Let's think like scientists

Use these questions to develop research skills and speaking and listening:

- **There are petitions (documents signed by lots of people) who think that wind farms are an 'eye-sore'. Are they right?**
- **Solar panels are put onto people's houses and even on school roofs – you may have some! What do they do?**
- **Why are solar panels on roofs?**
- **How can you generate electricity from wave power? Would you go swimming there?**

Must-see topic websites

- www.kids.esdb.bg/newenergy.html has information for children to research renewable energy sources.
- www.alliantenergykids.com/EnergyandTheEnvironment/RenewableEnergy/ has some useful definitions and further information.
- www.childrensuniversity.manchester.ac.uk/interactives/science/energy/renewable/ is a great website that has some exhibits as well as information on where we get electricity from.

Games galore

Quick challenges

- Show the children pictures of some question and answer games that they may have seen or played. Explain how each game is played. Ask them how they think electricity plays a part in the game.
- Provide some electronic games for the children to explore, e.g. operation, steady hand games.

Main activities

Whole class learning: Ask the children how they think the games they have tried work and whether they can see where the electricity they have been using so far comes into this. If necessary, show the workings of some games, such as the matching game and how the steady hand game works.

A great video which shows you various games that the children can choose from is: http://www.bbc.co.uk/education/clips/z7k3cdm. Have the children discuss what they have seen and start to brainstorm their own ideas and how they might do it. They might choose from a matching answer game, a steady hand game or a game, like the clown game, where a picture is used and part of it acts as a switch to create a noise or light a bulb. This is an opportunity for the children to be very creative and design and plan their own game for their friends to play.

As a class, produce a point-scoring system on the games so they can be peer assessed, e.g. quality of questions, how hard/easy it is to do, how well it is made, originality of design, etc.

Get into groups: The children decide on the game they would like to design, draw their circuit diagram and come up with questions if they need to and make the game.

Class consolidation: They then let others test their games and report on how good they are, using the criteria decided on previously.

You will need

- Buzzers
- Wire
- Bulbs
- Batteries
- Switches
- Card
- Foil
- Crocodile clips

Support and extend

- **Support:** Provide some examples of games and some diagrams so the children can work from these to make their own.
- **Extend:** Challenge the children to make something you or other teachers will find hard to answer – they may need to research questions if they go down this route, or make a very tough steady hand game!

It's all new

Quick challenges

- Show a range of renewable sources of energy and see if the children can name them.
- Demonstrate a solar panel making a motor rotate. Is it magic?
- Show the meter readings for the school and do some simple maths to work out how much it costs to run the lights in the school. How much pocket money is that equivalent to?

Main activities

Whole class learning: How can we save electricity? What should we do? Discuss turning off lights and powering down devices not being used. But what about changing the electricity supply? Is it better to have renewable sources? What does this mean?

Get into groups: Groups research a type of renewable power for electricity and present their findings of how it works to the rest of the class. They will need to include pros and cons as well as now much we use it already.

Alternatively, the groups can research and survey the amount of electricity being used in school and how much it costs. This last session is an opportunity for children to use their 'working scientifically' skills to review real-life information. There is lots of information about solar farms being set up in rural counties, e.g. Shropshire (www.shropshirestar.com/news/2013/09/30/giant-solar-farm-plan-near-shrewsbury/). The children can find newspaper articles or reports and create their own based on an imaginary scenario where their school swaps electricity for renewable energy.

You will need

- Access to computers

Support and extend

- **Support:** The children look at types of renewable energy and what is being used in their area. Can they write or video a news report to showcase the use of renewable energy in the area?
- **Extend:** The children write a story or newspaper article set in the future. Electricity has run out completely and people are looking for the best renewable energy to use. They make a case for one of the types of energy and how it would make a difference to life in the future and what it can be used for.

Assess the topic

Now you have reached the end of the 'Electrifying!' topic. Use the statements below to assess the children in your class. Assess them further with the 'Electrifying!' topic test (see Activity resource book, page 44).

Some children can...

- interpret more complex circuit diagrams.
- describe the differences between wires usually used for circuits and fuse wires.
- design games and activities independently.
- explain clearly and scientifically what has been learned.

Most children can...

- suggest ways of changing the brightness of a bulb in a circuit.
- draw circuit diagrams and construct circuits from diagrams using conventional symbols.
- set up a circuit which can be used to investigate an idea.
- use knowledge about electrical conductors and insulators to answer questions about circuits.
- represent information about circuits clearly and scientifically with symbols.

All children can...

- recognise symbols for some electrical components.
- construct some working circuits with specified components.