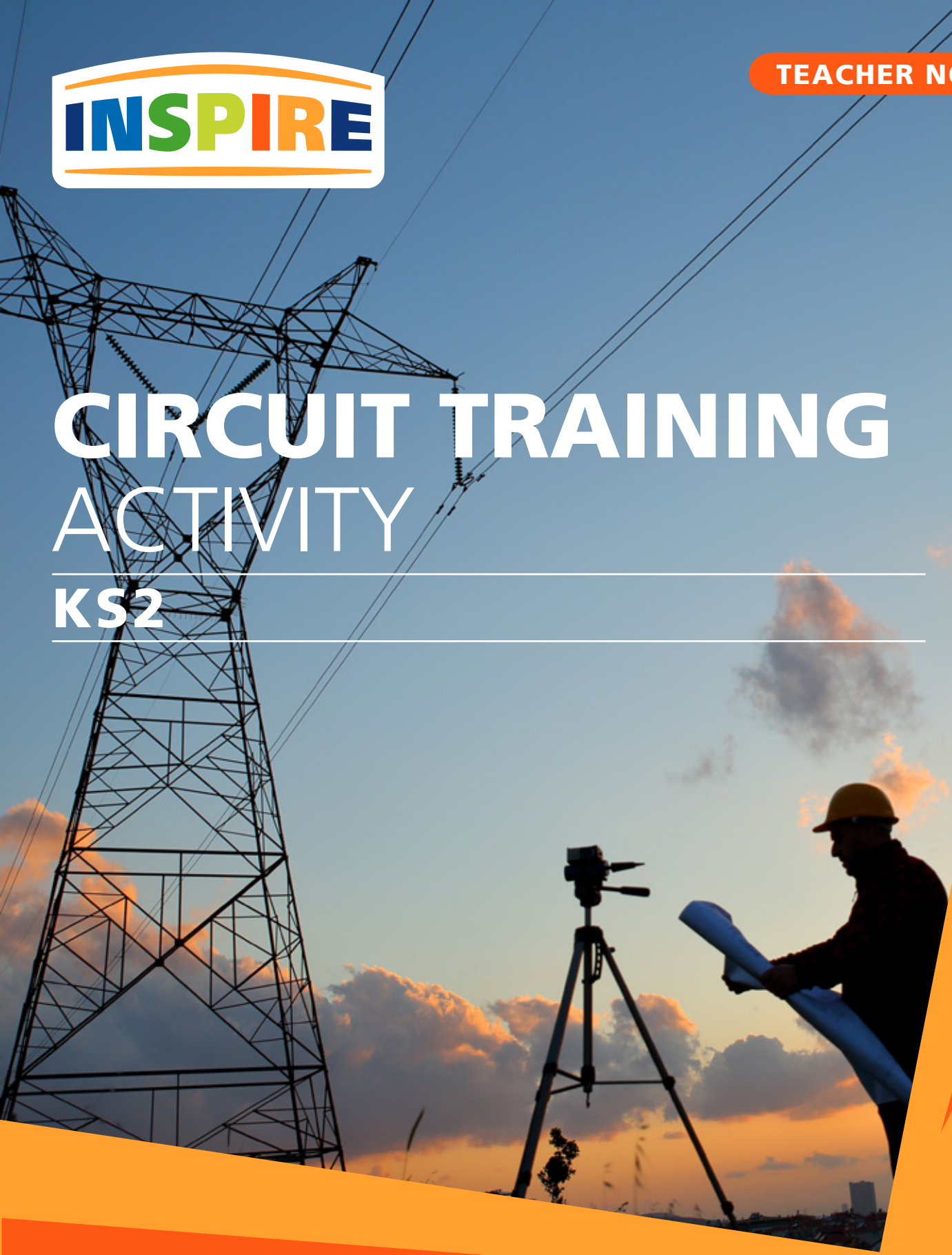
INSPIRE

TEACHER NOTES

CIRCUIT TRAINING ACTIVITY

KS2



SAVE INK - don't print this first page!

EDF ENERGY HPC CGN

Lesson overview

In this activity, students learn about electrical conductors and insulators. We examine the importance of conductors to help complete circuits and the importance of insulators for safety.

Learning objectives

- Learn about the difference between conductors and insulators
- Understand how this helps to create safe and effective electrical circuits
- Explore how people stay safe in jobs where they work with electricity, and future jobs in the energy industry

Subjects

Science
PSHE

Gatsby Benchmarks

This activity supports the following Gatsby Benchmarks:
2: Learning from career and labour market information: Discover a range of jobs in the energy industry.
4. Linking curriculum learning to careers: Explore ways in which people who work with electricity stay safe.

Timings

- Warm-up: 30 minutes
- Main activity: 40 minutes

Materials and set-up

For Part 1, children will need to gather a selection of household objects that represent a mix of electrical conductors and insulators. These might include: cutlery, plastic/paper cup, soft drinks can/bottle, hair clip, hair slide, book, glass jar, lolly stick, paperclip, pencil eraser, pencil and screwdriver. If you're delivering this at home, you might want to think in advance about what you have and where the items are located. Or if you're delivering this in a classroom environment, place a selection on a table, or consider hiding them around the room for children to find!

Optional materials:

- Toy circuit tester (such as an energy ball or energy stick);
- Circuit kit (for example, LittleBits)
- Alternatively, Operation or a similar 'steady-hand' buzzer game!

This **Activity Pack** contains the following materials:

- Teacher notes
- Student worksheet

This activity can be used in the classroom, led by a teacher. Or used for home schooling, as it involves objects commonly found in the home.

WARM-UP (30 mins)

Part 1: Electricity in its place

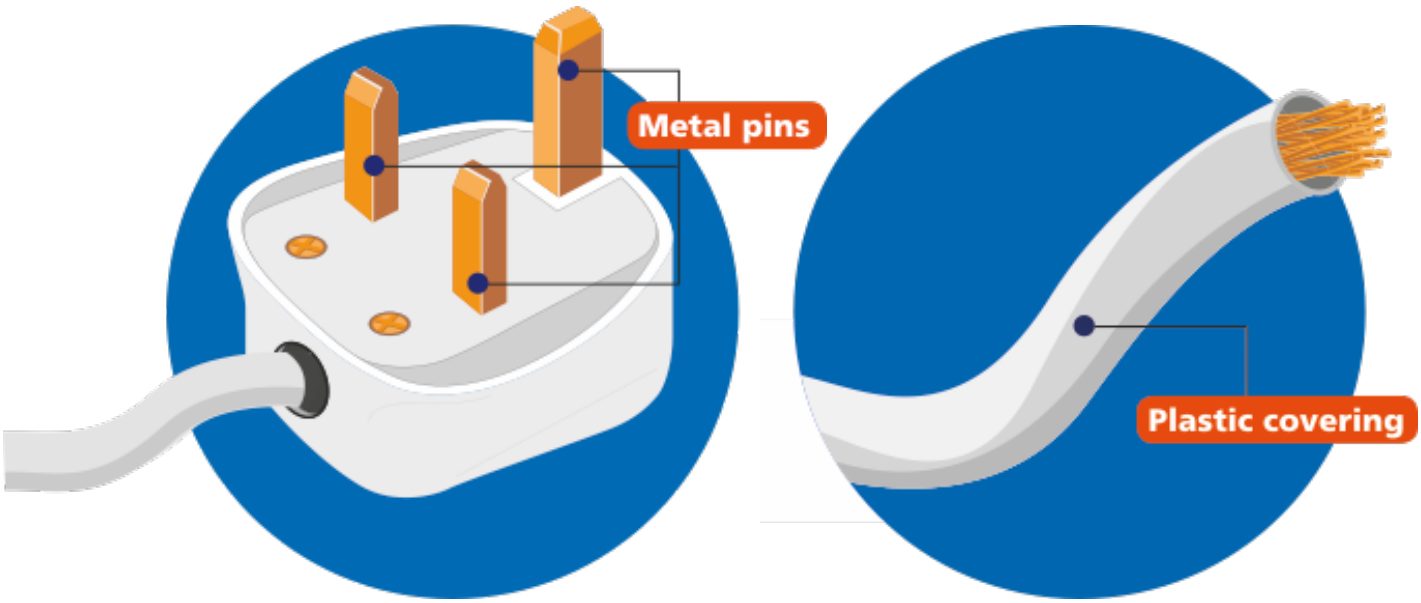
We use electricity to power many things in our homes. ***Ask students to look at the first task in their Worksheet and circle the things in the kitchen picture that use electricity.***

Now get them to think about where electricity flows and doesn't flow, by using these questions as a group discussion point:

- Why is it safe to touch mains devices, such as a washing machine or fridge?
- Why is it usually safe to touch a mains power lead or extension cable?
- But why must you be careful when inserting or removing a plug?

Prompt them, if necessary, to reach the conclusion that electricity doesn't flow through the outside of a device or cable. But it does flow through the pins on a plug.

Part 2: Conductors and insulators



How do we get electricity to go where we want it?

And how do we stop it going where it isn't wanted? The answer is we use a combination of **conductors** and **insulators**.

Ask students if they know the difference.

Materials that allow electricity to pass through them easily are known as **electrical conductors**. Materials that do **NOT** allow electricity to pass through them are known as **electrical insulators**.

We use conductors and insulators together to make safe 'pipes' for electricity to travel through. The metal core of a wire and the metal pins are great conductors. But the wire is wrapped in insulating plastic, which stops electricity escaping and causing damage or injury.

Part 3: Why is electricity dangerous? (Optional)

Electricity is the main way that energy travels to our homes and the power-hungry devices within them. Our devices need this energy – but the human body doesn't!

If you have one available, ask students to hold an energy ball or energy stick in both hands. It lights up because our bodies conduct electricity.

Try getting two people to join hands and hold the ball or stick in their other hand. **Does it still light up? How many people can the current pass through?**

IMPORTANT! People conduct electricity. So when we touch a live wire, the current flows through us. That's not a problem when it's a tiny battery powering an energy ball or stick. But mains electricity is powerful enough to cause serious damage, like burns. It could even be fatal.[1]

[1] https://firstaidforlife.org.uk/electric-shocks/

Part 4: Working with electricity

Many people work with electricity for a living. Some examples include:

- **Electricians:** An electrician is responsible for getting power safely into our homes and workplaces. They're highly trained in electrical circuits and safety, and regulated by a professional group to make sure they stick to the rules.
- **Vehicle mechanics:** Many mechanics work with the electric systems in traditional petrol cars – like its lights or ignition systems. But with more electric cars hitting the roads – which are powered by electricity – more mechanics will need to be trained in how to work safely with the powerful batteries and high-voltage circuits that electric cars use.
- **Electrical line workers:** These workers are trained to install and repair the high-voltage cables transporting electricity around the country. The lines carry dangerously high voltages and sometimes they can't be switched off, so knowing how to use electricity safely – and to take the necessary precautions to stay safe – is vital[2].
- **Construction workers:** Sometimes construction teams need to work near live electricity. For example when widening a road under overhead lines. This is why construction workers will receive training, follow set procedures, and you may see signs near where they're working to help keep them safe[3].

People who work with or near electricity are highly trained and take many safety precautions. The best one is to turn the electricity off altogether when working near or with it. Also, tools like screwdrivers and pliers typically have insulating handles for protection. And as an extra precaution, electricians and line workers may wear special insulating gloves or shoes to reduce the chances of a shock.

Ask students to look at the pictures of people working with or near electricity in their Worksheet. Can you label the equipment and actions they're taking to keep safe?

Testing mains wiring

This electrician is wearing eye protectors as he uses a multimeter to test a circuit. His hard hat also helps to protect him, while his hi-vis vest make sure other workers can see him.

Wiring a mains circuit

This electrician is holding the insulated handle of a screwdriver. He's wearing insulating rubber gloves for extra safety.

[2] https://www.payscale.com/research/UK/Job=Lineman/Salary
[3] https://www.guardiangoalposts.com/purchasing?imt=1&gclid=EAIaIQobChMIv_aU-eHB6QIVze3tCh2VjwPNEAAYAiAAEgIXp_D_BwE

Working on a live line

These line workers are separated from live wires by thick rubber sheeting and line 'shrouds' (these are the insulating orange tubes placed around the line). They're also wearing hard hats and harnesses to protect them from falls.

Working under live lines

Ever seen one of these before on construction sites? It's called a 'goalpost' and it marks a safe crossing point under live overhead wires. High visibility poles alert drivers to the risk, and prevent over-height vehicles getting too close to dangerous voltages.

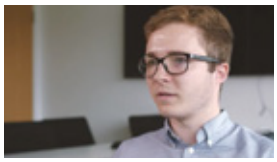
Mechanic working on car electrics

This mechanic is using a circuit tester to check for dangerous currents before working on a car's electrics. The mechanic is wearing insulating gloves for extra protection.

Future jobs in energy

There are so many upcoming jobs in the nuclear power industry. By the time you've left school, we'll have started producing electricity at Hinkley Point C... So we'll be looking for people like you to come and work for us!

With apprenticeships, you learn on the job while getting paid. Watch these films to hear from two young people working in nuclear power who took this career route.



Watch **this film** with Joel, a Nuclear Business Apprentice at EDF, to find out what he loves about his apprenticeship.

Hear from Rachel, a C&I Apprentice, in **this film** about the range of things she's learnt in her apprenticeship.

Find out more about **jobs in nuclear**

MAIN ACTIVITY

(40 mins)

Part 1: Which household items conduct electricity?

We're going to think about which household items conduct electricity, and which are insulators. Let's start with a treasure hunt! ***In five minutes, see how many of the following items you can find in different rooms around your home or classroom:***

Bathroom: toothbrush (I), hairbrush (I), hair slides (I/C), shampoo/shower gel bottle (I), plastic bath toy (I), flannel/small towel (I)

Kitchen: cutlery (C), plastic/paper cup (I), saucepan (C), wooden spoon (I), cheese (C), apple/pear (C), fizzy drink can (C)

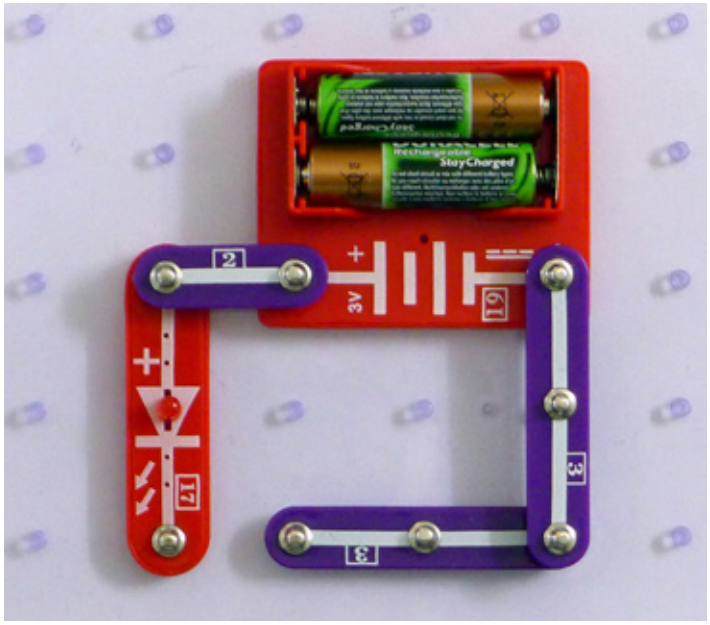
Elsewhere: sticky tape (I), adhesive putty (e.g Blu Tack) (I), DVD (I), paperclip (C), Lego brick (I), pencil (I), pencil eraser (I), screwdriver (C), coins (C), rubber welly boot (I)

Take a look at the items you've collected. Which ones do you think conduct electricity? Use the table in your Worksheet and record whether you think each item is a conductor or an insulator.

NB: Each of the items above is labelled below with an I (Insulator) or C (Conductor) so you can check students' answers.

If you're having trouble guessing, think about what each item is made from. Can you think of something else made from that material that's either a conductor or insulator – for example, a power cable made from metal and plastic?

Do you think some items might conduct electricity between some points on them, but not others? Why? Items like Coke cans and bikes only conduct between unpainted points. Bikes also have insulating parts, like tyres and bar grips. Many tools are made from metal so they're strong, but have a plastic or wooden handle that offers some protection against shock.



Time to test! *(Optional – move onto the next section if you don't have any of the items available)*

Here's how to test your guesses, depending on what you have available:

- **Energy ball/energy stick:** Hold the ball/stick in one hand and the item to test in the other. Gently touch the item to the ball or stick to see if a current flows through you and lights up the ball/stick.
- **Circuit kit:** Build a simple circuit with a battery block and a low-power device – ideally an LED if available (see the diagram, *opposite*). Test that the device lights or runs, then remove one link. Now place the item you're testing across the gap in the circuit and see if the device still powers up.

- **Operation/'Beat the Buzz' style game:** You'll need a couple of lengths of wire to make this work – insulated bell wire is ideal. Tape a length of wire to an Operation site or a site on the bendy wire. If you're using a buzzer game where the wand is captive around the bendy wire, move the wand to the game's safe space and tape a second length of wire to its tip. Test Operation – or any other buzzer game you're using – by touching the free ends of the wires together. If the buzzer sounds, you're ready to test some household objects!

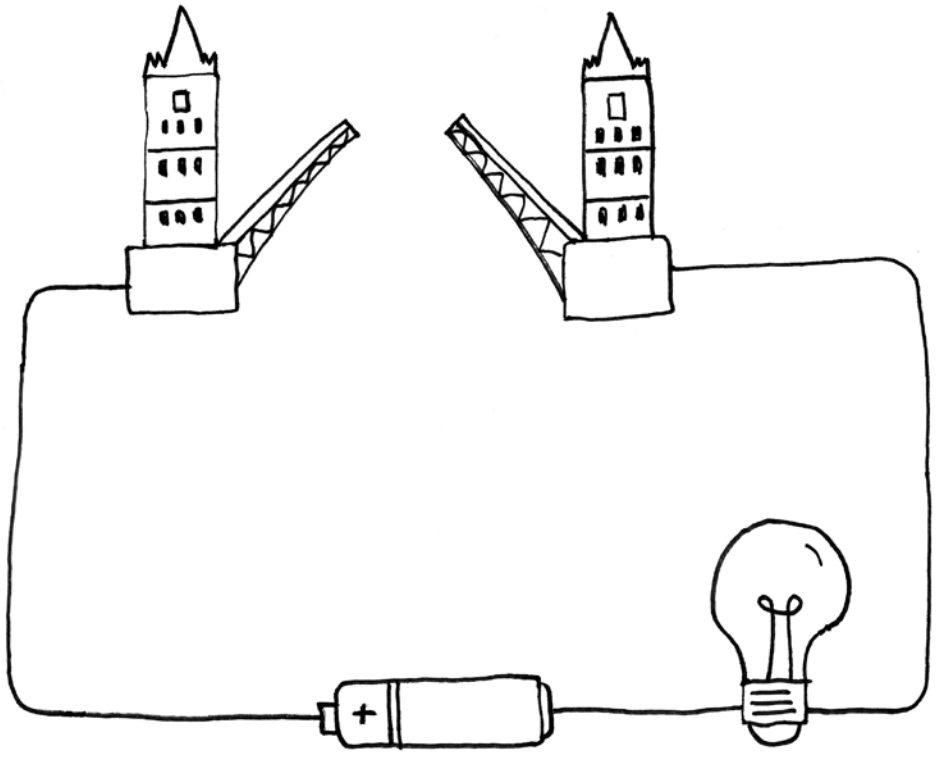
Some ways of testing are more sensitive than others. The energy ball or stick is best, whereas buzzer games aren't particularly sensitive so might not give you as clear a result.

Test all the objects you included in your table and complete the 'results' column in your Worksheet. How many did you guess right? Did any of the results surprise you? Can you see a reason why an object didn't do what you expected? This might include being painted or coated (e.g. coloured paperclip), or being made from a different material than the student originally thought (e.g. a plastic hair slide vs. a metal hair slide).

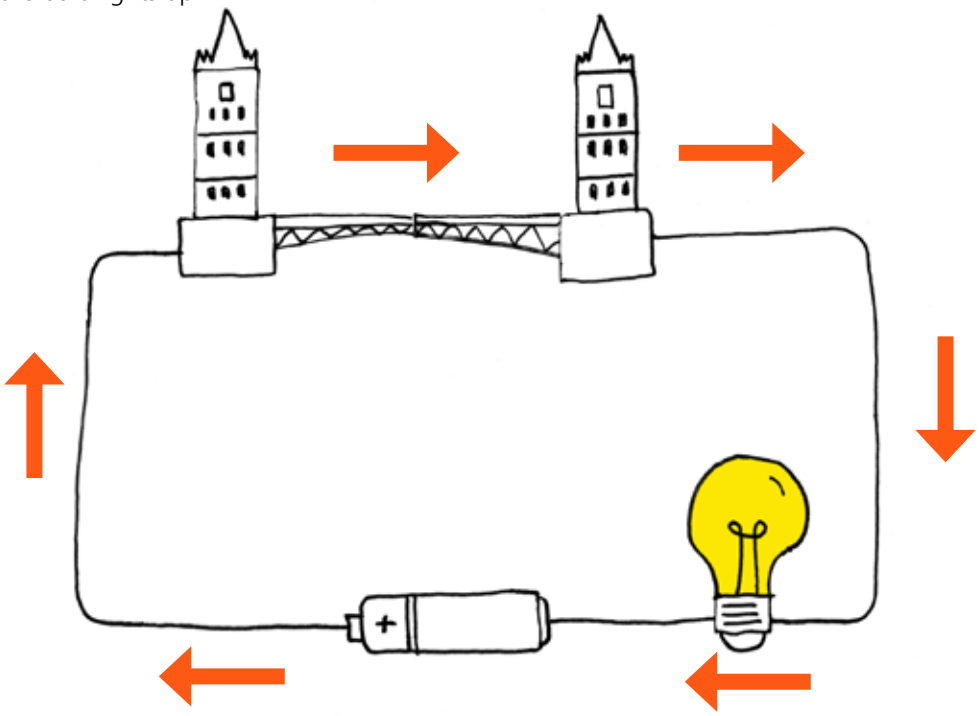
Part 2: The circuit of life

The electricity that powers the world around us always flows in a circuit, from a power source, through a device (like a motor), then back to the source. Electricity only flows when the circuit is complete.

For the simplest example, think of a torch with a battery, switch, and a bulb. When the switch is open (off), the circuit is incomplete and electricity can't flow – a bit like traffic waiting while Tower Bridge opens up (like in the diagram below).



When you close the switch – or Tower Bridge, in this example – there's a full circuit through the bulb and back to the battery. Electricity flows and the bulb lights up.



In this simple example, opening the switch breaks the contact between the conductors that make up the circuit.

If you used an energy ball, circuit kit or buzzer game to test your conductors and insulators, then good news! You've already built a circuit, and your household items were a type of of switch that bridged the gap in the circuit.

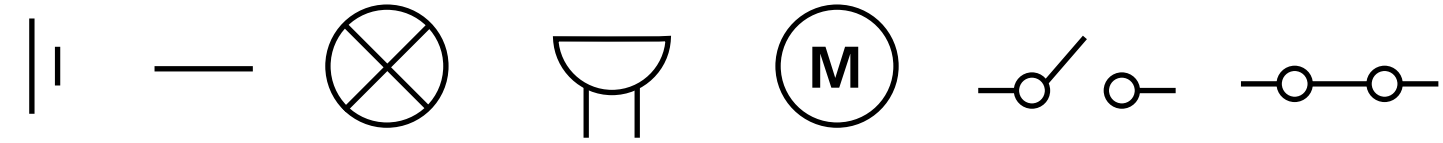
Circuit symbols
Can you see why there might be a problem with the kind of circuit diagrams we've drawn above?

People who work with electricity need to understand how things have been designed and wired, but they can't do that if everyone draws circuits in different ways – or uses a picture of Tower Bridge instead of a switch!

We need an immediately recognisable way to draw common components like bulbs, wires and motors. And that's why there's a set of standard symbols used to draw circuits.

Quick quiz

Each of the symbols in your Worksheet represents a component in a basic electrical circuit. Can you match up the definitions with the symbols?



Battery **Wire** **Bulb** **Buzzer** **Motor** **Switch (off)** **Switch (on)**

Know your circuits

Can you label the components in the two circuit diagrams in your Worksheet and answer the question at the bottom?

Diagram 1

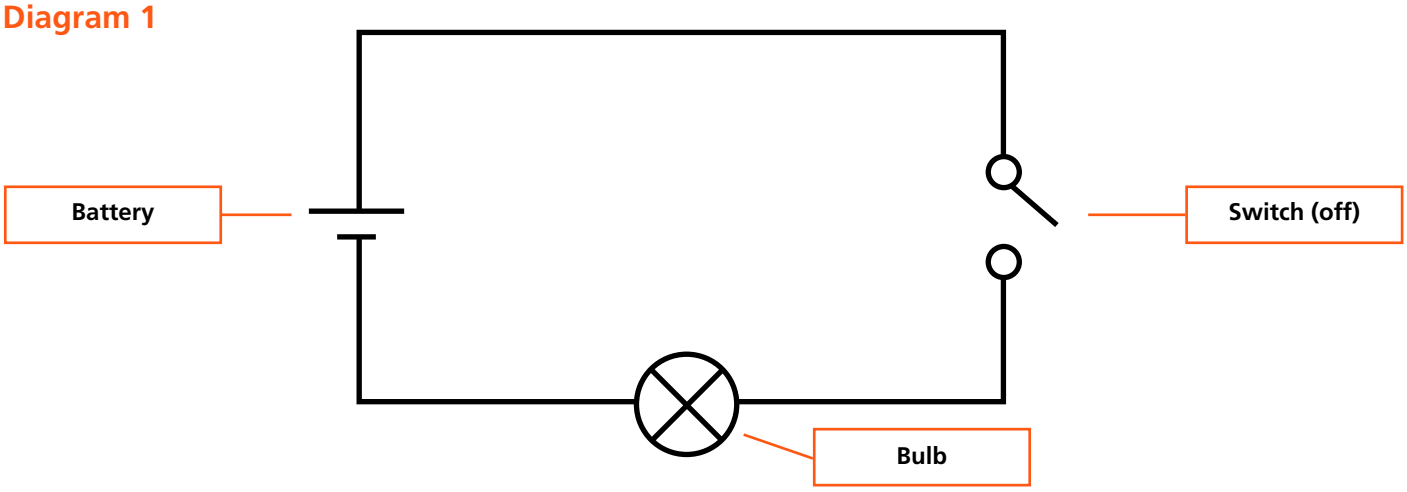
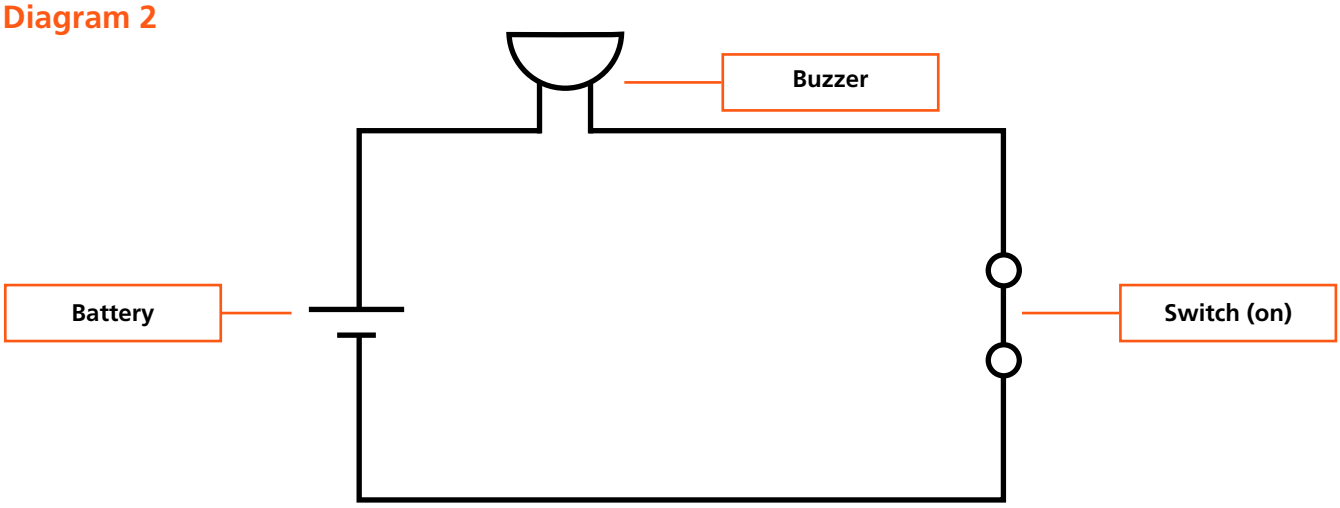


Diagram 2



Q. Which diagram shows a closed circuit – and how do you know this?
A. Diagram 2 because the switch is closed and it's a complete circuit.

Curriculum links

Science: Electricity

PSHE: Living in the wider world: L5. ways of carrying out shared responsibilities for protecting the environment in school and at home; how everyday choices can affect the environment (e.g. reducing, reusing, recycling; food choices).

Find out more about **Hinkley Point C** and **careers in the nuclear industry**

WARM-UP

Part 1: Electricity in its place

We use electricity to power many things in our homes: from mobile phones to games consoles, and kettles to lights.

Circle the things in the picture below that use electricity.

Part 4: Working with electricity

Look at these pictures of people working near electricity. **Can you circle the equipment and actions they're taking in each picture to keep themselves safe?**


Source: https://www.hse.gov.uk/pubnS/gs6.pdf

MAIN ACTIVITY

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Kitchen: cutlery, plastic/paper cup, saucepan, wooden spoon, cheese, apple/pear, fizzy drink can

Elsewhere: sticky tape, adhesive putty (e.g Blu Tack), DVD, paperclip, Lego brick, pencil, pencil eraser, screwdriver, coins, rubber welly boot

Take a look at the items you've collected. Which ones do you think conduct electricity? Use the table below to record what you've found and whether you think each item is a conductor or an insulator.

ITEM	GUESS: CONDUCTOR OR INSULATOR?	RESULT

ITEM	GUESS: CONDUCTOR OR INSULATOR?	RESULT

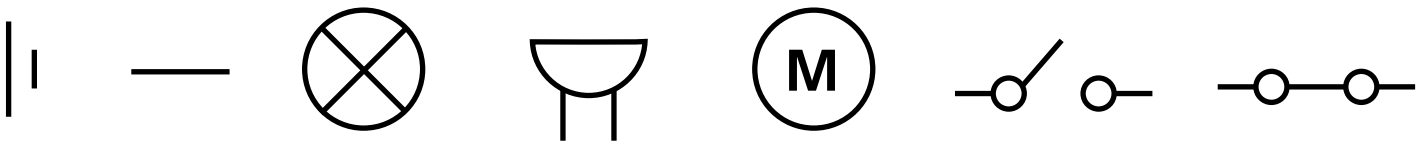
If you're having trouble guessing, think about what each item is made from. Can you think of something else made from that material that's either a conductor or insulator – for example, a power cable made from metal and plastic?

TALKING POINT: Do you think some items might conduct electricity between points on them, but not others? Why?

Part 2: The circuit of life

Circuit symbols: Quick quiz

Each of the symbols below represents a component in a basic electrical circuit. **Can you draw a line to match up the definition with the correct symbol?**

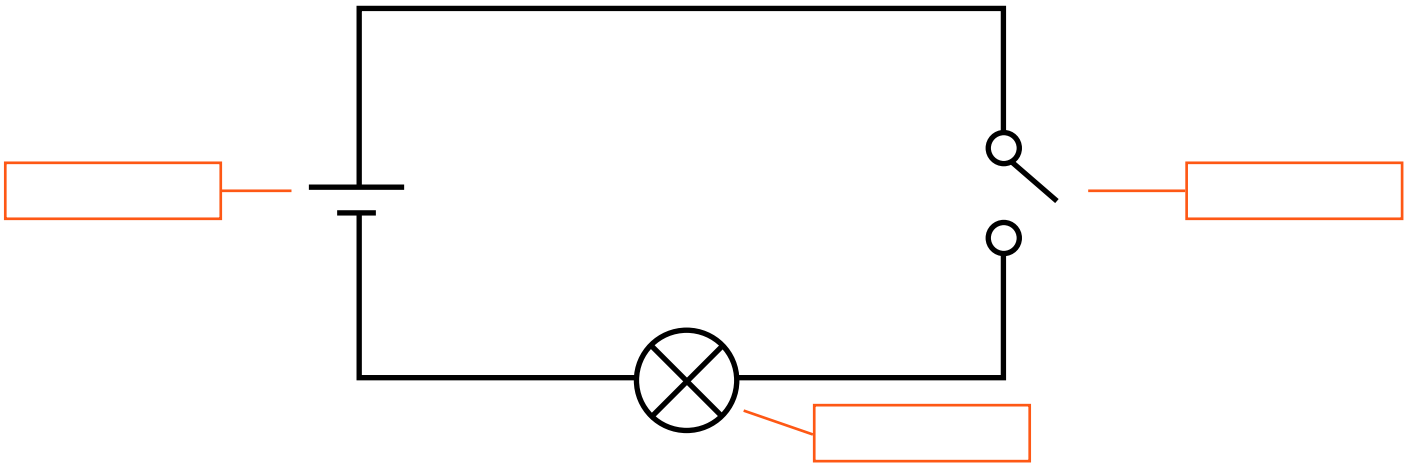


Switch (off) **Battery** **Buzzer** **Wire** **Bulb** **Switch (on)** **Motor**

Know your circuits

Can you label the components in the two circuit diagrams and answer the question at the bottom?

Diagram 1



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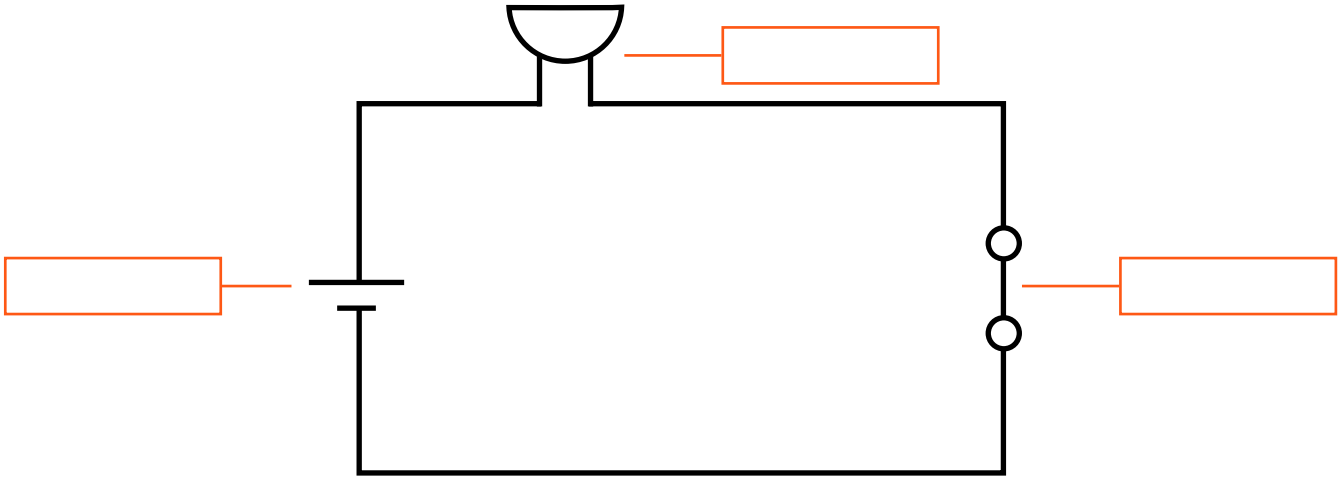

Q. Which diagram shows a closed circuit – and how do you know this?

A. _____

_____