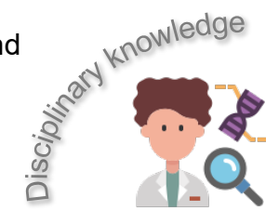
Science | Year 6 | Electricity

Working Scientifically

During years 5 and 6, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.
- taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
- recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
- using test results to make predictions to set up further comparative and fair tests
- reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and a degree of trust in results, in oral and written forms such as displays and other presentations
- identifying scientific evidence that has been used to support or refute ideas or arguments.



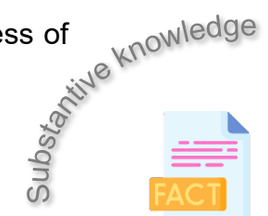
Big Ideas

9 **Energy makes things happen and can be seen by its effects (light, sound, electricity); it can be transferred but is not used up**

National Curriculum Objectives

Pupils should be taught to:

- Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit.
- Compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches.
- Use recognised symbols when representing a simple circuit in a diagram.



Links To Prior Learning

Electricity - this unit builds on pupils' knowledge and understanding from Year 4 where they will have already:

- identified common appliances that run on electricity
- constructed a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers
- identified whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery
- recognised that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit
- recognised some common conductors and insulators, and associate metals with being good conductors

Pupils should also know the basics of electrical safety and this knowledge will be revisited during the unit.

Vocabulary: series circuit, cell, battery, wire, bulb, switch, buzzer, electrical conductor, electrical insulator, mains electricity, electrical energy

Common Misconceptions

! **Electricity is a substance.** Some pupils may think that electricity could leak out of a broken circuit.

! **Mains electricity does not flow in a circuit.** It does but the wires are not immediately visible or encased in a single cable.

! **A switch must be placed before a component in an electrical circuit to work.** A switch can be placed anywhere in a circuit.

! **The more cells (batteries) used in a circuit, the brighter the lamp or louder the buzzer will be.** Brightness or volume depends on factors like the type of bulb or buzzer, resistance in the circuit, and not solely on the number or voltage of cells.

! **All components of a circuit, such as bulbs and buzzers, should function the same way regardless of variations in the circuit.** Variations in component function can result from factors like resistance, the type of component, and the arrangement of the circuit.

! **Any symbols can be used in a circuit diagram**. There are standardised symbols for components in circuit diagrams. Using recognised symbols ensures clear communication and understanding.

These misconceptions should have already been addressed in the Year 4 unit on electricity, but it would be worthwhile to check that pupils' have remembered this.

Building component knowledge - **Electricity**

How can we represent a simple circuit in a diagram? → How does the number of batteries affect the brightness of the bulb? → What else impacts the brightness of a bulb in a circuit? → What can effect the function of a component in a circuit? → How can I use my knowledge of electrical components to make a device?

Electricity – Unit Preparation

Suggested Significant People

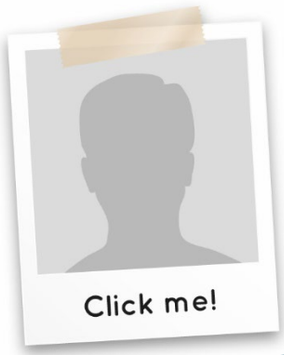
Beyond living memory…

Nikola Tesla (1856-1943)

Serbian inventor famous for contributions to the AC electricity supply system

Within living memory…

M.Stanley Whittingham (1941-present)



British chemist & Nobel Prize winner for the evolution of the lithium-ion battery

Possible Enrichment Opportunities

Inside the classroom

- STEM offers lots of freely available practical ideas for extending learning inside the classroom.
- Share research journals: kids.frontiersin.org / Science Journal for Kids

Out and about – the local area

- Using the 'Design for a Better World' from Practical Action resource pack available on STEM, pupils could lead a project focusing on Global Goal 7: affordable and clean energy.

Out and about – further afield

- Arrange to Visit a nuclear power station | EDF (edfenergy.com) or alternatively a renewable energy site such as a wind or solar farm through General 2 — Earth Energy Education. This could prompt a debate or project on the importance of renewable energy and climate change.

Vocabulary

Tier 2: symbol, device

Tier 3: series circuit, cell, battery, component, voltage

Disciplinary (*non-statutory*)**:** causal relationship, classification key, comparative test, conclusion, *control,* diagram, enquiry, *equipment,* evidence to support/refute, fair test, graph (scatter/bar/line), *information-record, measurement, observation, pattern,* prediction, repeat reading, *research,* results, *secondary source,* table, variable

Resources

Enquiry 1: components to make a simple circuit, including bulb, buzzer and motor, electrical symbol cards.

Enquiry 2: components to make a simple circuit (preferably enough for one set of equipment per pair), data logger.

Enquiry 3: as above.

Enquiry 4: components to make a simple circuit, copies of circuit diagrams to support pupils to record into their books.

Enquiry 5: components to make a simple circuit, junk modelling materials (cardboard tubes, tape etc), coloured acetate for traffic lights.

Reading List

'Disciplinary Literacy'

How It Works: Electricity - Victoria Williams and Miguel Bustos

Investigating Electricity - Jacqui Bailey

DKfindout! Energy - DK

Electricity: Let's Investigate - Ruth Owen and Victoria Dobney

Electricity - Peter Riley

Electric Circuits for kids 8-12: Electricity Book for Kids - BOOKSGEEK

Electric Circuits For Kids: Simple Projects And Activities - Ian Crawford

Cool Circuits and Wicked Wires: Special, Sparky Experiments - Susan Martineau

Awesome Electronics Projects for Kids - Colby Tofel-Grehl

Inventor Lab: Awesome Builds for Smart Makers - DK

Enquiry 1

How can we represent a simple circuit in a diagram?

Why this? Why now?

In Y4, pupils will have already learnt how to light a bulb or sound a buzzer in a simple circuit using a battery and wires. This first inquiry revisits this, introducing a motor, and teaches pupils the symbols and diagrammatic representations that are commonly used when recording an electric circuit. This will form the foundation for the subsequent scientific inquiries into variations in how components function and the effect of adding more than one component into a circuit.

Substantive Knowledge

- Know the symbols and the conventions that are used to represent the components.
- Know how to organise a working electric circuit and how to draw a circuit diagram using them.

Disciplinary Knowledge

- Create circuits of increasing complexity and represent them using diagrams, annotated with scientific diagrams and labels.
- *Know how scientists have developed ideas over time and improved efficiency (Nikolas Tesla).*
- *Understand why scientists use symbols i.e. international understanding, efficiency*

Vocabulary: series circuit, cell, battery, symbol, component (wire, bulb, switch, buzzer, motor)

Resources: components to make a simple circuit, including bulb, buzzer and motor, electrical symbol cards

Lesson outline

Recap prior learning by asking pupils to quickly name several appliances that use electricity. Remind pupils that they would have covered electrical safety in Y4. Take time to emphasise:

- the dangers of mains electricity.
- never putting implements in sockets or implements into toasters.
- keeping sockets switched off.
- water and electricity don't mix (can pupils think of examples to be careful off – mugs near computers). Not taking appliances into the bathroom.

Tell pupils that the work this term uses batteries rather than mains electricity. Cells in batteries convert chemical energy to electrical energy.

Give pupils the components to make a simple series circuit, including a motor and ask them (in pairs) to either light the bulb, start the motor or sound the buzzer.

✎ Ask pupils to make and explain the circuit to their partner. Circulate around the room, correcting any misconceptions. Model a correct explanation, emphasising any common misconceptions.

Did you know… that Serbian-American inventor, **Nikolas Tesla** discovered that electrical machines work better using an alternative current. This means that the flow of electricity reverses back and forth. His AC system was in the 'war of the currents' with his old boss Thomas Edison's direct current (DC) system, where the electricity flowed only in one direction.

Watch this short video (up to 5:05) https://youtu.be/mvyJrY1ZmLY which provides a short biography of Tesla's early life and later achievements. Make the connection with the achievements of Thomas Edison who was introduced in Year 3.

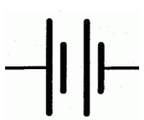
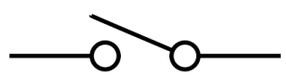
Explain that electricity flows round the **circuit** (emphasise the names of each of the **components**, including the word **series circuit** to describe the circuit they have made). Emphasise the fact that electrical energy is stored in the **battery** and once the circuit is complete, electricity flows and the bulb lights up or the buzzer sounds or the motor turns.

Summarise this into the following **little idea**:

A circuit will always have a **battery** (cell) as well as other components. Components such as **bulbs, buzzers, switches** and **motors**, need a battery in order to work.

Ask pupils what the electrical energy is converted to in the motor (movement). Remind pupils about the electrical conversions in bulbs and buzzers. Ask them what electrical energy is converted to in a kettle or an iron (heat).

Tell pupils that over time various scientists developed faster and more accurate way to record an electric circuit. Show pupils the symbols for each component. **Discuss the difference between the cell and the battery**.

 **Battery**	 **Cell**	 **Switch**
 **Bulb**	 **Motor**	 **Buzzer**

Share the following little idea:

When drawing **circuit diagrams**, rather than drawing detailed **components**, we use simple **symbols** to represent the different components.

If using sets of cards, pupils can test each other with the cards. Otherwise show randomly on an IWB and ask pupils to write down what they are and ask them to draw the symbols when you read out the names. Ensure pupils have quick practice both naming and drawing the symbols.

Construct a simple, series circuit using components (under a visualiser). Demonstrate how this is drawn as a circuit diagram. Use the correct conventions for drawing a circuit and emphasise these.

- Simple, series circuits are usually drawn as an oblong.
- Wires in a circuit are drawn as straight lines and not crossing.
- Components are drawn correctly as symbols in the circuit.
- There are no gaps in the circuit.

Construct a different circuit. Ask pupils to draw the circuit diagram. This can be practised by pupils making circuits for their partner to draw in their book as a diagram.

Circulate to pick up misconceptions and revisit these showing the correct representation on the board.

Reinforce learning from this lesson so that pupils know how to **use recognised symbols when representing a simple circuit in a diagram –**

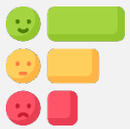
Pupils should independently answer the enquiry question from the session in their science books – **How can we represent a simple circuit in a diagram?** – this should be a written paragraph (to demonstrate disciplinary writing) and may include supporting diagrams.

Finish the lesson by revisiting the **little ideas** – pupils could use this to add any missing information (preferably in a different colour) to their recorded answers for the enquiry question (see above):

A circuit will always have a **battery** (cell) as well as other components. Components such as **bulbs, buzzers, switches** and **motors**, need a battery in order to work.

When drawing **circuit diagrams**, rather than drawing detailed **components**, we use simple **symbols** to represent the different components.

If time allows, allow pupils (as a class or individually) to complete a short quiz such as 'Activity 2: Circuit Symbols Quiz' available on Circuit symbols - BBC Bitesize



Ready to progress?

☑ Can pupils draw an accurate circuit diagram using the appropriate electrical component symbols?
☑ Are pupils able to build a simple working electrical circuit using given components?

Enquiry 2

How Does the Number of Batteries Effect the Brightness of the Bulb?

Why this? Why now?

In this inquiry, pupils will build on their understanding of a simple, series circuit and carry out a supported fair test to find out how the brightness of a bulb (or volume of a buzzer) is impacted by the number (and voltage) of cells used in the circuit. **The discussion should centre on making the test as accurate as possible.**

Substantive Knowledge

- Know the brightness of a bulb (or the volume of a buzzer) is associated with the number and voltage of cells used in the circuit.

Disciplinary Knowledge

- Recognise which variable to control in a fair test and carry out a fair test to see how the number of cells in a circuit affects the brightness.
- Consider the reliability of results.
- Understand why scientists often repeat readings to increase the accuracy and precision of their results.
- Use a data logger to measure the brightness of a bulb. Create a scale to compare according to brightness.
- Reflect on accuracy of measuring methods.
- Record and represent findings, including drawing conclusions.

Vocabulary: battery, cell, voltage, variable, control, fair test, accuracy

Resources: components to make a simple circuit (preferably enough for one set of equipment per pair), data logger

Lesson outline

Teacher Preparation Note

Ensure that all components are working, particularly batteries.
Purchase bulbs (lamps) that have been designed for different voltages. For some investigations the children will easily 'blow' bulbs designed for low voltages. Whereas bulbs designed for say 6 Volts will enable the children to place many cells together (until around 7.5V).

Recap previous learning by practising naming and drawing electrical symbols learnt in the previous lesson. This can be either with sets of cards or on whiteboards. Ask pupils if they can remember the difference between a **cell** and a **battery;** introduce them to the measurement of **voltage.**