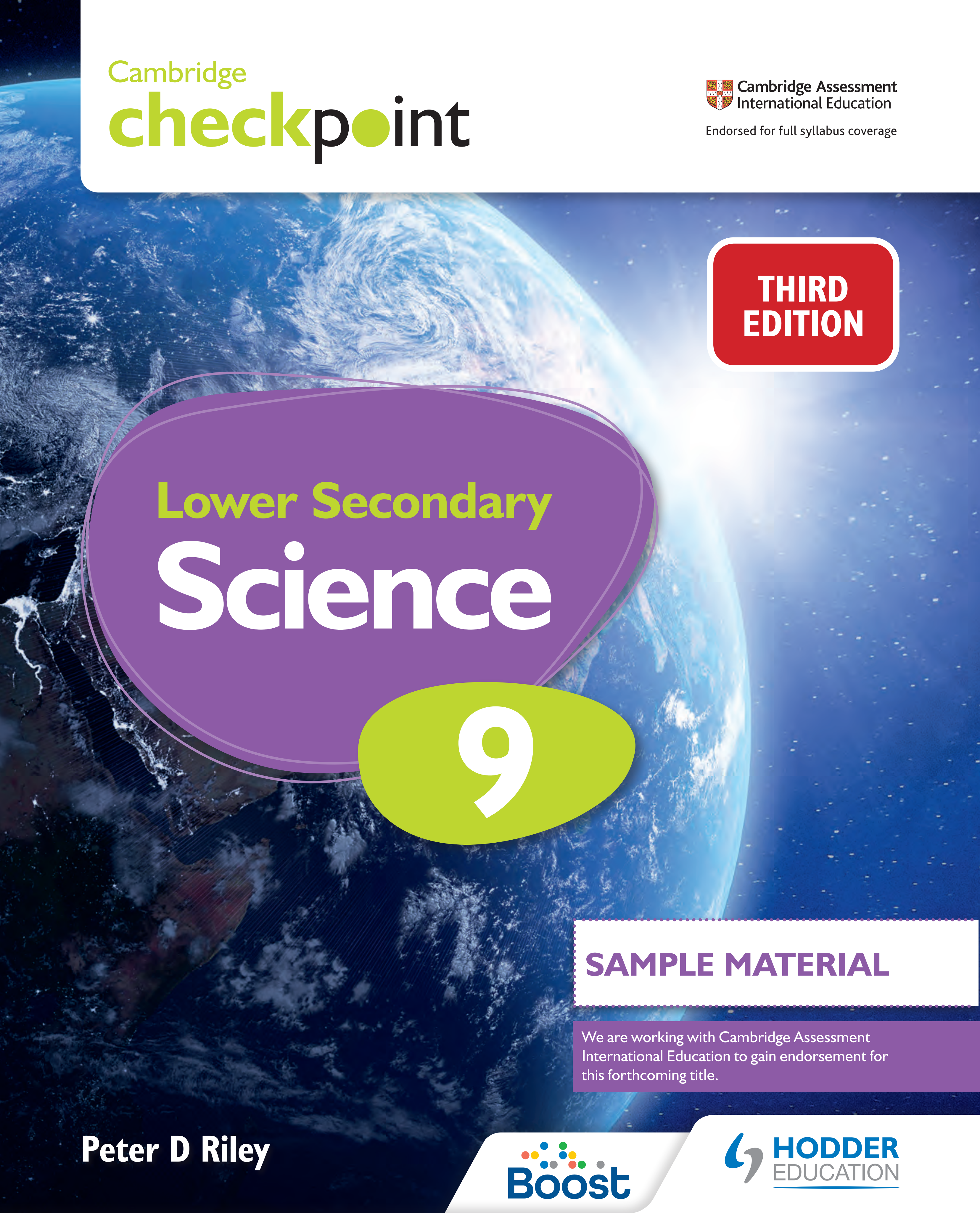
Cambridge checkpoint

Cambridge Assessment International Education

Endorsed for full syllabus coverage



THIRD EDITION

Lower Secondary Science 9

SAMPLE MATERIAL

We are working with Cambridge Assessment International Education to gain endorsement for this forthcoming title.

Peter D Riley

Boost

HODDER EDUCATION

Please note this is a sample and not a full chapter

We are working with Cambridge Assessment International Education to gain endorsement for this forthcoming series.

Help students engage with and fully understand topics they are studying with engaging content following the new Cambridge Lower Secondary Science curriculum framework (0893) from 2020.

Student's Book £19.50 March 2021	Boost eBook £13 for 1-year access March 2021	Workbook £7.25 June 2021	Teacher's Guide with Boost subscription £150 for access until 2026 July 2021
Student's Book 7 9781398300187	eBook 7 9781398302136	Workbook 7 9781398301399	Teacher's Guide 7 9781398300750
Student's Book 8 9781398302099	eBook 8 9781398302174	Workbook 8 9781398301412	Teacher's Guide 8 9781398300767
Student's Book 9 9781398302181	eBook 9 9781398302228	Workbook 9 9781398301436	Teacher's Guide 9 9781398300774

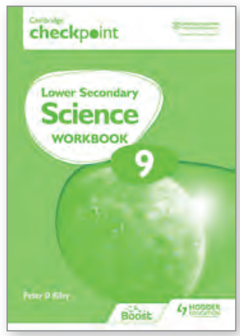
Boost eBooks – interactive, engaging and completely flexible

Boost eBooks use the latest research and technologies to provide the very best learning experience for students. They can be downloaded onto any device and used in the classroom, at home or on the move.

- **Interactive:** Packed with features such as notes, links, highlights, bookmarks, formative quizzes, flashcards, videos and interactive revision.
- **Accessible:** Effortlessly support different learning styles with text-to-speech function.
- **Flexible:** Seamlessly switch between the printed page view and interactive view.

Practise and consolidate knowledge gained from the Student's Book with this, write-in workbook full of corresponding learning activities.

- Provide guidance for students on successfully covering all learning objectives within the new curriculum framework.
- Reinforce students' understanding of key scientific concepts with varied question types, quizzes and the use of ICT.
- Challenge students with extra practice activities to encourage regular self-assessment.



Created with teachers and students in schools across the globe, Boost is the next generation in digital learning for schools, bringing quality content and new technology together in one interactive website.

The Cambridge Checkpoint Lower Secondary Science Teacher's Guides include a print handbook and a subscription to Boost, where you will find a range of online resources to support your teaching.

- **Confidently deliver the new curriculum framework:** Expert author guidance on the different approaches to learning, including developing scientific language and the skills required to think and work scientifically.
- **Develop key concepts and skills:** Suggested activities, quizzes and guidance on assessment, as well as ideas for supporting and extending students working at different levels.
- **Support the use of ESL:** Introductions and activities included that have been developed by an ESL specialist to help facilitate the most effective teaching in classrooms with mixed English abilities.
- **Enrich learning:** Audio versions of the glossary to help aid understanding, pronunciation and critical appreciation.

Cambridge checkpoint

THIRD EDITION

Lower Secondary Science 9

Peter D Riley

HODDER EDUCATION
AN HACHETTE UK COMPANY

Photo credits: p.3 *t*, *l* © Hans-Joerg Krohn; p.3 *t*, *c* © INNA FINKOVA/Alamy Stock Photo; p.3 *t*, *r* © Arbalest/stock.adobe.com; p.5 *t* © Panther Media GmbH/Alamy Stock Photo; p.5 *b* © Photo Researchers/Science History Images/Alamy Stock Photo; p.8 *t* © Martyn F. Chillmaid

Orders: please contact Bookpoint Ltd, 130 Park Drive, Milton Park, Abingdon, Oxon OX14 4SE.
Telephone: +44 (0)1235 827827. Fax: +44 (0)1235 400401. Email: education@bookpoint.co.uk
Lines are open from 9 a.m. to 5 p.m., Monday to Saturday, with a 24-hour message answering service.
You can also order through our website: www.hoddereducation.com

ISBN: 9781398302181

First published in 2021
This edition published in 2021 by
Hodder Education,
An Hachette UK Company
Carmelite House
50 Victoria Embankment
London EC4Y 0DZ

www.hoddereducation.com

Impression number 10 9 8 7 6 5 4 3 2 1

Year 2025 2024 2023 2022 2021

Cover photo © NicoElNino – stock.adobe.com

Illustrations by Integra Software Services Pvt. Ltd., Pondicherry, India. Figure 14.1 by Barking Dog Art.

Typeset in Integra Software Services Pvt. Ltd., Pondicherry, India.

Printed in the UK.

A catalogue record for this title is available from the British Library.

Contents

How to use this book

Introducing science

Biology

Chapter 1 Water and life
Chapter 2 Photosynthesis
Chapter 3 Genetics
Chapter 4 Care in fetal development
Chapter 5 Environmental change and extinction

Chemistry

Chapter 6 The Periodic Table
Chapter 7 Bonds and structures
Chapter 8 Density
Chapter 9 Displacement reactions
Chapter 10 Preparing common salts
Chapter 11 Rates of reaction

Physics

Chapter 12 Energy
Chapter 13 Waves
Chapter 14 Electric circuits

Earth and space

Chapter 15 The planet Earth
Chapter 16 Cycles on Earth
Chapter 17 Earth in space
Chapter 18 Theories of everything

Glossary

Index

Acknowledgements

14 Electric circuits

- A simple circuit
- Series and parallel circuits
- Current
- Voltage
- Resistance
- Buzzers
- Batteries

Do you remember?

- Name a good conductor of electricity.
- Name an electrical insulator.
- If you make a circuit and it does not conduct electricity, what do you need to check?

▲ **Figure 14.1**

- Draw circuit diagrams that would work based on the components each student has in front of them. How will they know if the circuit is complete?
- What is the name given to the tiny parts of an atom that make a current of electricity?
- How could you use a bag of lemons to light an LED?

DID YOU KNOW?
Electricity travels at the speed of light – about 300000 kilometers per second.

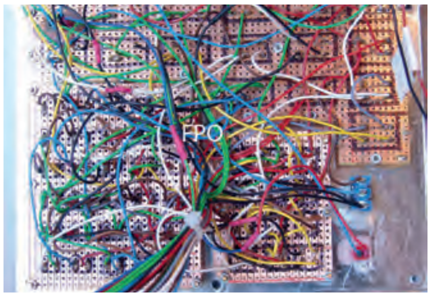


Figure 14.2 Complicated wiring

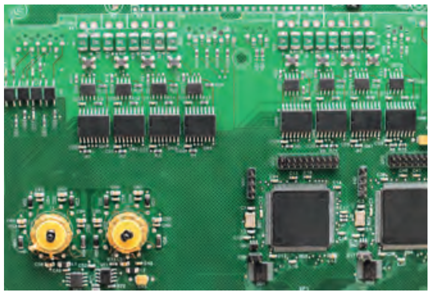


Figure 14.3 Microcircuits on a computer circuit board

Figure 14.4 Circuits on a microchip

Electrical circuits can be very complicated as shown by Figures 14.2, 14.3 and 14.4 above.

It does not matter how complicated the electrical circuit is, they all work due to the properties and processes of simple circuits that we use in school science laboratories. This means that a study of simple electrical circuits can lead some people to an interest in electrical engineering, and an involvement in developing the circuits shown in the figures above.

DID YOU KNOW?
A bird can sit on a power line because it is not part of a circuit. If it touched a second power line with its beak and made a circuit, the bird would be electrocuted.

A simple electrical circuit

Figure 14.5 below shows the simple circuit you studied in Stage 7. See how many of the questions you can answer to check the knowledge of electrical circuits you already have.

1. How do you
   a. close this circuit
   b. open this circuit?
2. What happens when the circuit is
   a. closed
   b. opened?
3. Use the symbols in Figure 14.6 to make a circuit diagram of the simple circuit in Figure 14.5.

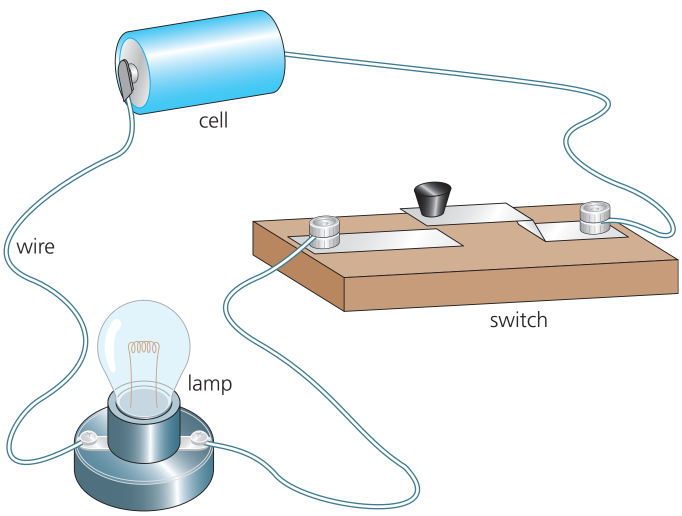


Figure 14.5

Figure 14.6 shows the symbols for components in the circuit:

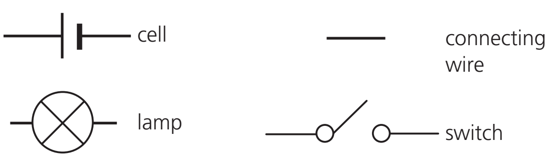


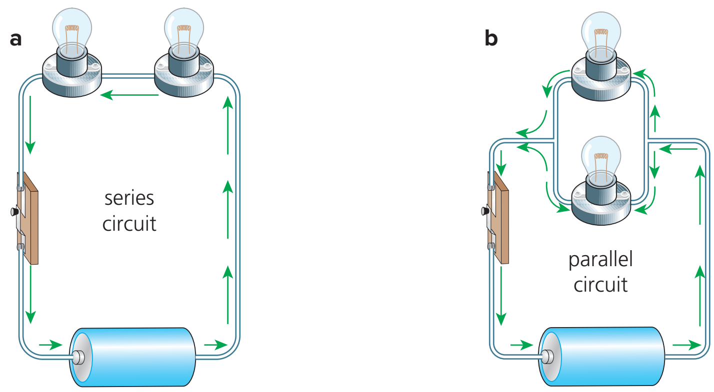
Figure 14.6

When two or more cells are joined together they make a battery. The symbols in Figure 14.7 show the arrangement for batteries with two cells, three cells and any number of cells.

▲ **Figure 14.7** The circuits symbols for two cells, three cells and any number of cells

Series and parallel circuits

There are two kinds of electrical circuits – series circuits and parallel circuits.



▲ **Figure 14.8a** A series circuit and **b** a parallel circuit

4 Use the symbols in Figure 14.6 to make circuit diagrams of Figures 14.8a and b.

In a series circuit, all the components are arranged in a line or a loop, as Figure 14.8a shows. In a parallel circuit, two or more components are wired up side by side, as Figure 14.8b shows.

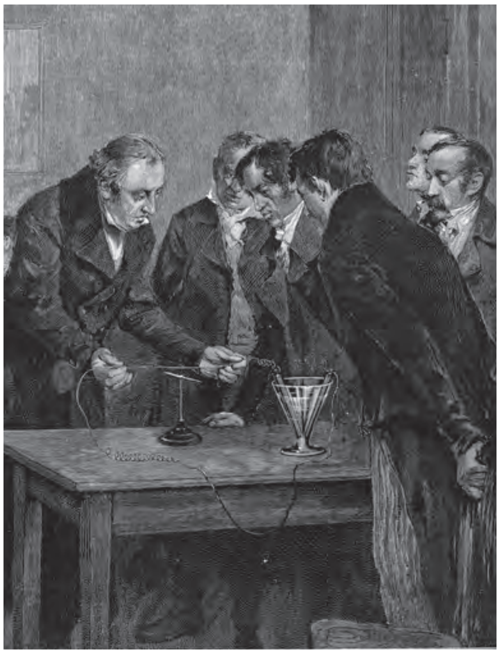
Current

When the current flows through a series circuit you can think of it as passing through all the components one after the other. When the current flows through a parallel circuit, it divides where the components are in parallel. The two currents flowing through each part of the parallel circuit is equal to the total current that flows from the cell of the battery (but see 'Measuring current in series and parallel circuits' on page 00).

Science in context

The current of electricity most widely used

The electricity that we use in our homes, schools and workplaces is not generated by cells like the ones used in this chapter. Most of the electricity we use today is generated by magnets that spin in coils of copper wire in power stations. This development came about in the following way.

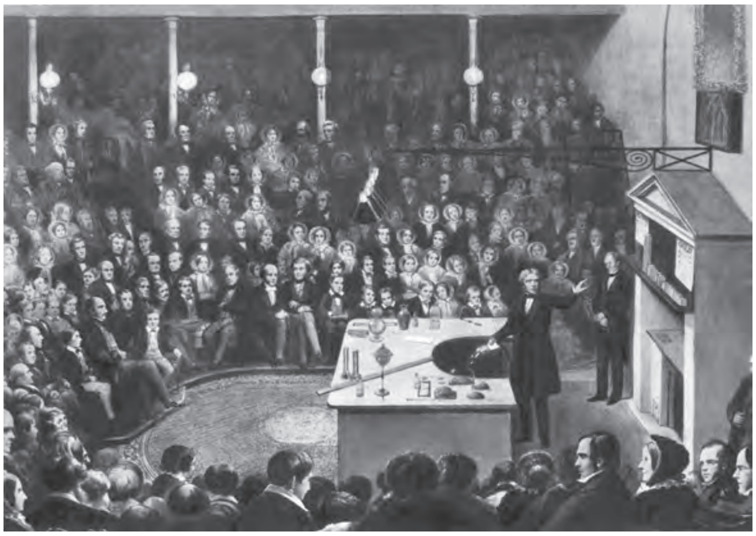


▲ **Fig 14.9** Ørsted demonstrating an experiment at the university of Copenhagen

A scientist living in Denmark, called Hans Christian Ørsted, was working with a battery and wires, as you have done, when he noticed that the magnet in a compass needle moved when electricity passed through a wire close by. He followed this discovery by making further experiments on electric currents and magnets, and published his work in 1820.

Later that same year, the French scientist André-Marie Ampére saw a demonstration of Ørsted's discovery and began developing ideas to explain it. He concluded that there was a relationship between electricity and magnetism that could produce a force.

The English scientist, Michael Faraday, studied Ørsted's and Ampére's work and discovered that magnetism could also be used to generate electricity.



▲ **Figure 14.10** Faraday demonstrating an experiment

5 What scientific skill did Ørsted use to make his discovery?

6 How did Ørsted communicate his discovery to other scientists?

7 How did Ørsted's discovery lead to the building of power stations?

CHALLENGE YOURSELF

Power stations provide electricity for street lights in many places across the world. What is their effect on the planet at night-time?

Use the internet to find images to answer this question. Find your location on the planet and compare it with the night-time images.

Does the study of street lights around the planet help identify human populations? Explain your answer.

LET'S TALK

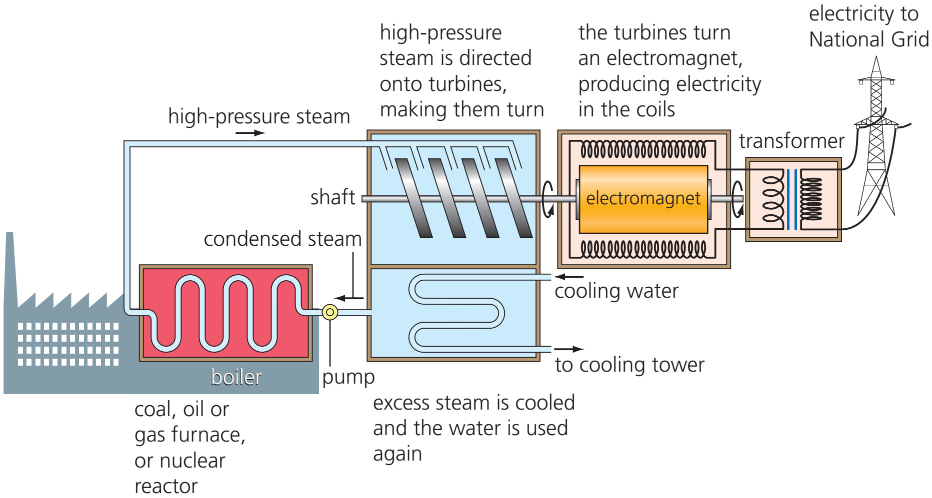
What are the benefits of power stations and street lights around the world? How may street lights affect other living organisms?

8 Can you remember how many electrons flow past any point in a circuit in one second when the current is 1 amp? Is it

a 6 million
b 6 million million
c 6 million million million
d 6 million million million million?

In Stage 8, you studied the magnetic field around a magnet. Faraday discovered that if you change the magnetic field around a wire, it generates a current of electricity in the wire.

Faraday was also a great communicator of science and performed many demonstrations of his work. Faraday's discovery was developed by engineers into the power stations that provide most of the electricity you use today.



▲ **Figure 14.11** The parts of a power station

The parts of a power station that use fossil or nuclear fuel generate steam. This spins the turbines and an electromagnet, generating electricity that passes along cables to towns and cities, sending it out to buildings such as homes, schools, factories and shops.

Measuring current

The unit for measuring the current flowing through a circuit is the ampere. It is usually shortened to the word amp or amps and its symbol is A.

The current flow in the circuit is measured using an ammeter. When it is placed in a circuit, the positive (red) terminal must be connected by a wire to the positive terminal of the cell, battery or power supply. It is always connected in series with the component through which the current flow is to be measured, as Figure 14.12 on the next page shows. Ammeters usually have a very low resistance so that the current passes through them without affecting the rest of the circuit.

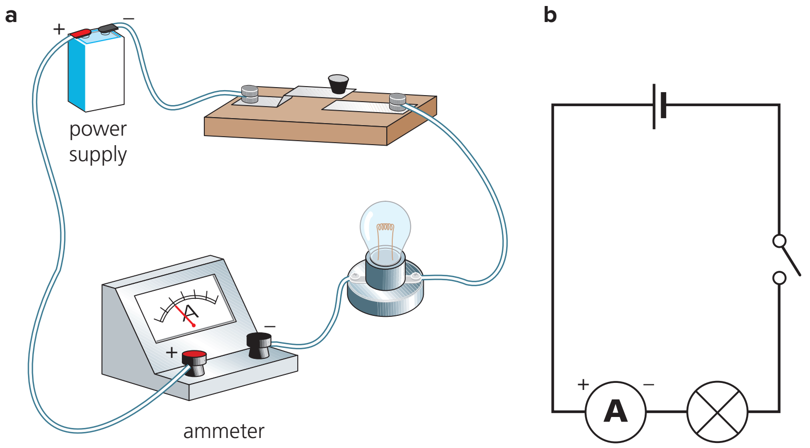


Figure 14.12a An ammeter connected in a circuit and **b** the circuit diagram showing its symbol

Measuring current in series and parallel circuits

Sometimes scientists make investigations to check what they have read. In this enquiry you will set up the circuits shown in Figure 14.13, but include a switch to find out about the current flow in them.

You will need:

a cell, two lamps, four wires, a switch and an ammeter.

Investigation

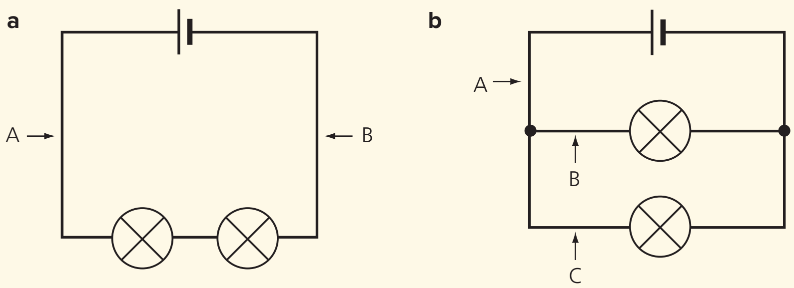


Figure 14.13 Measuring current in **a** series and **b** parallel circuits

Set up each circuit in turn and measure the current at the points shown. Record your measurements.

Analysis and evaluation

Compare your data with the information in this chapter.

Conclusion

Draw a conclusion from your evaluation and state its limitations.

Suggest how the investigation could be improved to provide more reliable data.

CHALLENGE YOURSELF

How would you measure the current produced by a lemon battery? Work out a plan and, if your teacher approves, try it.

Voltage

The ability of the cell to drive a current is measured by its voltage. This is indicated by a figure on the side of the cell with the letter ‘V’ after it. The volt, symbol V, is the unit used to measure the difference in electrostatic potential energy (usually just referred to as ‘potential difference’) between two points. The voltage written on the side of the cell refers to the difference in potential between its positive and negative terminals. It is a measure of the electrical energy that the cell can give to the electrons in a circuit.

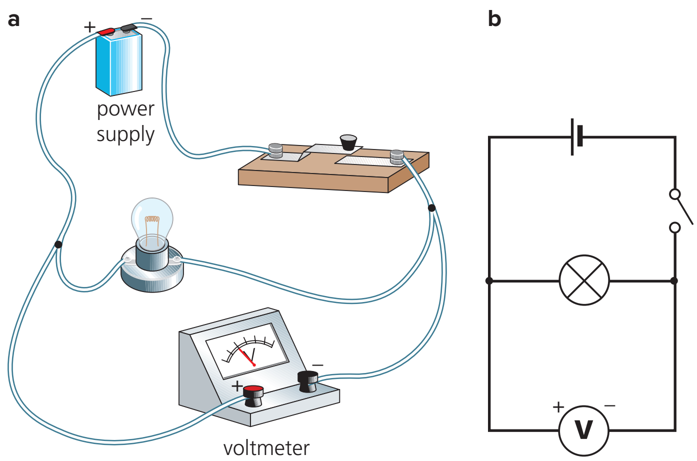
When cells are arranged in series, with the positive terminal of one cell connected to the negative terminal of the next cell, the current-driving ability of the combined battery of cells can be calculated by adding their voltages. For example, two 1.5 V cells in series produce a voltage of 3 V. The two cells together give the electrons in the circuit twice as much electrical energy as each one would provide separately.

DID YOU KNOW?
A lightning flash only lasts for a few microseconds, but in that time, 1 billion volts and a current of up to 200000 amperes is generated.

▲ **Figure 14.14** The voltage is clearly displayed on the packaging of cells and batteries

Measuring voltage

The voltage or potential difference between two points in a circuit is measured using a voltmeter.



▲ **Figure 14.15a** A voltmeter connected in a circuit and **b** the circuit diagram showing its symbol

9 Compare how an ammeter and a voltmeter are connected into a circuit by looking at Figure 14.12 on the previous page and Figure 14.15 on this page.

The voltmeter is connected into a circuit with its positive (red) terminal connected to a wire that leads towards the positive terminal of the cell, battery or power supply. The negative (black) terminal must be connected to a wire that leads towards the negative terminal of the source of the current. However, unlike the connection of an ammeter, the wires are attached to either side of the part of the circuit being tested – that is, it is arranged in parallel with this part of the circuit. Voltmeters generally have a very high resistance (see next section), so when connected in parallel they take little current and do not affect the rest of the circuit.

Comparing voltages

You will need:

two cells, a switch, two lamps, nine wires and a voltmeter.

Investigation

1. Draw a circuit diagram to show how you would check the voltage of a cell in a circuit with a switch and a lamp. Check it with your teacher and, if approved, try it.
2. Look at the voltage of the cell you are to test. When you make your test, compare your voltage reading with the voltage stated on the cell. What do you find?
3. Draw a circuit diagram with a second lamp arranged in series in your previous circuit. Show how you would check the voltage of the two lamps and the cell in the circuit and, if your teacher approves, try it. What do you find?
4. Draw a circuit diagram with two lamps and two cells arranged in series in your previous circuit. Show how you would check the voltage of the two lamps and the two cells in the circuit and, if your teacher approves, try it. What do you find?
5. Draw a circuit diagram with a cell and two lamps arranged in parallel. Show how you would check the voltage of the two lamps and the cell in the circuit and, if your teacher approves, try it. What do you find?

Resistance

In Stage 7 of your science course we looked at how electrons push their way through wires and other components in circuits. As the electrons push their way through, the matter in the materials pushes back on them and opposes their movement. This property of a material to oppose the movement of electrons is called resistance. As the electrons push their way through the material and rub against it, the material gets hot, just as if you rub your hands together, they get hot. Some materials like the wires in lamps used in school science experiments get so hot they give out light.

We can calculate the resistance of a circuit by measuring the voltage and the current and then using the equation

resistance = voltage/current.

Investigating resistance with lamps

You will need:

a cell, five wires, a switch and three lamps.

Hypothesis

Construct a hypothesis to explain what might happen when a circuit is set up with one lamp, then with another lamp added in series, and then with a third lamp added in series.

Prediction

Make a prediction based on your hypothesis.

Investigation

1. Make circuit diagrams of
   a. a cell, a switch and one lamp
   b. a cell, a switch and two lamps
   c. a cell, a switch and three lamps.
2. Set up each circuit in turn, close the switch and record the result.
3. Use the ammeter and voltmeter to record the resistance of each of these circuits.

Analysis and evaluation

Compare the data produced by each circuit.

Conclusion

Compare your evaluation with your hypothesis and prediction and draw a conclusion.

How could the investigation be improved? For example, how could using a white or dark card behind the lamps and using a camera help with recording data?

Summary

- ✔ There are two kinds of circuit: series and parallel.
- ✔ In parallel circuits, the current divides between the parts of the circuit that are in parallel.
- ✔ An ammeter is used to measure the current in a circuit.
- ✔ The voltage is the difference in potential between two points in a circuit and is also the ability of a cell to drive a current around a circuit.
- ✔ A voltmeter is used to measure voltage.
- ✔ Resistance is the property of a material to oppose the movement of electrons.
- ✔ Resistance can be calculated with the use of the following equation:

  $\text{resistance} = \frac{\text{voltage}}{\text{current}}$ or $\Omega = \frac{V}{I}$
- ✔ Fixed resistors and variable resistors are used to control the flow of an electric current in a circuit.
- ✔ The buzzer is a component that makes a sound when electricity passes through it.

End of chapter questions

1 How are lamps arranged in
  - a a series circuit?
  - b a parallel circuit?

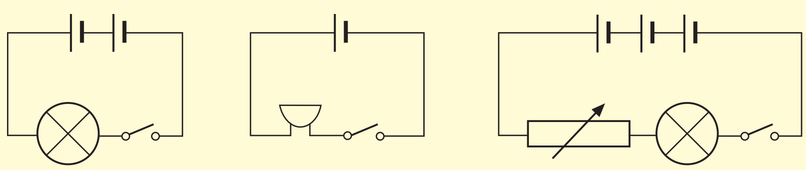
2 What is an ammeter?

3 How do you set up an ammeter in a circuit?

4 What is a voltmeter?

5 How is a voltmeter set up in a circuit?

6 Make a list of the components in each of the three circuits shown in Figure 14.16.



▲ **Figure 14.16**

7 Draw one example of a series circuit and one example of a parallel circuit.

8 A student measured the voltage in a circuit and found it was 2.0V, then measured the current and found it was 0.5A. What was the resistance in the circuit?

9 What is the difference between a fixed and a variable resistor?

Cambridge checkpoint

Lower Secondary Science 9

Help students engage with and fully understand topics they are studying with engaging content following the new Cambridge Lower Secondary Science curriculum framework.

- Provide activities to increase students' subject knowledge and develop the skills necessary to think and work scientifically.
- Test students' comprehension of each topic with questions designed to develop deeper thinking skills.
- Embed knowledge and increase students' vocabulary with whole class and smaller group discussion.

For over 25 years we have been trusted by Cambridge schools around the world to provide quality support for teaching and learning. For this reason we have been selected by Cambridge Assessment International Education as an official publisher of endorsed material for their syllabuses.

Working for over 25 YEARS WITH Cambridge Assessment International Education

This resource is endorsed by Cambridge Assessment International Education

- ✓ Provides support as part of a set of resources for the Cambridge Lower Secondary Science curriculum framework (0893) from 2020
- ✓ Has passed Cambridge International's rigorous quality-assurance process
- ✓ Developed by subject experts
- ✓ For Cambridge schools worldwide

We are working with Cambridge Assessment International Education to gain endorsement for this forthcoming series.

HODDER EDUCATION

e: education@bookpoint.co.uk

w: hoddereducation.com

ISBN 978-1-3983-1041-4