# 1. Shock to the system

1 hour activity

This activity revises concepts covered in Year 4. It gives children the opportunity to build circuits and use the correct vocabulary for the components. They explore issues around the safe use of electricity and sustainable production.

## OBJECTIVES

- Y4: Identify common appliances that run on electricity
- Y4: Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers
- Y6: Use recognised symbols when representing a simple circuit in a diagram
- Y6: Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit

## RESOURCES

(per group of 4 children, unless otherwise stated)

- Activity sheets 1-4
- Circuit set - including at least 2 wires, 2 batteries, 2 bulbs, buzzer or motor, and items they will require as red herrings
- At least 6 tennis balls
- A4 paper
- 30-40 small coloured stickers

## ADVANCE PREPARATION

Circuit symbol cards, Activity sheet 1.

These could be laminated for future use, or allow the children to cut out the cards as part of the activity.

Stick one sticker on each tennis ball and have the rest available for the tennis ball activity.

## INTRODUCING THE ACTIVITY

Discuss the importance of electricity, e.g. you could play a CD as the children come into the class room. Then suddenly turn it and the lights off.

*What powered the CD and lights?*

*What happened when I turned it off?*

Discuss which items in the room or at home require electricity. Generate a discussion about what the children know about electricity. Children to discuss in groups: 'Life without Electricity' and record as a PMI activity (positives, minuses and interesting – see Activity sheet 3).

Give groups a large sheet of paper and spend 10 minutes writing and drawing items that are powered by electricity. Sort into two groups, high voltage (potentially dangerous) and low voltage (can run off batteries and/or mains).

Children identify the dangers on scenarios showing electricity in every day use (interactive whiteboard or photocopies of Activity sheet 4). Some excellent interactive websites to use for this activity are:

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

## REVISING CIRCUITS

See Appendix B (+Tennis Ball Analogy) Children pass tennis balls from the battery to the bulb and stickers are used to represent the electrical charge.

## MAIN ACTIVITY

Give the children a range of components (including some 'red herrings') to independently construct a circuit to make a buzzer sound, a bulb light, or turn a motor.

Ask the children *what makes a circuit?*

Encourage discussion until all elements of a working circuit have been explained.

Each group then makes a circuit. For more able pupils, ask them to adapt the circuit to make the buzzer louder/quieter, bulb brighter/dimmer or motor faster/slower and explain why it had that effect. The children may either put, more or less batteries into the circuit, more or less components in the circuit.

Ask the children to record their circuit in a diagram using mini whiteboards. This provides a good assessment of what they know or remember about circuit diagrams. They may need to be introduced to circuit diagrams as a standard way of drawing circuits, or they may need to be reminded of the circuit symbols.

Give each group a selection of circuit cards (Activity sheet 1). Ask children to use the cards to show simple circuits using battery, wires and a bulb, buzzer or motor. Take this opportunity to revise the vocabulary of electricity.

Pose different challenges such as asking the children to use their cards to show you a circuit with a brighter/dimmer bulb or louder/quieter buzzer etc. Discuss the responses the children come up with and challenge any misconceptions. The children could test out their ideas by making the circuits.

Provide Activity sheet 2, if they need help to interpret symbols.

## PLENARY

**Batteries**

Ask the children where the energy to power the circuit comes from.

Explain that batteries contain materials that produce electricity when they mix.

Batteries are not practical for generating electricity on a big scale – explain to children using the information supplied below.

*What are the advantages of using a battery instead of mains electricity?*

The use of batteries will overcome the need to have a mains supply and will eliminate trailing wires.

What are the disadvantages of using a battery?

The power that they supply is lower and they run out (even re- chargeable batteries).

Batteries are not practical for providing electricity on a big scale because they would require large amounts of chemicals, produce relatively low amounts of electricity and they are not sustainable.

Other methods that can produce high power electricity continuously are necessary.

Explain how a lot of electricity is generated by converting movement energy to electrical energy. Coal, gas, oil and nuclear power stations generate electricity through heating water and converting it into steam to drive turbines. Alternatively wind and hydro-electric power stations drive turbines using natural sources.

***http://www.eia.doe.gov/kids/energyfacts/index.html***

Review different sources of electricity. Discuss the fact that non-renewable sources of energy use an ever depleting natural resource that cannot be replaced and will eventually run out. However, renewable sources of energy do not run out.

## EXTENSION

As a homework activity children make a list of renewable and non-renewable sources of energy.

Make a battery using one of the methods on the following websites:

***https://education.theiet.org/primary/teaching-resources/fruit-lights/***

This shows how chemical energy is used to create electricity. The current of the resulting battery is very low so it will only power LCD equipment (digital watch or LCD calculators) or LEDs (light emitting diodes: tiny bulbs that fit easily into an electrical circuit - often form the numbers and light up the controls on digital clocks). LEDs can easily be obtained cheaply from many school science catalogues.

**Ben Adams Generator**
Alternatively try out the generator as described in Appendix C.

**Literacy Link: Developing research skill and Discussion Texts**
Research advantages and disadvantages of each energy source (using some of the websites outlined in Appendix A).

This could inform a class debate: with each group representing different sides of the arguments and pressure groups.

# **Appendix A:** Websites

The table below shows useful websites with information relevant to the unit.

## INFORMATIVE WEBSITES FOR TEACHERS

***https://www.reachoutcpd.com/courses/upper-primary/electricity/***

Mini online CPD units to boost subject knowledge and suggest practical activities for teaching electricity and circuits.

***www.windpower.org/en/kids/index.htm***

Interactive schematics about the building and working of turbines.

***https://thekidshouldseethis.com/post/48611338726***

Information about wind generators for teachers.

***Hunkinsexperiments.com/default.htm***

Here are more activity ideas (some quite complex) - great for science club.

***https://www.sustainablelearning.com/resource/build-your-own-wind-turbine***

Instructions for making a model turbine.

## INTERACTIVE WEBSITES FOR CHILDREN TO USE

***https://www.switchedonkids.org.uk/***

Great, child friendly information, lesson plans and activity ideas about energy.

***www.eia.doe.gov/kids/energyfacts/index.html***

This site allows children to explore the origins and issues surrounding different energy producers.

***https://thekidshouldseethis.com/post/48611338726***

Animated wind turbines to generate electricity.

***www.windpower.org/en/kids/index.htm***

How a generator and dynamo work.

***www.andythelwell.com/blobz***

Information about circuits and a quiz.

***http://powerup.ukpowernetworks.co.uk/powerup/en/teachers-parents/interactives/***

Interactive activities to engage and challenge pupils' understanding of electricity, circuits, and safety.

# **Appendix B:** Tennis ball circuit analogy

How do circuits work? The tennis ball analogy:

The children sit in a row with the two children at each end labelled the battery and the bulb (hats would be a good way to label). The tennis balls, each with a sticker, are given to the battery in a container. The balls are passed by the children (the wires) from the battery to the bulb. Explain that the idea is to give energy to the bulb from the battery so that it can light. The energy is represented by the stickers. This energy will have to be carried by something; in this case balls that represent electrons ('balls' of charge).

The children should notice that this can only happen for a very short while before the battery runs out of balls.

Ask how the bulb could be lit for longer. Possible answers include having more balls (i.e. a bigger battery) or having the light return the balls quickly. The first answer would work, but again only for a very short while. The second answer introduces the idea of a **circuit** - a complete path where the balls are returned to their starting point ready to be given more energy and used again. (If you connect a bulb to only one terminal of a battery, will it light? The answer is no, but in fact a little current will flow for a very short time, just as the balls moved to the bulb and stopped there in this demonstration. There is, however, not enough energy transferred to cause a glow!).

The children now sit in a circle with the battery and bulb joined from both sides by the rest of the children representing the wires. The balls are passed around the circle. The bulb removes the stickers to get the energy to light up and the battery replaces the stickers. Each child is only allowed to hold one ball at a time. This reinforces the idea that the current flows smoothly. Also if you put a switch into your circuit, when the switch stops passing balls then the current will stop flowing.

The battery will eventually run out of stickers which is what will happen when the battery goes flat. In a rechargeable battery the voltage in the electron is replaced. In a normal battery the voltage is produced by a non-reversible chemical reaction.

Now ask students how we could increase the power that the bulb is receiving, and hence light brighter. Obviously there are several possible answers.

One is to make the balls carry more energy by making them bigger - using basketballs or soccer balls, for instance. This would work but in practice we are generally limited to using electrons (tennis balls) which are small, negative charges. The bigger, positive charges don't tend to be the ones that move.

Another answer would be to use bigger stickers. This does have a direct electric counterpart - **voltage (V)**. Voltage is simply a measure of how much energy each electron is given by the battery. If we send the same number of electrons, but give each one more energy (i.e. a bigger 'push'), we obviously send more power.

A third answer is to send the balls over at a faster rate, that is, send more balls, (two per child) over each second. This corresponds to **current (I)**, or **amperage**. The electric current is simply how many electrons pass by each second (though we actually count groups of electrons, since they are so small and there are so many of them!). Clearly, if we send twice as many identical electrons each second we are sending twice the energy.

Another thing we could do is both of the last two at once - send more balls, harder. This brings up a very simple equation. The **total power (P)** is simply the product of the number of balls and how much energy each one has. In electrical talk we would say that power is the product of the current and the voltage. i.e. **P = I x V**

The information provided is to help non science specialist teachers to understand the process. The activity can help children to understand how an electrical circuit works.

# **Appendix C:** Making an electricity generator

Electricity generators work by passing a magnet quickly back and forth through a coil of wire, or by passing a coil of wire quickly through a magnetic field (between two magnets). The stronger the magnets and the more coils of wire will generate more electricity. Therefore on an industrial level the coils of wire are huge and the magnets very strong.

The difference between different forms of electricity generators is the method of producing the movement of the magnet or wire. These are often steam turbines where the steam is produced by burning fuel (coal, oil, gas, wood or even waste) or in a nuclear reactor (non-renewable energy). However turbines can be turned by wind (wind turbines) or water (wave, tidal or hydroelectric power). Solar power also generates electricity without using turbines.

**The Ben Adams generator:**

Attach a magnet or two together to a piece of dowling. Pass through a hole in the bottom of a plastic cup.

Wind insulated copper round the outside of the cup about 1000 turns (over the top and the base) so that the magnets are hidden from view. Remember to leave approximately 10 cm of wire either end. Sand down the ends to remove coating and attach to the LED.

Attach a wheel on the end of the dowling with a handle and spin as fast as you can.

If it doesn't work change the LED round as it will only work in one direction.

Alternative ideas can be found on the Vega science trust resource website:
***http://www.vega.org.uk/video/subseries/27***

These include the simplest generator under the title *Shake-A-Gen* which is made of a coil of wire, a magnet, an LED and a camera film case. It also contains another more complex generator under the title *Simple Generator*.