YEAR 4 UNIT 5: Power it up (Electricity)

Enquiry Question: How does a circuit work?

Related units: Year 3 Unit 3: How do we see things?
Year 5 unit 1: Why do we have night and day and why does the Sun appear to move?

Unit overview

National Curriculum links Year 4: Electricity
Pupils should be taught to identify common appliances that run on electricity and construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers. They will be able to 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. They will recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit and recognise some common conductors and insulators, and associate metals with being good conductors. They will revisit some uses of electricity and the importance of safety before constructing simple circuits. Understanding how to change a circuit by changing its components makes up the third part of this topic, leading in a final application of knowledge and skills when children design and make an alarm using their knowledge of circuits.

Assessment (Expectations)

1. Describe 2 dangers associated with mains electricity
2. Explain what a simple series circuit is
3. Explain why some circuits work and others do not
4. Explain how changing batteries affects the bulb in a circuit

Scientific vocabulary

- electricity
- socket
- conduct
- conductor
- insulator
- battery
- cell
- current
- wires
- component
- re-chargeable
- buzzer
- operate
- bulb
- appliance
- circuit
- terminal
- mains
- voltage

Working Scientifically

- Observing patterns e.g.
  - that bulbs get brighter if more cells are added;
  - that metals tend to be conductors of electricity;
  - that some materials can and some cannot be used to connect across a gap in a circuit
- To use results to draw simple conclusions
- To explore patterns produced by altering circuits, making comparative tests

Cross-curricular links

Maths:

- Use of tables and bar charts to record experiments with circuits;
- multiplying numbers with one decimal place (voltages on batteries).

Teacher knowledge

Electricity is the most useful form of energy. It can be transformed into other forms of energy relatively easily. It makes things turn using motors, heats and lights up places like our homes, and produces sound in loudspeakers. Most mains electricity is produced in power stations and carried to users by overhead power lines. Power stations use coal, oil, gas or nuclear fuel to heat water, produce steam, drive a turbine and turn a generator to produce electricity. Batteries contain chemicals which react in a special way to produce an electric current. The current from a lemon battery is very small and will not light a bulb. But several fruit batteries will light a small LED. A potato can power a special clock, which can be purchased quite easily, such as from Amazon.
Voltage indicates the amount of energy delivered by a source of electricity. The voltage of the most common household batteries varies from around 1.5V to 12V, but some specialist batteries can be much higher. Mains electricity in this country is 230V. Overhead power cables carrying sufficient supply for thousands of users can carry voltages as high as 400,000V. The children may be aware of the term 'voltage', but they do not need to know about this in depth. Completely pure water does not conduct electricity, but when impurities that are present in our normal water supply get into it or when mixed with the salt on our skin, it does conduct. This is why you must never turn on the lights with wet hands. The spark produced by the flicking of the light switch will travel through the body, giving us a shock as it goes to earth.

There are two types of circuit. A series circuit has all its components wired into one simple circuit: all the components are one after another, as in a series on television. A parallel circuit is one with different branches which behave like mini-circuits and can work independently of each other. Only simple series circuits are investigated in Key Stage 2. Conventional bulbs contain a filament made from wire. As electrons flow through the wire, they encounter resistance. It's like lots of people trying to squeeze through a small doorway. The more people or the smaller the gap, the more resistance felt. When a wire is very thin, it has a large resistance. The electrons get hot as they try to move through it (just as people do going through a small doorway!) and we can feel this. If
it gets very hot, it glows – as in the filament of a light bulb. When investigating the changing of components in a circuit, the brightness of a bulb depends on the current or number of electrons passing through it. The more bulbs you have, the slower the electricity flows because the battery 'runs out of push', so the electrons flow more slowly, due to the resistance through the wires, and the bulbs, so the dimmer the light. The opposite is true of adding more batteries (the electricity flows faster). The batteries must be connected in series with positive terminals connected to negative ones. If a battery is reversed, its value is regarded as negative. So, if three batteries are connected in series and one is reversed, this will be equivalent to one battery.

Metals are good conductors of electricity. Most non-metals do not conduct electricity. They are insulators. The rest of the information here is for your understanding but not the children at this stage. All materials are made of atoms, but metals are special. Instead of each atom being a separate entity (for the sake of neatness this is how we can picture them), metal atoms have electrons which are not tied to one particular atom. They are free to move within the metal in a 'sea' and this movement of electrons is what produces an electric current. Non-metals do not have these free electrons, so a current cannot pass through a non-metal. The exception is graphite, which conducts electricity but is a form of carbon. Carbon is a non-metal that can exist in different forms.
One form is diamond, which is an insulator as it doesn't have free electrons. Some compounds, such as sodium chloride (table salt), contain positive and negative particles called ions. They do not conduct electricity when they are solid, but they do conduct when they melt or dissolve in water, hence the previous activity using salt water to demonstrate water conducts. In liquids, ions are free to move and there is a flow of charge, i.e. an electric current.

Did you know?

- Electric eels can produce a strong electric current to stun their dinner.
- Lightning is a type of electricity and can travel at over 130,000 miles per hour.
- Our bodies use electricity. The nerves that mean we can feel hot and cold, for example, send an electrical signal to our brains to tell use to move away.
- Electric shock was used as a type of medicine when electricity was first discovered.
- Evidence of batteries goes back over 2000 years. But they weren't like the ones that were developed 1500 years later

Misconceptions: Children might think:

- That electricity from batteries is not dangerous: (batteries can present a fire risk when over-charged, short-circuited, submerged in water or if they are damaged)
- That both ends of the battery produce electricity: (when connected in a circuit, a battery can produce electricity).

- That the first bulb in a circuit will be brighter than the second in a circuit: (in a circuit two lamps are dimmer than a single lamp on its own, three lamps in series are even dimmer but they are all equal brightness in the same circuit).
- That wires are made of plastic as they are coated in it : (the wires are metal to conduct the electricity, the plastic is an insulator for safety).
- That a bulb uses the electricity
- That all metals conduct electricity

Resources

www.sciencekids.co.nz/gamesactivities/electricitycircuits.html has a simple online game to construct circuits. Useful if you have limited equipment and want to run a circus of activities.
Fun facts about electricity and also some lesson plan ideas at: www.alliantenergykids.com
www.chromebattery.com/battery-kids/projects/light-a-bulb-with-a-balloon is an activity to 'wow' children, although static electricity is not part of the curriculum. chemistry.about.com/od/chemistryhowtoguide/a/fruitbattery.htm How to make a fruity battery?