Mendell Primary School

Aspire Challenge Achieve

Medium Term Plan Science

Year Group: 6	Term: Autumn 1 Teacher: Sarah Wearing / Dionne Sinatti	Subject lead: Sarah Bride

Common Misconceptions:

Some children may think:

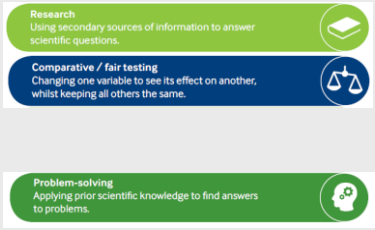
- larger-sized batteries make bulbs brighter
- a complete circuit uses up electricity
- components in a circuit that are closer to the battery get more electricity.

Unit key Vocabulary:

Circuit, complete circuit, circuit diagram, circuit symbol, cell, battery, bulb, buzzer, motor, switch, voltage N.B. Children do not need to understand what voltage is, but will use volts and voltage to describe different batteries. The words "cells" and "batteries" are now used interchangeably

Overview: Electricity

- 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



Key End Points: By the end of this unit children will be able to:

- Explain that electrons have a negative charge and protons have a positive charge
- Explain where electricity comes from and different ways in which electricity can be generated
- Identify and name the basic parts of a simple electric circuit (cells, wires, bulbs, switches, batteries)
- Explain the difference between a series and a parallel circuit
- Draw and construct working circuits
- Recognise symbols for various common circuit components
- Describe the function of electrical components and match them to their symbols
- Explain the effect of changing the number and voltage of cells in an electrical circuit
- Explain how the brightness of a bulb can be altered by changing the wires and or circuit
- Explain why an electrical appliance might blow if the voltage is too high

Links to other learning:

DT

Prior Learning:

- Identify common appliances that run on electricity. (Y4 - Electricity)
- Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers. (Y4 - Electricity)
- Identify 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. (Y4 - Electricity)
- Recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit. (Y4 - Electricity)
- Recognise some common conductors and insulators, and associate metals with being good conductors. (Y4 - Electricity)

Scientists studied - Thales of Miletus, William Gilbert, Benjamin Franklin, Michael Faraday, Lewis Howard Latimer and Mildred S Dresselhaus

Future Learning:

- Electric current, measured in amperes, in circuits, series and parallel circuits, currents add where branches meet and current as flow of charge. (KS3)
- Potential difference, measured in volts, battery and bulb ratings; resistance, measured in ohms, as the ratio of potential difference (p.d.) to current. (KS3)
- Differences in resistance between conducting and insulating components (quantitative). (KS3)
- Static electricity. (KS3)

High Quality Text:

Goodnight Mr Tom - There are opportunities for children to also explore the relationship between the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit, switches and use recognised symbols when representing a simple circuit in a diagram. **Alternative text suggestions:** Blackout- John Rocco, Hitler's Canary – Sandi Toksvig

Scientist to study:

Maria Telkes, Michael Faraday, Charles F Brush, Olga Gonzalez-Sanabria, Esther Sans Takeuchi

Risk Assessment:

http://primary.cleapss.org.uk/Resource/P017-Batteries-for-practical-circuit-work.aspx

Health and Safety. Ensure that at this early stage a discussion is held about the safety aspects of learning with electricity. Point out that they will not be using mains electricity. The following video will help - http://www.bbc.co.uk/learningzone/clips/the-dangers-of-electricity/1646.html

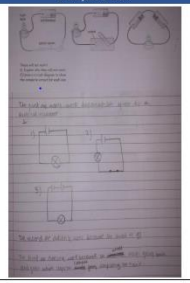
When handling electrical components, children should be aware of breakable bulbs, bulbs that do not match the battery voltage and short circuits.

Teacher CPD:

Reach Out CPD - https://www.reachoutcpd.com/ sign up for free.

ASE Plan Julie work.

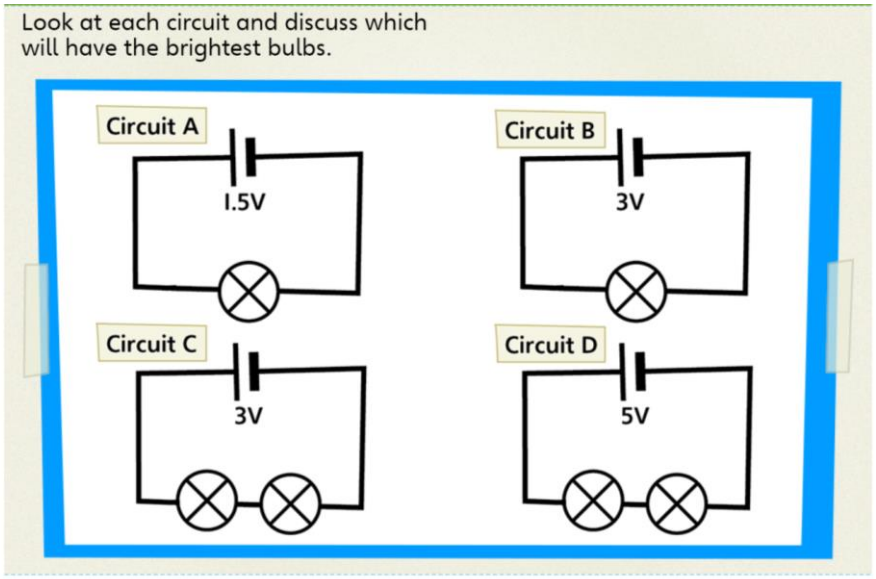
	Learning Intention	Lesson Outline (Key Questions in colour)	Resources	Vocabulary	Lowest 20% Adaptations
1	L.I. I can research electricity and understand ways it can be generated. 	**This is a Science lesson. In Science, we study nature and the behaviour of natural things. The skill we will be using this lesson is researching and asking questions.** **Recap: What is electricity? How do we use it?** - assess children's knowledge and understanding using the prior learning info above ask children to record in a min map for pre assessment - return to this in lesson 6 to annotate what they now know. **Word of the week**: Electricity - is a flow of charged particles. Show children the key vocab list and ask them to colour code it following the instructions. Can they give definitions to their green words? This will be repeated again in the last lesson to show progression. To develop the children's chronology of electricity play the timeline game on Ogden Trust Website; https://www.ogdentrust.com/resources/timeline-card-sort-game-electrical-inventions **Big Question**: **How can electricity be generated?** Gather ideas from the children following discussions. How many ways can they identify? – wind, solar, water/waves, coal, nuclear. Share the generation of electricity timeline and allow the children time to discuss the information provided. Show the Michael Faraday PowerPoint and allow the children to discuss the importance of his work and wind turbines today. . Explain to the children that they will be working in small groups to research different ways of generating electricity and how this has developed from work in the past up to present day. children will create a mind map to answer the big question - How can electricity be generated? Possible research links: https://www.theschoolrun.com/homework-help/electricity-and-power-generation&:~:text=Electricity%20can%20be%20generated%20using,to%20save%20what%20we%20can. https://www.bbc.co.uk/teach/class-clips-video/primary-science-how-is-electricity-made/zfhfgwx https://www.twinkl.co.uk/teaching-wiki/electricity	Ogden Trust sorting game PowerPoint Paper, paperclip, straw Key vocab list.	**Renewable energy, electricity, generated.**	
2	L.I. I can identify and use correct symbols for a circuit diagram. 	**This is a Science lesson. In Science, we study nature and the behaviour of natural things. The skill we will be using this lesson is making predictions and observing.** **Explorify starter:** Odd One Out – Take Your Turn – https://explorify.uk/en/activities/odd-one-out/take-your-turn - renewable energy link to first lesson. **Word of the week** – circuit diagram. Year 4-recap activity prior learning: Organise children into small groups, giving each group a tray of electrical components including some that they won't need for the activity. Include batteries (cells), bulbs, bulb holders, wires, switches, buzzers and motors. **What will you need to construct a circuit that makes the bulb light?** Children draw a circuit that would make a bulb light. **Big question: How do we draw circuits correctly?** Compare drawings as a class to demonstrate that although the circuits may have the same components, they all look slightly different. **Why might this be a problem if you were a scientist, engineer or electrician?** (They could make a mistake and think that a buzzer was a bulb, etc.) Explain that we use standard symbols to avoid confusion and to help us build circuits quickly. **Where have you seen symbols used before?** (E.g. on road signs and maps.) Watch; https://www.bbc.co.uk/bitesize/topics/zq99q6f/articles/zs7g4j6	Trays; paper; sticky notes; blue pens; batteries (cells) of different voltage; wires; crocodile clips; bulbs compatible with different voltages; bulb holders; buzzers; bells; motors; different types of switch.	**Circuit, complete circuit, circuit diagram, circuit symbol, cell, battery, bulb, buzzer, motor, switch**	

		Show the children the electrical symbols and the component that they stand for. Provide each pair of children with symbol cards; symbols on one side and the picture of the component and word on the other side. The children can test each other – quiz quiz trade style. In addition, the teacher could call out a particular component and the children must draw the symbol on a white board and then hold it up. Using these as reference, children redraw their circuits on the right hand side of their paper. When completed, swap drawings and test each other's circuits by constructing them to check if the bulb lights up. **Did you have any difficulties getting the bulb to light up?** Share the variety of faults that occurred. **How did you solve them?** In groups, children record faults that would stop a circuit from working on sticky notes (e.g. loose connections, flat batteries or broken components). Underneath each fault, children record a possible remedy. Use the sticky notes to create a 'Fault finder' poster matching up faults with their remedies. Add any they have missed using fault finder resource. (Note that this is a teacher-facing worksheet and should not be handed out to the class.) Explain that like electricians, children can use their poster as a reference to help solve any problems they encounter throughout the unit. Show children two circuits. (One that will make a bulb switch on/off and one that will make a buzzer sound.) In groups, children describe what they think each circuit will do. They then make the circuits to test their suggestions. In pairs, children draw a circuit diagram that will switch a buzzer on and off. They swap with other pairs who comment on any mistakes that they think have been made in the circuits, noting them on the sheets. **CH:** Children draw diagrams for more complex circuits including multiple components such as more than one bulb, or including a buzzer and a bulb, etc. **Exit Pass:** The children were given further pictorial diagrams and asked to predict whether the circuits would work or not, based on their knowledge from Year 4. They were then also asked to draw circuit diagrams for each of the circuits corrected to make them work. **Evidence of Learning** Oral evidence Examples of work  **Assessment** Knowledge Julie uses her subject knowledge from Year 4 to correctly predict which circuits would or would not work, giving reasons why. She draws the circuit diagrams, although the incorrect symbol for the switch is used (see note on page 3). Teacher observations Julie is using the terms 'cathode' and 'anode' for the terminals of the battery (beyond Key Stage 2) to explain why circuit 3 does not work. Working scientifically			
3	L.I. I can associate the brightness of a bulb with the number of	**This is a Science lesson. In Science, we study nature and the behaviour of natural things.The skill we will be using this lesson is setting up tests and communicating results.** **Word of the week** – cell Recap: Organise children into groups and give them a tray of electrical components and play a game where children match each symbol with the real components in front of them. The power of a battery (wider picture of how batteries are used): allow children time to research the following female scientists who have enhanced the use of batteries in different ways. **Olga Gonzalez-Sanabria-** González-Sanabria was part of the team that developed the long cycle-life nickel-hydrogen	Batteries (cells) of different voltages (1.5V, 3V, 4.5V, 6V); battery holders; wires; crocodile clips; bulbs compatible with battery voltage; bulb holders; a switch,	**Circuit, complete circuit, circuit diagram, circuit symbol, cell, battery, bulb, buzzer, motor,**	

	bulbs in a circuit.	batteries that first powered the electricity on the International Space Station. **Esther Sans Takeuchi -** In the mid-1980s, Takeuchi took on the challenge of increasing the power of batteries used to power implantable cardiac defibrillators. Big question: **How can we change the brightness of a bulb?** Word of the week: voltage. Discuss and explore meaning. Display the concept cartoon for the children and allow for discussion time, take feedback from the children as to which child/children they think are correct. Using post it notes ask the children to predict who they think are right/wrong. Following discussions tell the children we will be gathering evidence to support or refute the statements.  Now explain that children are going to investigate whether there is a link between the brightness of a bulb and the number of bulbs in the circuit. Get the children to construct a simple circuit using a switch with one bulb. Remind them that if they have problems getting bulbs to light, they can use their 'Fault finder' poster to help solve the problem. Once children have made a circuit with a bulb that they can switch on and off, tell them they are going to gradually increase the number of bulbs in the circuit by adding a bulb at a time and recording any changes to the brightness of the original bulb. Groups conduct their investigations. The experimental method is left up to each group, but they will need to record their predictions, method and results to be able to share their findings with the rest of the class. Circulate to probe understanding and suggest any changes needed to experimental methods. Reinforce correct circuit symbols when drawing the circuits they create. Discuss as a class the children's findings – can the children explain what their results show them. What does this tell them about how electricity behaves in a circuit.		**switch, voltage**	

		Exit pass; In pairs, children come up with a suggestion about how electricity lights a bulb. Children use their understanding about the way electricity works to explain the effects they saw when they changed the number of bulbs in a circuit.			
4	L.I. I can associate the brightness of a bulb with the number and voltage of cells used in the circuit. 	**This is a Science lesson. In Science, we study nature and the behaviour of natural things.The skill we will be using this lesson is setting up tests and communicating results.** **Recap prior learning: say a circuit component and ask the children to draw the correct symbol.** Provide small groups of children with some suggested statements about why we might take repeated measurements in an investigation. They must first decide which ones are incorrect, and place these to one side. They could then decide if any of the remaining statements are more important than others. Statements could include: Correct ones: ● Because the first reading might not be right ● Because readings can be different ● Because things might be a little different, so we will need an average ● Because we need to check our results ● Because we need more evidence Incorrect ones: ● Because we need to make the test fair ● Because we need to measure accurately ● Because we need to all have a go **Can you think of another way to change the brightness of the bulb?** If necessary, draw children's attention to the battery (cell) and the voltage marked on it. Give each group a selection of different batteries with different voltages of up to 6 volts. Explain that you want them to explore the relationship between batteries and the brightness of bulbs. **Big Question: How will the number of batteries (amounts of Volts) affect the brightness of the bulb?** **Recording** The children could write the question, and with the support of the teacher, record what is being changed (number of batteries) and what is being observed (the brightness of the bulb). **Fair-testing**. Discuss with the children how they will keep their tests fair – i.e. keep the same components each time; only changing the number of batteries. **Observing the dependent variable**. Discuss with the children how they will 'measure' how bright the bulb is each time. They could decide to invent their own scale; i.e. very dull, dull, bright, very bright. They could decide to make a separate circuit using just one battery against which they will compare their test circuit. Finally they might choose to use a data-logger to measure the brightness of the bulb in lux. If they choose this final method, they will need to invent a means by which the data logger only receives light from the bulb; i.e. maybe they place a cardboard tube on the light sensor part of the data-logger and then place the lit bulb inside the other end of the tube. Ensure that the children discuss: ● Accuracy – How accurate are each of the methods for measuring? ● Reliability – If they choose to measure each of the conditions once, how reliable will their results be? Thus, encourage the children to choose a method that will generate accurate results, and to repeat their measurements in order to improve the reliability of their results. **Recording** The children could draw a table in which they record their results. Performing the fair-test. It is probably best that children have a bulb designed for 3.5 volts. This way, they will be able to combine three 1.5v cells without 'blowing' the bulb.	Correct and incorrect statements about why we take repeated measurements Components for making circuits Data-loggers Lengths of rope (about 3 metres long) – enough for one for each group of 6 children. Bibs – ones with pictures of a 1.5v battery upon them, and ones with a picture of a 3.5 bulb upon them	**Circuit, complete circuit, circuit diagram, circuit symbol, cell, battery, bulb, buzzer, motor, switch, voltage**	

		Groups conduct their investigations. The experimental method is left up to each group, but they will need to record their predictions, method and results to be able to share their findings with the rest of the class. Circulate to probe understanding and suggest any changes needed to experimental methods. Reinforce correct circuit symbols when drawing the circuits they create. Share findings between groups. Record their conclusions. **Does the voltage of the battery affect the brightness of the bulb?** (The greater the battery voltage, the brighter the bulb - unless the voltage is too high and it blows the bulb, i.e. the very thin wire or filament inside the bulb gets so hot that it melts which breaks the circuit.) **Does the number of batteries affect the brightness of the bulb?** (It does if you are adding extra batteries into the circuit, although a bulb will be brighter with one 5V battery than with two or three 1.5V batteries.) Ensure the fact that brightness is linked to voltage and not to the number or size of the batteries (cells) forms part of the discussion. In groups, children make a circuit with the dimmest bulb possible. Share the different techniques used, e.g. increased additional components, low voltage battery or a combination of both. **Drama/modelling - Using drama to develop children's conclusions/explanations**. Combine the groups so that there are now 6 children in each group. Give each group a rope (around 3 metres in length) and inform them that this is to represent the travelling 'electricity'. Give each group two bibs that must be worn by a different member of the group. On one bib should be a picture of a bulb, and on the other, a picture of a 1.5V battery. Challenge the children to represent the series circuit with bulb lighting up using these resources. With some guidance, the children could tie the rope so that it makes a circle, which they then all hold across the top of their hands. The 'battery' child should then push the rope in one direction whilst the other children let it glide over their hands. The 'bulb' child can call out 'light' (possibly 'heat' too) as the rope glides over their hands. Next, allow the children access to more 'battery' bibs. They must continue the analogy; working out what affect the 'battery' children have on the 'bulb' child. The battery children should be pushing harder and faster. The bulb child should be calling out 'brighter' (possibly 'hotter'). **Recording** Using the thinking that they have been developing during their drama, the children will need to discuss the key words that they will need to use in their explanations. Finally, the children can write their explanations using their key words and any drawings that might help their explanations. **Evaluating their investigation** Provide the children with the acronym FAR ('F'air, 'A'ccurate and 'R'eliable). **Recording** Ask them to provide an explanation as to how fair, accurate and reliable their investigation was.			
5	L.I. I can associate the volume of a buzzer with the number and voltage of cells used in the circuit.	**This is a Science lesson. In Science, we study nature and the behaviour of natural things.. The skill we will be using this lesson is setting up tests and communicating results.** **Recap prior learning:** **What is electricity?** **What is a cell?** **How can electricity be generated?** Show the four different circuits below. In groups, children rank the circuits in order to predict the brightness of the bulbs in each circuit diagram. Share predictions as a group, encouraging them to explain their thinking. Word of the week – buzzer **What would happen if the bulb was replaced with a buzzer? How might the sound that the buzzer makes change? (**Volume of the buzz, i.e. loudness is altered.) Children can add further information to their predictions to explain their thinking further. In groups, children make the circuits to check their earlier predictions around bulb brightness. Remind them of the 'Fault finder' poster in case they experience difficulties. Children then replace the bulbs with a buzzer to see if their predictions about buzzer volume were correct. Note that the buzzer has a transistor inside which only allows the current to flow one way. If any of the buzzers don't make a noise, swap the connections to the buzzer. Record this fault on the 'Fault finder' poster along with the remedy (change the connecting wires round) for future reference. Challenge groups to construct a circuit where a buzzer emits the quietest buzz they can manage.	Batteries (cells) of different voltage; wires; crocodile clips; bulbs compatible with different battery voltages; bulb holders; buzzers; switch;	**Circuit, complete circuit, circuit diagram, circuit symbol, cell, battery, bulb, buzzer, motor, switch, voltage**	

		Once they have constructed their circuits, children record them using a circuit diagram. Display the circuit diagrams. *Were any two circuit diagrams the same?* Listen to the different circuits and distinguish if there is a clear winner. *Why do you think this circuit* (one with quietest buzzer) *was the most successful?* 			
6	L.I. I can investigate the effect of different wires within a circuit.	**This is a Science lesson. In Science, we study nature and the behaviour of natural things. The skill we will be using this lesson is setting up tests and communicating results.** Recap what the children know about altering the brightness of a bulb and the volume of a buzzer. *Is there any part of a circuit that could alter brightness or volume that hasn't been investigated yet?* If necessary, prompt children to think of wires. Show children a selection of different wires and discuss the differences, e.g. thickness, materials they are made from, different fuse wires, etc.  e investigated by matching different wires to the brightness of a bulb. Share some ' *Does the length of wire make a difference to the bulb brightness? If we change the thickness of the wire, what happens to the brightness of the bulb? Does curling the wire make any difference to the brightness of the bulb?* Each group selects and records a question to investigate. Aim to have at least two groups per question so results can be compared.	Battery (cells); bulbs; different types of wire including wire made from different materials, fuse wires and wires of different thickness; bulbs compatible with the battery (cell) voltages; data loggers if available; boxes to block out classroom light so brightness can be measured with the data logger if used; sticky notes; white paper or card, large paper.	**Circuit, complete circuit, circuit diagram, circuit symbol, cell, battery, bulb, buzzer, motor, switch, voltage**	

		Is it possible to measure bulb brightness? You may need to remind children about using data loggers. Explain that if they are going to record light levels of the bulb, the circuit will need to be placed in an opaque box to block out any background light. (If they don't want to take measurements, it is possible to compare brightness levels by making simple observations.) In their groups, children predict the answer to the question they are investigating. Remind them to refer to the 'Fault finder' poster and to add any new faults on sticky notes along with their solutions. They plan and carry out their investigations before sharing the results with other groups. Check if groups attempting the same question got similar results. *Can you identify any patterns from the results? Can you use an analogy to explain them?* Children record what they have found out on large paper, presenting their results and conclusion to the rest of the class. Organise children in a large circle and explain that they are going to make a giant circuit. Make a simple standard circuit with one cell, one bulb and two wires. Explain that they are going to add in more and more wires to the circuit. *What might happen to the bulb? Can you predict how many wires it will take to make the bulb stop shining?* Keep adding wires into the circuit until the light starts to dim and is finally no longer lit. It can help to hold a piece of white paper or card behind the bulb to check whether there is still a dim light. Children explain the effect using their analogies. Add to mind map from lesson 1 as post assessment opportunity.			