

Autumn Block 2

Electricity

Small steps

Step 1

Construct and draw series circuits using symbols

Step 2

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Step 4

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Construct and draw series circuits using symbols

Notes and guidance

In Year 4, children explored the basic concepts of electricity. They made and drew pictorial representations of circuits and components. In this small step, children build on their understanding of circuits to construct and draw series circuits using symbols. Children should build circuits alongside their drawings to understand how the pictorial representation links to the physical example. It is essential that children draw circuits accurately. They should use a pencil, ruler and the wires of the circuit should be drawn using straight lines.

In this step, children are introduced to the terms “current” and “voltage”. They should understand that current is the flow of electricity and voltage causes the current to flow.

Things to look out for

- Children may draw pictorial representations of circuit components when drawing circuits rather than symbols.
- When drawing circuits, they may think that wires should be drawn as a “wiggly” line. State to children that wires should be drawn as straight lines using a pencil and a ruler.

Key questions

- What is a series circuit?
- What are circuit symbols?
- What is the symbol that represents a bulb/battery?
- What are the rules for drawing circuits and symbols?
- What is current?
- What is voltage?
- What would happen if the cells or batteries were removed from the series circuit?
- Why will this bulb not light up in this series circuit?

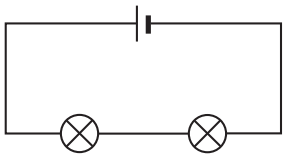
National curriculum links

- Use recognised symbols when representing a simple circuit in a diagram.
- **Working scientifically** – Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.

Construct and draw series circuits using symbols

Key vocabulary

- **Series circuit** – A circuit where all the components are in one single loop.



- **Cell** – A source of electrical power (voltage).



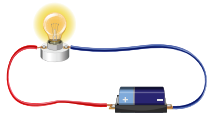
- **Battery** – A source of electrical power (voltage). A battery is more than one cell.



- **Bulb** – A component in a circuit that produces light.



- **Current** – The flow of electricity in a circuit.



- **Voltage** – Causes the current to flow.

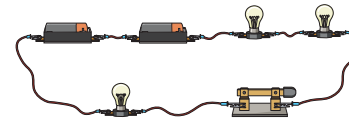


Practical ideas

- In pairs or groups, ask children to make different series circuits. Give them a range of components – batteries, wires, bulbs, switches and buzzers.

Ask them to construct different series circuits.

How many circuit variations can they make?



Ask children to draw the different circuits that they have made using the correct symbols for each component.

Children can then compare their circuit diagrams with other groups.

Factual knowledge

- A series circuit is where all the components are in one continuous loop.
- Components in a series circuit include the battery, buzzers, wires, bulbs and switches.
- Each component in a circuit has a symbol.
- Current is the flow of electricity in a circuit.
- Voltage causes the current to flow.

Complete and incomplete circuits

Notes and guidance

In this small step, children look at complete and incomplete circuits. They should explore reasons why a circuit may be incomplete. Examples of this include disconnected wires, the battery terminals are the wrong way round in the holder or the switch is open.

It is important that children use the term “current” when explaining whether a circuit is complete or incomplete and why components may or may not work. They should understand that the current cannot flow when the circuit is incomplete. Children should continue to draw and build circuits throughout this step.

Things to look out for

- Children may believe that when a circuit is incomplete, then the electricity or current disappears or “escapes” from the circuit. Explain that electricity or current does not flow at all in incomplete circuits and does not disappear or “escape”.
- Children may think that if all the components are in place, then the circuit is complete. Explain that even if all the components are in place, if the switch is open then the circuit is incomplete.

Key questions

- What is a complete/incomplete circuit?
- Why does this circuit work?
Give reasons.
- Why does this circuit not work?
Give reasons.
- Why is it important to connect the wires properly in a circuit?
- What is the role of a switch in a circuit?
- What happens to the current in an incomplete circuit?

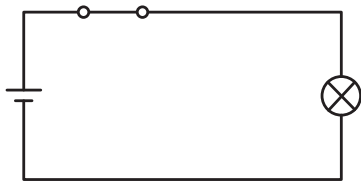
National curriculum links

- 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.
- **Working scientifically** – 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.

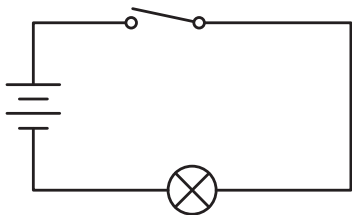
Complete and incomplete circuits

Key vocabulary

- **Complete circuit** – Circuits that do not have breaks in them.



- **Incomplete circuit** – Circuits that have breaks in them, such as an open switch.



- **Switch** – Allows current in a circuit to be turned on and off.



- **Buzzer** – A component that makes a buzzing or beeping sound.



Practical ideas

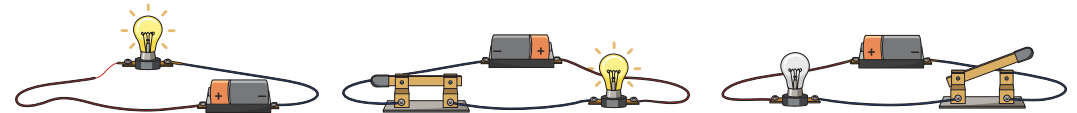
- Children work in pairs or small groups to create their own complete and incomplete circuits.

They can then swap places and explain why their partner's or group's circuits are complete or incomplete, giving their reasons.

- Have several mini-stations around the room.

At each station, place a circuit that is either complete or incomplete. In pairs or groups, allow children to visit each station and draw the circuits using pencils and rulers.

The children can then record whether the circuits are either complete or incomplete and give reasons why.



Factual knowledge

- For a circuit to be complete, all the components, including a battery, are connected by wires and the switch is closed.
- An incomplete circuit may have a break in the wires, a switch may be open or the battery is the wrong way in the holder.
- The current does not flow at all in an incomplete circuit.

Variations within circuits

Notes and guidance

In this small step, children explore variations within circuits and the effects of having fewer or more components. They should construct a range of series circuits with varying numbers of components such as bulbs, buzzers or switches. Children should work methodically to observe any changes or differences when adding one component at a time to a circuit.

It is important that children refer to current when learning about variations within circuits. They should spot patterns between the number of components and the brightness of bulbs and loudness of buzzers.

Children should identify that if the voltage in the circuit remains the same, but more bulbs or buzzers are added, this will dim or quieten these components.

Things to look out for

- As children construct their circuits, they may see that when there is just one bulb, it is brighter than when more are added. Adding more bulbs means that it is more difficult for the current to flow around the circuit. This is why the brightness of bulbs decreases when more are added.

Key questions

- What do you notice about the brightness of the bulb when there are more components in the circuit?
- What do you notice about the brightness of the bulbs when there are fewer components in the circuit?
- What do you notice about the loudness of the buzzer when there are more components in a the circuit?
- What do you notice about the loudness of the buzzer when there are fewer components in the circuit?
- Why does the brightness of the bulbs and loudness of the buzzers decrease when there are more components in the circuit?

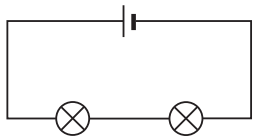
National curriculum links

- 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.
- **Working scientifically** – Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.

Variations within circuits

Key vocabulary

- **Series circuit** – A circuit where all the components are in one single loop.



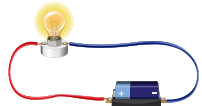
- **Battery** – A source of power in a circuit.



- **Bulb** – A component of a circuit that produces light.



- **Current** – This is the flow of electricity in a circuit.



- **Voltage** – Causes the current to flow.

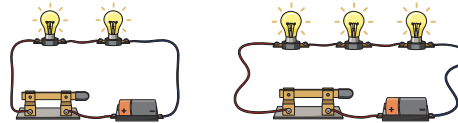


- **Buzzer** – A component that makes a buzzing or beeping sound.



Practical ideas

- Children should work in pairs or groups.



Begin by creating a circuit with one battery, a switch and a bulb.

Ask children to observe the brightness of the bulb.

Ask children to add one more bulb to the circuit.

Has anything changed regarding the brightness of the bulbs?

Add one more bulb to the circuit.

What has happened now?

- Children should repeat this process using buzzers rather than bulbs. They should increase the number of buzzers within a circuit, making observations about any changes in the loudness of buzzers each time.

Children should state which components are changing and which are remaining the same.

Factual knowledge

- The more components there are in a circuit, the dimmer the bulbs and the quieter the buzzers.
- The more components there are in a circuit, the more difficult it is for current to flow.

Plan – voltage experiment

Notes and guidance

For the next three steps, children will complete a fair test to explore how the voltage in a circuit affects the brightness of bulbs and the loudness of buzzers. In this small step, children focus on planning their investigation. Children have been introduced to variables in Year 5 and when planning they should identify the “independent”, “dependent” and “controlled” variables.

In Year 6, children do not need to use a voltmeter to measure voltage in a circuit, but they can increase voltage by adding more batteries.

When planning their investigation, children should be encouraged to identify the equipment they will use and explain why each piece is necessary.

Things to look out for

- When planning the investigation, children may confuse the variables.
- Children should discuss the reliability of the results and how this can be determined, for example repeating the experiment and then comparing the new results to the previous results to see if there are any anomalies.

Key questions

- How will the circuit be constructed?
- What materials and equipment are needed?
- Which variable will you change (the independent variable)?
- Which variable will you measure (the dependent variable)?
- Which variables will you keep the same (the controlled variables)?
- Make a prediction. What do you think will happen?

Enquiry question

- How does the voltage in a circuit affect the brightness of a bulb and the loudness of a buzzer?

National curriculum links

- Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit.
- **Working scientifically** – Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

Plan - voltage experiment

Key vocabulary

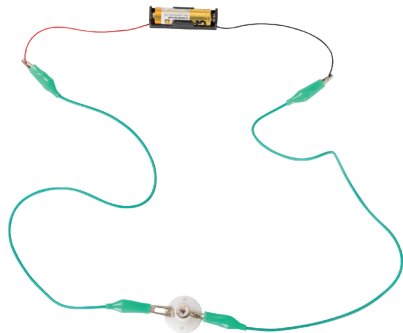
- **Independent variable** (what will change) - The voltage, or the number of batteries.



- **Dependent variables** (what will be measured) - The brightness of the bulbs and the loudness of the buzzers.



- **Controlled variables** (what is kept the same) - The type of batteries used and the number of components in the circuit.



Experiment information

Equipment needed

- Rechargeable batteries
- Wires
- Bulbs (one per group)
- Switches (one per group)
- Buzzers (one per group)



Practical activity

- Put children in small groups.
Give each group the equipment needed for the experiment.
Children should identify what the equipment is and why it is used within the experiment.

Planning sentence stems

- I predict that...
- I think this will happen because...
- The independent variable will be...
- The dependent variable will be...
- The controlled variables will be...

Investigate – voltage experiment

Notes and guidance

In this small step, children carry out the voltage experiment they planned in Step 4. To obtain valid results, a minimum of three batteries should be used to assess whether voltage affects the brightness of a bulb and the loudness of a buzzer.

When creating their series circuits, it is important that children check that all the components are connected properly. They also need to carefully observe any changes in the brightness of the bulbs and loudness of buzzers as they increase the number of batteries or voltage.

Children should also draw associated circuit diagrams when constructing each circuit.

Things to look out for

- Explain when the children are completing their tables of results, that the independent variable is stated in the first column (on the left) and the dependent variable is stated in the second column (on the right).
- Remind children that when they are drawing their circuits, they need to use a pencil to draw the correct symbols and wires should be drawn as straight lines using a ruler.

Key questions

- What do you think will happen in the investigation and why?
- When you change the number of batteries, why is it important to keep the number of bulbs, buzzers and switches the same?
- How will the results from the investigation be recorded?

Enquiry question

- How does the voltage in a circuit affect the brightness of a bulb and the loudness of a buzzer?

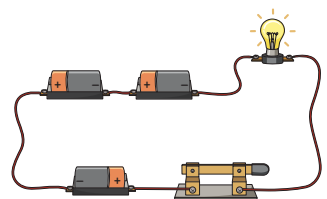
National curriculum links

- Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit.
- **Working scientifically** – Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

Investigate – voltage experiment

Key vocabulary

- **Voltage** – Causes the current to flow.
- **Current** – The flow of electricity in a circuit.



- **Repeatability** – The likelihood of getting similar results if the experiment is carried out again.

Attempt 1

Number of batteries	Brightness of bulb
1	dim
2	brighter
3	brightest

Attempt 2

Number of batteries	Brightness of bulb
1	dim
2	brighter
3	brightest

Experiment information

Equipment needed

- Rechargeable batteries
- Wires
- Bulbs (one per group)
- Switches (one per group)
- Buzzers (one per group)



Method

1. Create a series circuit with one battery, one bulb and one switch.
2. Make sure all the components are connected properly.
3. Turn the switch on and note the brightness of the bulb.
4. Insert two batteries to the circuit with the same bulb and switch.
5. Note the brightness of the bulb when the voltage has increased.
6. Insert three batteries to the circuit with the same bulb and switch.
7. Note the brightness of the bulb now the voltage has increased.
8. Repeat steps 1 - 7 to allow children to identify any possible anomalous results.
9. Children should then repeat the experiment but should replace the bulb for a buzzer.

Evaluate – voltage experiment

Notes and guidance

In this small step, children look at their results from the voltage investigation. They should be encouraged to evaluate their results and suggest experiment improvements. They should determine that increasing voltage or the number of batteries increases the brightness of bulbs and the loudness of buzzers.

When evaluating their experiment, children should refer to “accuracy” and how this could be improved. This could be through using light meters to measure the brightness of bulbs and decibel meters to measure the loudness of buzzers.

Children should think about how they can extend their investigation. This may involve using different types of battery and comparing their effects on bulbs and buzzers.

Things to look out for

- Children may confuse “accuracy” and “repeatability”. Ensure they are confident with these terms stated in the key vocabulary section.
- Children may state that they can improve their experiment by working with another person or group. Explain that this does not improve the experiment.

Key questions

- What was your prediction?
- How does increasing voltage or the number of batteries affect the brightness of a bulb or the loudness of a buzzer?
- Did your results match your prediction?
Why/why not?
- How could the investigation be improved?
- What could be done differently to improve the results?

Enquiry question

- How does the voltage in a circuit affect the brightness of a bulb and the loudness of a buzzer?

National curriculum links

- Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit.
- **Working scientifically** – Using test results to make predictions to set up further comparative and fair tests.

Evaluate – voltage experiment

Key vocabulary

- **Repeatability** – The likelihood of getting similar results if the experiment is carried out again.

Attempt 1

Number of batteries	Brightness of bulb
1	Dim
2	Brighter
3	Brightest

Attempt 2

Number of batteries	Brightness of bulb
1	Dim
2	Brighter
3	Brightest

- **Accuracy** – How close a result is to the standard value. Accuracy can be improved by the quality of the equipment used.



- **Evaluation** – To consider the quality of the results obtained and suggest improvements to the investigation.

Practical ideas

- Children could test whether the size of the battery affects the brightness of bulbs or the loudness of buzzers.



- Children could research using secondary sources to explore how to make their own battery.



Evaluation sentence stems

- I predicted that...
- My prediction was correct/incorrect because...
- From looking at our results, I can see that...
- This happened because...
- To make our investigation more accurate, we could...
- For future investigation, I would like to find out...