Investigating batteries

We are learning how to:

- Describe the link between chemical energy and electricity.
- Investigate how fruit batteries work.

We have learnt how electricity and magnetism are linked. There is also a link between electricity and chemical energy, which we now explore.

FIGURE 2.6.10a: Alessandro Volta and his battery, in about 1800

Different types of battery

There are many different types of batteries in the world. They all have one thing in common – energy is transferred by chemical reactions to electrical energy. The amount of chemicals and types of reactions involved determine how much energy can be transferred.

The first **battery** was developed by Alessandro Volta, who placed brass and copper plates in a salty solution. The brass contains zinc, which enables the battery to work.

By using different metals and solutions, more or less electricity can be transferred.

1. Why do you think batteries become hot if they are used for long periods of time?
2. Draw an energy transfer diagram to show the changes taking place in a battery.

How do batteries work?

In Topic 5.5 you learned about static electricity – the transfer of charged particles by rubbing different materials together. The resulting force of attraction or repulsion leads to the transfer of energy by movement.

Charged particles are also involved in current electricity. In a battery, negatively charged particles, called **electrons**, move as a result of chemical changes in the battery. They build up on the negative terminal of the battery, causing electrons within the metal wires in all parts of the circuit to move away from the negative terminal. The flow of electrons forms the **electric current** – this can be used to transfer energy that makes appliances work. The bigger the difference in charge between the negative and positive terminals of the battery, the greater is the energy that can be transferred by the current.

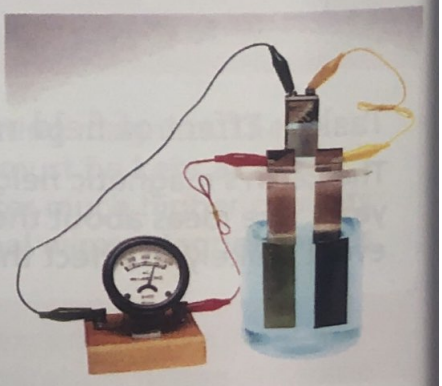

FIGURE 2.6.10b: Charged particles move through the solution between the copper plate and the zinc plate. This creates an electric current in the circuit.

The disadvantage of using batteries, compared to generating electricity from movement energy using a dynamo, is that the energy is transferred out of the battery and the battery needs to be replaced or recharged.

3. Summarise in a bullet list how a battery works.
4. What are the advantages of using batteries, compared with a dynamo, to make an electric current?

Explaining fruit batteries

Figure 2.6.10c shows a fruit battery in operation. Two different metals are placed, a distance apart, at the same depth within the fruit. Wires connect the two metals in a circuit containing a meter that shows a **voltage** is produced. The liquid inside the fruit enables charged particles in the fruit to take part in the chemical changes – a battery will not work with dried fruit.

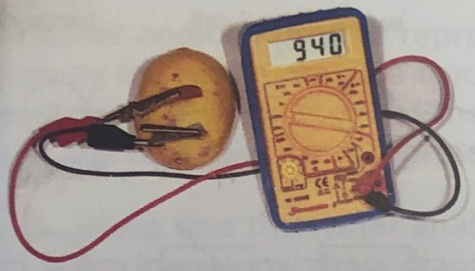

FIGURE 2.6.10c: A fruit battery

Different combinations of metals will produce different results. Table 2.6.10 shows the voltages from an investigation of different combinations of metals.

TABLE 2.6.10: Results from an investigation of different combinations of metals

Metal 1	Metal 2	Voltage produced (V)
copper	zinc	0.75
copper	magnesium	1.37
copper	iron	0.49
zinc	magnesium	0.67
zinc	iron	0.31
iron	magnesium	0.95

5. Look at Table 2.6.10 and Figure 2.6.10d. Can you see a pattern between the metals that produce the highest voltage and their reactivity?
6. Apart from changing the metals, can you think of two other ways of increasing the voltage from a fruit battery? Explain how each one works.

Did you know...?

The first rechargeable battery was made in 1836. It was a lead–acid battery, a system still in use today.

potassium	most reactive	K
sodium		Na
calcium		Ca
magnesium		Mg
aluminium		Al
carbon		C
zinc		Zn
iron		Fe
tin		Sn
lead		Pb
hydrogen		H
copper		Cu
silver		Ag
gold	least reactive	Au
platinum		Pt

FIGURE 2.6.10d: Reactivity series of elements

Key vocabulary

battery
electron
electric current
voltage