ACET Junior Academies'

Scheme of Work for Science

Big Idea – Electricity, Sound & Light

Year 4 – Electricity

About this unit:

PoS – Electricity

This unit is an introduction to electricity. Students should learn that electricity flows through some materials, but not others. They should explore what happens when electricity flows through lamps, buzzers and motors, and learn that a complete circuit is needed for the electricity to flow. It can be tempting to introduce these concepts, and move on with more complex ones, but it's really important to consolidate their basic understanding of electricity and circuits so that they have a good base of knowledge and understanding from which to move on.

Getting used to scientific terms – one 'battery' is called a cell. Only say 'battery' when you have more than one cell joined together. 'Lamp' should be used instead of 'bulb'. These are the terms that should be used right from the beginning.

Students should NOT be taught parallel circuits – it leads to confusion when they have not really consolidated knowledge about series circuits. Most students arrive at KS3 with poor understanding of electricity and circuits.

Students do **not** need to be able to draw circuit diagrams – they should be able to draw and troubleshoot 'real' pictures of circuits and components. They need to know about cells, lamps, buzzers and motors, but do not need to learn the symbols.

PhET simulations are excellent to really show students what's going on in circuits – but only as an **addition** to exploring real equipment.
https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab

Unit structure

This unit is structured around seven science enquiries:

1. How do we use electricity?
2. Can electricity flow through any material?
3. How do you keep the electricity flowing?
4. Can we play with electricity?
5. Are switches important?
6. Is electricity always the same?
7. Can you make a torch?

Links to previous and future National Curriculum units

Y1 – Everyday materials

Y2 – Uses of everyday materials

- Y6 - Electricity

<table>
<tr><td colspan="4">Enquiry 1: How do we use electricity?</td></tr>
<tr><td>Links to previous learning</td><td>Scientific skills</td><td>Assessment criteria</td><td>Curricular links</td></tr>
<tr><td rowspan="3"></td><td>EA – Identifying, grouping and classifying

Asking questions
Making predictions</td><td rowspan="3">Can your children:
- Discuss the safety issues involved with electricity
- Tell you why they have put appliances in to groups</td><td rowspan="3">Horizontal:

Vertical:
Y6 - Electricity</td></tr>
<tr><td>Key concepts:</td></tr>
<tr><td>There are safety guidelines we have to follow when working with electricity.
We should always be able to explain our reasons for putting things into groups.</td></tr>
<tr><td colspan="2">Key terms</td><td colspan="2">Common misconceptions</td></tr>
<tr><td colspan="2">Electricity, flow, wires, appliance, mains, cell, safety</td><td colspan="2"></td></tr>
<tr><td>Suggested activities</td><td>Resources</td><td colspan="2">Useful links</td></tr>
<tr><td>Identify electrical appliances around the room and in pictures. Think about electrical appliances that you use at home.

How do you know that they run on electricity? Investigate what they have in common – they need to be plugged in, or they have cells (batteries). They usually have a switch.

Use this lesson to discuss safety relating to electricity – including cells. See link on ‘button batteries’. Students should know that cells contain chemicals that can leak if they are roughly handled. Some cells can be recharged – but ONLY if it says so on the outside.

Make sure the students know the difference between mains electricity and battery power. Both types of electricity involves negative charge (they can just think of ‘electricity’ flowing, rather than negative charge) flowing through cables, and through an appliance. All appliances have electricity flowing in and out.

Cells have stored electricity, while mains appliances receive a constant supply through sockets – discuss the fact that this electricity is delivered through wires – students could investigate where the mains electricity arrives at the school.

GD – cells like Duracell contain chemicals which produce electricity. The electricity can run out. Some cells – like phone cells - can be re-charged, using mains electricity.</td><td>Demonstration
- Simple circuit with one cell and a lamp
- Simple circuit with one cell and a buzzer
- Simple circuit with one cell and a motor (see link)

Pictures of electrical appliances</td><td colspan="2">https://www.youtube.com/watch?v=mDyBT5qr_UI – simple circuit with a motor.

This can be used if you don’t have simple motors, and also if you’re unsure of how to set up a simple circuit.

http://www.switchedonkids.org.uk/electrical-safety-in-your-home

https://www.capt.org.uk/button-batteries</td></tr>
</table>

Students can group electrical appliances (**they will be working on grouping living things and materials in subsequent terms**). *This could be in terms of what they do, or how they work, or the type of electricity they use – how they group them is not as important as the students being able to express their reasoning for grouping them.* Demonstrate simple circuits with buzzers, lamps and motors. Students need to know that a buzzer makes a noise, a lamp lights up, and a motor rotates when electricity flows through them. Compare these with a timer, a lamp in the room, and an electric fan – these simple circuits are what are inside those more complex appliances.		

<table>
<tr><th colspan="4">Enquiry 2: Can electricity flow through any material?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="3">Y1 – Everyday materials
Y2 – Uses of everyday materials</td><td>EA – identifying, grouping and classifying

Asking questions
Making predictions</td><td rowspan="3">Can your children:
- Describe how to test a conductor
- State that metals allow electricity to flow through them, non-metals do not</td><td rowspan="3">Horizontal:

Vertical:
Y6 - Electricity</td></tr>
<tr><td>Key concepts:</td></tr>
<tr><td>If a lamp lights up, it means that electricity is flowing/moving.
Metals let electricity flow, non-metals do not.
GD – use the word conductor.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Electricity, flow, metal, non-metal</td><td colspan="2"></td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">Students should be given a simple circuit to test whether a range of objects conduct electricity or not. They should explore this for themselves, and as with the previous lesson, try and group the objects according to whether they can conduct electricity or not.

Students should set up the simple circuit, with guidance, and test that it works initially.

Before testing materials, students should make predictions about whether ta material will conduct or not. They should always be encouraged to justify their decisions – previous experience is a valid reason, but they should explain what their previous experience is as clearly as possible.
They should conclude, in general, that metals conduct electricity, and that most non-metals do not.

GD – can discuss whether materials are conductors or not, and whether some are better at conducting than others.

PhET has some examples of conductors/insulators. Note – hands/dogs as shown on PhET are insulators. This is true when we are using cells – even if we use lots of them. However will WILL conduct electricity if there is enough of it. The electricity coming down the mains cables comes from a power station, not a cell,</td><td>Simple circuit – cell, 3 wires, lamp or buzzer – one set per group

A range of materials to be tested for conductivity. Try and keep them all a similar size.</td><td>https://www.youtube.com/watch?v=pVwWjsabDXE – use this if you're not sure how to set it up. You can use exposed wires (as in the video), or crocodile clips. DON'T show the clip to students, or use liquids for testing – it will confuse the safety message for students of this age. Testing water and liquids is a concept for KS4 involving dissolved ions.</td></tr>
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<table>
<tr><th colspan="4">Enquiry 3: How do you keep the electricity flowing?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="2"></td><td>EA – Pattern seeking

Asking questions
Making predictions
Observing and measuring</td><td rowspan="2">Can your children:
- State that electricity has to flow through a component for it to work
- Look at pictures of complete and incomplete circuits and say whether the components will work or not</td><td rowspan="2">Horizontal:

Vertical:
Y6 - Electricity</td></tr>
<tr><td>Key concepts:
Electrical components work when electricity flows/moves through them.
You need a complete circuit of components and wires for electricity to be able to flow.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Electricity, circuit, flow, component, lamp, buzzer, motor, cell, wire, complete, incomplete</td><td colspan="2">Misconception – it's difficult to see how appliances that are plugged into the mains are part of a circuit. Show them the bottom two pins of a plug – the electricity is carried in one of them, and out of the other – the circuit is completed by the National Grid. Students can also be taught that the electricity from the mains is alternating current – it moves back and forth, but that electricity from a battery moves in one direction only. You can demonstrate that in both these cases, there needs to be a complete circuit.</td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">Recap from previous lessons – appliances and components work when electricity flows through them.

Give the students some equipment (wires, cells, lamps). Can they get the lamp to light up?

Students should be taught to disconnect cells quickly after checking whether a circuit works or not – DON'T leave cells connected for long. In a complete circuit, lamps will heat up quickly and can cause burns, and a circuit which doesn't work can damage the components.

Have a range of circuits to look at – some drawings, some physical circuits. Have some that are a complete circuit, and others where it is incomplete, e.g with one wire unattached.</td><td>Equipment for the students to use – wires, cells, lamps</td><td>https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab</td></tr>
</table>

Demonstrate the physical circuits. PhET simulations can be useful for students to explore further, after they have experience with physical equipment. Show pictures of complete and incomplete circuits. Students should name the components in each circuit, and say whether they will work or not (according to whether the circuit is complete). *GD - Students can also be taught that the electricity from the mains is alternating current (AC) – it moves back and forth, but that electricity from a battery moves in one direction only (DC). You can demonstrate that in both these cases, there needs to be a complete circuit.*		

<table>
<tr><th colspan="4">Enquiry 4: Can we play with electricity?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="2"></td><td>EA – Pattern seeking

Asking questions
Making predictions</td><td rowspan="2">Can your children:
- State that the buzzer sounds when the circuit is complete
- Describe how the game works in terms of circuits</td><td rowspan="2">Horizontal:
D&T

Vertical:
Y6 - Electricity</td></tr>
<tr><td>Key concepts:
Electricity only flows if there is a complete circuit.
When the loop touches the wire, the circuit is complete.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Electricity, circuit, complete, loop, flow</td><td colspan="2"></td></tr>
<tr><th>Suggested activities</th><th>Resources</th><th colspan="2">Useful links</th></tr>
<tr><td>Students to make a ‘steady hand game’ using buzzers. Lamps can be used if there are not enough buzzers.

Use the lesson to emphasise that the electricity does not flow if the circuit is not complete. Make sure the students understand that the buzzer is activated when a complete circuit is made.

Can you explain how the game ‘operation’ works? Can you explain why the tweezers are attached to the board by wires?</td><td>Wires, crocodile clips, stiff metal wire, buzzer (or lamps), batteries, electrical tape, wooden board or stiff cardboard.</td><td colspan="2">https://www.instructables.com/id/Wire-Loop-Game-Tutorial/ - How to make a steady hand game

https://www.bbc.co.uk/bitesize/clips/z28b4wx - making games with circuits

https://www.argos.co.uk/product/3900059 - advert for ‘operation’</td></tr>
</table>

<table>
<tr><td colspan="4">Enquiry 5: Are switches important?</td></tr>
<tr><td>Links to previous learning</td><td>Scientific skills</td><td>Assessment criteria</td><td>Curricular links</td></tr>
<tr><td rowspan="2"></td><td>EA – Pattern seeking

Asking questions
Making predictions
Observing</td><td rowspan="2">Can your children:
- Identify what a switch does in an appliance
- Look at pictures of open and closed switches and state whether a component will work or not</td><td rowspan="2">Horizontal:

Vertical:
Y6 - Electricity</td></tr>
<tr><td>Key concepts:
Most appliances have switches to control when the electricity flows.
When the switch is open, the circuit is not complete, so the appliance/component will not work.</td></tr>
<tr><td colspan="2">Key terms</td><td colspan="2">Common misconceptions</td></tr>
<tr><td colspan="2">Electricity, circuit, complete, loop, flow</td><td colspan="2"></td></tr>
<tr><td colspan="2">Suggested activities</td><td>Resources</td><td>Useful links</td></tr>
<tr><td colspan="2">Identify a range of different appliances that use switches. What happens when you press the switch?

Try and think of switches that are automatic – my kettle switches off when it is boiled, my washing machine door unlocks when the washing is finished.

Make a circuit for a torch (cell, wire, lamp, wire back to the cell), and then make another one with a switch (cell, wire, lamp, wire to a switch, wire back to the cell). If you don't have a switch, you can just have two wires. Leave them apart for the switch to be open/off, and put the ends together to close the switch/turn it on.

The students should observe how much more useful having a switch is. They should draw both circuits, explaining the role of each component, and which one is best for inside a torch (they can make a torch in the final lesson of the unit).

Link this to the previous lessons – a component will only work when it is part of a completed circuit. If the switch is open, there is not a complete circuit.

GD – try and work out how switches in different appliances might work – no need for them to be correct – just investigate and explore.</td><td>Pictures of appliances that have/need switches.

Demonstration – see link
Wires, cell, lamp, carboard, split pins, paperclips</td><td>https://www.google.com/search?q=making+a+switch+with+a+paperclip+ks2&rlz=1C1GCEA_enGB846GB846&oq=making+a+switch+with+a+&aqs=chrome.0.0j69i57j0l5.5146j0j4&sourceid=chrome&ie=UTF-8#kpvalbx=_xqSeXvPdBPq71fAPjO-gmA438
how to make a switch with a paperclip</td></tr>
</table>

<table>
<tr><th colspan="4">Enquiry 6: Is electricity always the same?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td></td><td>EA – Pattern seeking

Asking questions
Making predictions
Recording data
Key concepts:
When you add more components, they get dimmer/quieter/slower.
When you add more cells, the components get brighter/louder/faster.</td><td>Can your children:
- Describe what happens when they add more components to a circuit
- Describe what happens when they add more cells to a circuit
GD – investigate methodically</td><td>Horizontal:

Vertical:
Y6 - Electricity</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Electricity, flow, circuit, complete, more, less, brighter, louder, double, half</td><td colspan="2"></td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">Students will need a range of equipment in order to investigate.

What happens when you add more lamps?
What happens when you add more cells?
What happens when you add more lamps AND more batteries – GD – can you investigate this methodically? It's easy to randomly add more components – can you investigate so that you can present a clear conclusion?

Lots of scope for investigation here. Good opportunity for students to think about how they are going to work methodically, and record their answers methodically, in order to present a conclusion. There is no need for them to construct a scientific table – but there should be some logic and organisation to how they record their results. They should be aware that they are looking for patterns.

If possible, allow students to explore the equipment – but in a way that they can give you answers about what's happening.

They should be 'trained' to make sure that all the electricity is flowing in a single loop before connecting the cell.</td><td>As many wires, lamps, cells as possible.

Some students could investigate using PhET while others used practical equipment – but it is important that all students have experience of making physical circuits.</td><td>https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab</td></tr>
</table>

<table>
<tr><th colspan="4">Enquiry 7: Can you make a torch?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="3"></td><td>EA – Problem solving

Asking questions
Making predictions
Interpreting and communicating data</td><td rowspan="3">Can your children:
- Draw the circuit that makes up their torch
- Describe how to turn the torch on & off in terms of circuits</td><td rowspan="3">Horizontal:
D&T

Vertical:
Y6 - Electricity</td></tr>
<tr><td>Key concepts:</td></tr>
<tr><td>The torch will work if we make a complete circuit.
The switch needs to be able to open and close to break and complete the circuit.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Electricity, circuit, complete, flow, switch</td><td colspan="2"></td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">Students should be able to annotate a plan of their torch, labelling the components, and describing the importance of each part.</td><td>Y4 how to make a torch resource

A small light bulb (3w)
Wire
Batteries
PVA glue
paper towel tube
masking tape
heavy duty aluminum foil
paper clip
split pins</td><td></td></tr>
</table>