YEAR 4: SPRING 1 – INVENTIONS
SCIENCE: Electricity

Ocean Academy Poole
an Aspirations Academy

UNDERSTAND, DESCRIBE AND EXPLAIN:

To understand that common appliances run on electricity and identify these

Electricity	***Electric current***	***Flow***	***Electric charge***	***Generate***	***Current electricity***	***Material***	***Wires***
Power source	***Appliance***	***Batteries (DC)***	***Mains electricity (AC)***	***Direct***	***Alternating***	***Energy source***	
Primary/secondary energy source		***Fossil fuels***	***Wind power***	***Solar power***	***Hydro power***	***Renewable/Non-renewable***	

Learning links:
Year 6: Science Electricity
Year 4: DT Rockband stages

What is electricity?

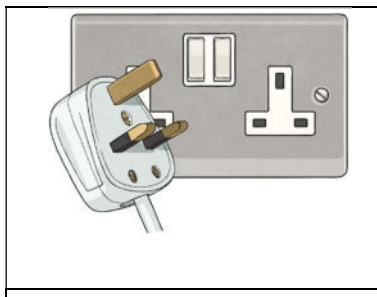
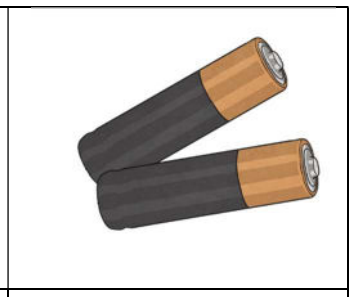
When we refer to ***electricity***, what we usually mean is ***electric current***, which is the ***flow of electric charge***. **Electricity** occurs naturally. For example, lightning, static electricity, bioelectricity produced in living things like electric eels and even in humans to deliver messages from the brain.

Electricity powers many of the things we use ***everyday*** - televisions, phones, computers, lights and microwaves. Over time, ***scientists*** worked out how to ***generate electricity*** so that it could be used ***to make things work***. This meant that ***electricity*** was more ***readily available*** and ***things*** could be ***powered*** more ***easily***. This sort of electricity is known as ***current electricity***.

THINKING POINT:

What is electricity? Can you think of any natural examples?

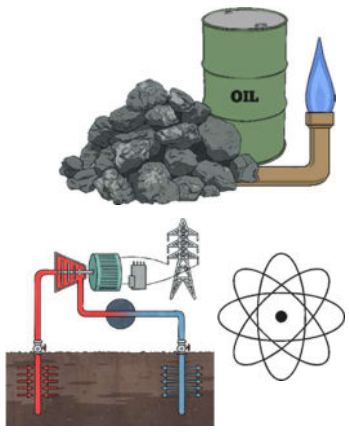
Current electricity is a ***flow*** of ***electrical charge*** through a ***material***. Often it ***flows*** through ***wires*** to ***travel*** from a ***power source*** to an ***appliance***. There are ***two types*** of ***electrical current*** that we ***use*** to ***power appliances***:

	
Mains electricity: which is an **alternating current (AC).**	**Batteries:** which generate a **direct current (DC).**

Where Does Electricity Come From?

An ***energy source*** is a way of ***powering something***. ***Electricity*** is a ***secondary energy source***.
Since ***electricity*** is a ***secondary source of energy***, it needs to be ***generated***, or made, from a ***primary source of energy***.
Primary sources of energy include:

- Burning fossil fuels like gas, oil or coal creates heat, which can be generated in to electricity.
- Harnessing wind power to turn windmills to generate electricity.
- Harnessing solar power to shine on special panels and turn UV energy in to electricity.
- Nuclear energy – combining or splitting atoms, which creates heat, which can be turned to electricity.



THINKING POINT:

Which of these is the most environmentally friendly?

Will we ever run out of electricity?

There are ***several different ways*** of ***generating electricity*** to use to ***power appliances***.
Some of these ***methods*** of generating electricity are ***renewable***. This means they will ***never run out***, so we can use them to ***generate electricity forever***.
However, ***some methods*** are ***non-renewable***. This means that they ***will run out***, and when they do we will not be able to use them to ***generate electricity***.

Renewable	Non-renewable
Solar **Nuclear** **Geothermal** **Hydro** **Wind**	**Fossil fuels** *Oil *Coal *Natural gases

Coal, ***oil*** and ***natural gas*** will all ***run out one day***. When they do, we will ***not*** be ***able*** to ***burn*** these materials to ***generate electricity***. However, these materials are ***cheaper*** than the ***non-renewable sources***. For this reason, ***most*** of our ***electricity*** is currently ***generated*** from ***fossil fuels***.

THINKING POINT:

Will we ever run out of electricity? What will happen when the fossil fuels run out?

EXPLORE AND INVESTIGATE:

HYPOTHESISE
ENQUIRE
TEST
RECORD
REPORT
CONCLUDE

What would life be like without electricity?

Look around you. Identify all of the electrical appliances.
Sort these appliances in to groups whether they run by mains electricity or batteries.
Discuss ways things would be different.
What would your classroom be like?
How would you learn?
What would your home be like?
How would people stay in touch?

KEY ASSESSMENT AND APPLICATION OPPORTUNITIES:

EXS:

1. What is electricity? Can you explain it in 5 sentences?
2. Where does electricity come from?

GDS:

1. Will we ever run out of electricity?

UNDERSTAND, DESCRIBE AND EXPLAIN:

To recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit

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

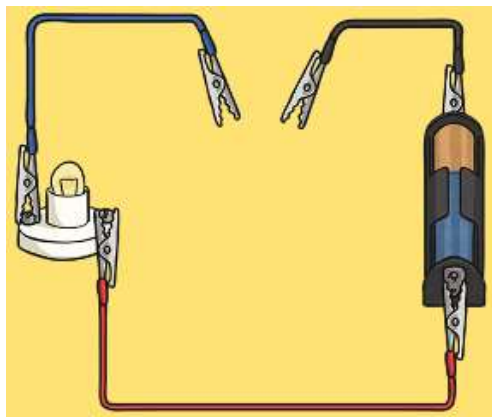
To construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers

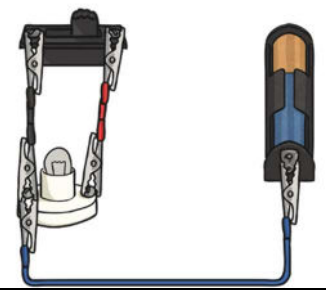
Learning links:
Year 6: Science Electricity
Year 4: DT Rockband stages

Electrical circuit	***Power supply***	***Mains (AC)***	***Battery (DC)***	***Positive***	***Negative***	***Complete***	***Incomplete***
Switches	***Dimmer switch***	***Pull switch***	***Paddle switch***	***Push-button switch***		***Selector switch***	***Electrons***

Electrical circuits:

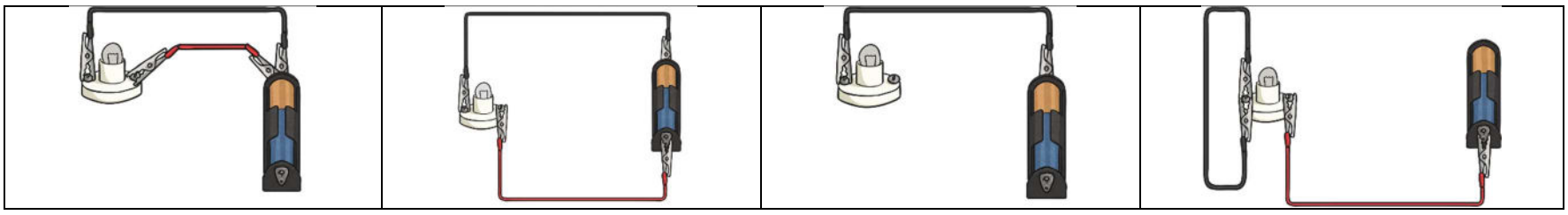
Current electricity is the ***flow*** of ***electrical charge*** though ***materials***.
A ***complete circuit*** must have a ***power supply***. This ***power supply*** could be the ***mains***, or it could be a ***battery***.
For a ***circuit*** to be ***complete,*** there ***must*** be ***wires connected*** to ***both*** the ***positive*** and ***negative*** ends of the ***power supply***. ***Electricity*** can ***only flow*** around a ***complete circuit*** that has ***no gaps***.



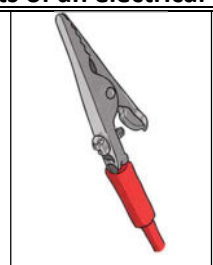
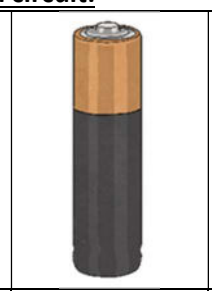
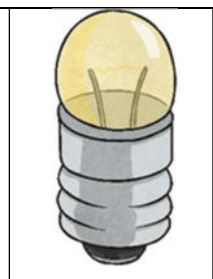
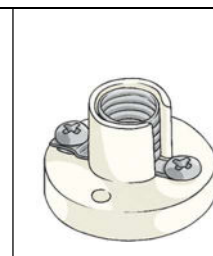
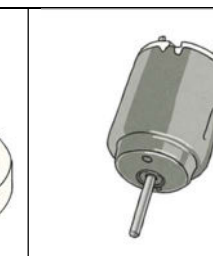
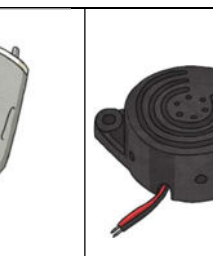
	
This is an ***incomplete circuit*** because: 1. There is a ***gap*** in the ***circuit***, so the ***electrical current cannot flow*** around it. 2. The ***wires do not connect*** to ***both*** the ***positive and negative ends*** of the ***power supply*** (the battery).	This is a ***complete circuit*** because: 1. There is a ***power supply*** (the battery). 2. There are ***no gaps*** anywhere, so the electrical current can flow around the ***entire circuit***. 3. The ***wires connect*** to both the ***positive*** and ***negative ends*** of the ***battery***.

THINKING POINT:

Look at the circuits below. Are they complete or incomplete? Why?

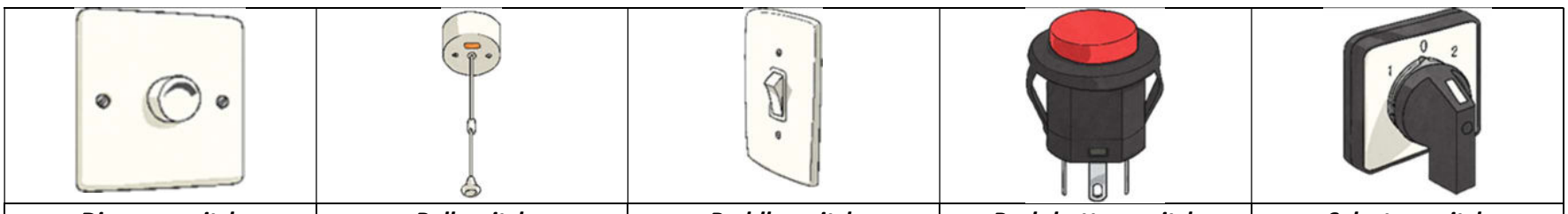


The different parts of an electrical circuit:

							
Battery holder	***Crocodile Clip***	***Battery (cell)***	***Bulb***	***Bulb holder***	***Motor***	***Buzzer***	***Wires***

Building and controlling circuits:

Complete circuits must have a ***power source*** (mains or battery) which is ***connected*** at both ends (positive and negative) by ***wires*** made from an ***electrical conductor*** (i.e. metal). These ***wires*** must ***connect*** the ***power source*** to the ***appliance*** with no gaps.
If you successfully build a ***complete circuit***, the ***appliance*** will ***remain on*** until the ***circuit is broken***. This poses ***problems*** in ***everyday life***, as we are ***unable*** to ***control*** the ***electrical appliance***. Would you want the kettle to boil all day and the lights to be on endlessly?
This is where ***switches*** are used. There are ***wide varieties*** of ***switches*** useful for ***different purposes***:

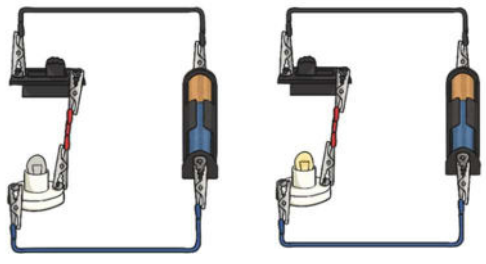
				
Dimmer switch	***Pull switch***	***Paddle switch***	***Push-button switch***	***Selector switch***

THINKING POINT:

Why have humans designed different switches like the ones above?

How does a switch work?

A ***switch*** '***breaks'*** a ***complete circuit*** on ***purpose*** to ***stop the flow*** of ***electrons*** when it is ***off.***
When the ***switch*** is ***on***, the ***circuit*** is ***complete*** and so the ***electrons*** are able to ***flow*** around the ***circuit.***
A ***circuit with a switch*** is not the same as an ***incomplete circuit.*** In an ***incomplete circuit***, the ***electrons*** are ***unable*** to ***flow*** at all ***whether the switch is on or off.***



UNDERSTAND, DESCRIBE AND EXPLAIN:

To recognise some common conductors and insulators, and associate metals with being good conductors

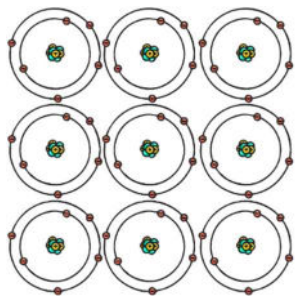
Conductors	*Insulators*	*Atoms*	*Electrons*	*Electric current*	*Electric flow*	*Complete*	*Incomplete*
Materials	*Testing*	*Conductivity*	*Insulation*	*Metals*	*Wood*	*Plastic*	*Glass*

Learning links:

Year 6: Science Electricity
Year 4: DT Rockband stages

Electrical conductors and insulators:

A ***conductor*** of ***electricity*** is a ***material*** that ***electricity*** can ***flow*** through ***easily***. ***Metals*** are ***good conductors***.
An ***insulator*** of ***electricity*** is a ***material*** which ***electricity*** is ***unable*** to ***flow*** through. ***Wood***, ***plastic*** and ***glass*** are good ***insulators***.

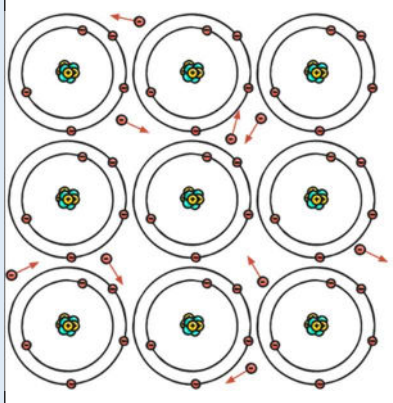


Electrical insulators, such as woods, plastics and glass:

In most materials, the ***atoms*** are ***organised*** like this:
The ***electrons cannot move freely*** in these materials and therefore ***no electric current*** can ***flow*** through.
These ***materials*** are called ***electrical insulators***.
If you create a ***circuit*** which ***includes*** an electrical ***insulator***, it will be ***incomplete*** (even if it looks complete!) as ***no electrons*** will ***flow*** through the material.

THINKING POINT:

Can you think of some everyday items where insulation is useful?



Electrical conductors, such as metal:

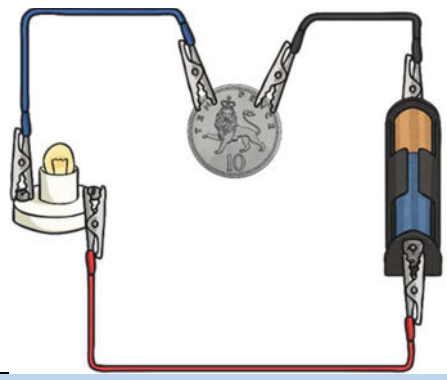
In some ***materials***, some of the ***electrons*** are ***free electrons*** and ***can move***.
If you create a ***circuit*** with these materials, the ***free electrons*** can be made to ***move*** in ***one direction***, creating an ***electric current***. These materials are called ***electrical conductors***.

THINKING POINT:

Can you think of some everyday items where conduction is useful?

Testing for conductivity:

You can ***test*** whether a ***material*** is a ***conductor*** or an ***insulator*** by setting up a ***complete circuit*** and then ***adding*** a ***material*** to the ***circuit*** using an extra pair of ***wires***. If the circuit ***continues to work*** with the ***material*** in the circuit, this shows ***good conductivity***. However, if the ***circuit*** becomes ***incomplete*** when the ***material*** is ***added***, this shows that this material is a ***poor conductor*** and therefore an ***insulator***.



THINKING POINT:

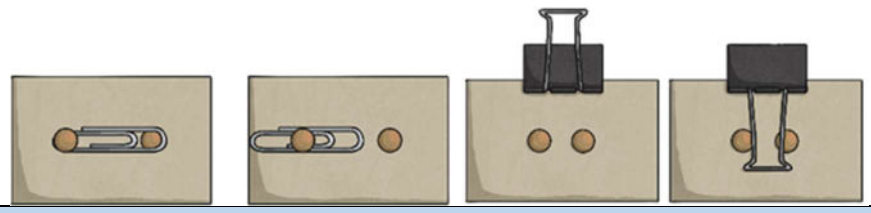
Would you be able to set up this simple investigation? Which materials would you test?

EXPLORE AND INVESTIGATE:

HYPOTHESISE
ENQUIRE
TEST
RECORD
REPORT
CONCLUDE

Investigating conductivity and switches:

1. Build a complete circuit with at least a battery and an appliance (bulb/buzzer/motor).
2. Add in 2 extra wires with crocodile clips and test the conductivity of different materials. Record which materials were successful or not.
3. How does the brightness of the bulb change with the different materials? Are some materials better than other conductors?
4. Sticking two pins in to a piece of cardboard create 2 switches as shown in the images below.
5. Test the switches in the different positions.
6. Time how long it takes to break and reconnect the circuit. Does it change for different switches?



KEY ASSESSMENT AND APPLICATION OPPORTUNITIES:

EXS:

1. What are the least amount of components needed to create a working circuit with a bulb?
2. Can you build a complete, simple, series circuit with a switch to control a bulb/buzzer?
3. What is the difference between a conductor and an insulator?

GDS:

1. Can you build a complete, simple series circuit and investigate what happens when you add more or less of a component and explain your findings?
2. Why do you think wires made of copper and coated in plastic?