Fully aligned with the Australian Curriculum

Magnetic moves

Year 4

Physical sciences

About this unit Magnetic moves

They're a useful way to stick things to a refrigerator. However magnets play a more important and often unseen role in our daily lives. Many common household items have magnets in them and are part of what makes these items work. We use magnets to hold cupboard doors shut. Electronic devices such as washing machines, telephones and sound systems have magnets in them. We entrust key information to a pattern of magnetisation on our credit cards and in our computers. Magnets help recycling centres to triage materials and large ones can be used to pick up cars.

The *Magnetic moves* unit is an ideal way to link science with literacy in the classroom. It provides opportunities for students to explore how magnets exert a force on certain objects and how that force affects the object. Through hands-on activities, students identify the materials that magnets attract, their poles and magnetic fields, the distance at which they act, and how the pull of magnetism is different from the pull of gravity.

Published by the Australian Academy of Science.

GPO Box 783
Canberra ACT 2601
Telephone: (02) 6201 9400
Email: pc@science.org.au
www.primaryconnections.org.au

Editor: Amy Stoneham
Illustrator: Shiloh Gordon
Proofreader: Catherine Mayer
Typesetter: Sharyn Raggett
Font: Helvetica Neue, DIN
Print house: Daniels Printing Craftsmen
Cover images: iStockphoto.com

ISBN 978 0 85847 706 3

Acknowledgments

Thanks to the trial teachers and students of the trial schools Australia-wide and Fellows of the Australian Academy of Science who contributed to this unit.

Trial schools: Fadden Primary, ACT; Ben Lomond Public School, NSW; Carramar Public School, NSW; Glenmore Road Public School, NSW; Greenwich Public School, NSW; Pretty Beach Public School, NSW; Lowanna Public School, NSW; MET School (Darkes Forest), NSW; MET School (Kellyville), NSW; The Athena School, NSW; Holy Spirit Catholic Primary School, NT; Peregian Springs State School, QLD; Riverview State School, QLD; Elizabeth Downs Primary School, SA; Wasleys Primary School, SA; Freeling Primary School, SA; Kingston Primary School, TAS; St Brendan's School Somerville, VIC; St Catherine's School, VIC; Alinjarra Primary School, WA; New Life Christian College, WA; Rossmoyne Primary School, WA; Trayning Primary School, WA; Australian International School, Hong Kong

Contents

Foreword

Never has there been a more important time for science in Australia. More than ever, we need a scientifically-literate community to engage in debates about issues that affect us all. We also need imaginative thinkers to discover the opportunities in our exponentially expanding knowledge base. Teachers play a vital role in nurturing the minds of our future citizens and scientists.

The Australian Academy of Science has a long, proud history of supporting science education. Our primary education program, Primary**Connections**: linking science with literacy, now has over 15 years' experience in supporting teachers to facilitate quality learning experiences in their classrooms. Regular evaluations demonstrate the significant impact the program can have on both teacher confidence and student outcomes.

Primary**Connections** has been developed with the financial support of the Australian Government and endorsed by education authorities across the country. It has been guided by its Steering Committee, with members from the Australian Government and the Australian Academy of Science, and benefitted from input by its Reference Group, with representatives from all states and territories.

Key achievements of the program include engaging over 24,000 Australian teachers in professional learning workshops, producing multi award-winning curriculum resources, and developing an Indigenous perspective framework that acknowledges the diversity of perspectives in Australian classrooms.

The Primary**Connections** teaching and learning approach combines guided inquiry, using the 5Es model, with hands-on investigations. It encourages students to explore and test their own, and others', ideas and to use evidence to support their claims. It focuses on developing the literacies of science and fosters lasting conceptual change by encouraging students to represent and re-represent their developing understandings. Students are not only engaged in science, they feel that they can do science.

This is one of 40 curriculum units developed to provide practical advice on implementing the teaching and learning approach while meeting the requirements of the Australian Curriculum: Science. Trialled in classrooms across the country and revised based on teacher feedback, and with the accuracy of the teacher background information verified by Fellows of the Academy, the experience of many brings this unit to you today.

I commend Primary**Connections** to you and wish you well in your teaching.

Professor John Shine, AC Pres AA
President (2018–2022)
Australian Academy of Science

The PrimaryConnections teaching and learning approach

Primary**Connections** units embed inquiry-based learning into a modified 5Es instructional model. The relationship between the 5Es phases, investigations, literacy products and assessment is illustrated below:

Primary**Connections 5Es teaching and learning model**

Phase	Focus	Assessment focus
ENGAGE	Engage students and elicit prior knowledge	**Diagnostic assessment**
EXPLORE	Provide hands-on experience of the phenomenon	**Formative assessment**
EXPLAIN	Develop scientific explanations for observations and represent developing conceptual understanding Consider current scientific explanations	**Formative assessment**
ELABORATE	Extend understanding to a new context or make connections to additional concepts through a student-planned investigation	**Summative assessment** of the Science Inquiry Skills
EVALUATE	Students re-represent their understanding and reflect on their learning journey, and teachers collect evidence about the achievement of outcomes	**Summative assessment** of the Science Understanding

More information on Primary**Connections** 5Es teaching and learning model can be found at:
www.primaryconnections.org.au

Reference: Bybee, R.W. (1997). *Achieving scientific literacy: from purposes to practical action*. Portsmouth, NH: Heinemann.

Developing students' scientific literacy

The Primary**Connections** program supports teachers in developing students' scientific literacy. Scientific literacy is considered the main purpose of school science education and has been described as an individual's:

- scientific knowledge and use of that knowledge to identify questions, acquire new knowledge, explain scientific phenomena and draw evidence-based conclusions about science-related issues
- understanding of the characteristic features of science as a form of human knowledge and enquiry
- awareness of how science and technology shape our material, intellectual and cultural environments
- willingness to engage in science-related issues, and with the ideas of science, as a reflective citizen.

Reference: Programme for International Student Assessment & Organisation for Economic Co-operation and Development. (2009). *PISA 2009 assessment framework: key competencies in reading, mathematics and science*. Paris: OECD Publishing.

Linking science with literacy

Primary**Connections** has an explicit focus on developing students' knowledge, skills, understanding and capacities in science and literacy. Units employ a range of strategies to encourage students to think about and to represent science.

Primary**Connections** develops the literacies of science that students need to learn and to represent their understanding of science concepts, processes and skills. Representations in Primary**Connections** are multi-modal and include text, tables, graphs, models, drawings and embodied forms, such as gesture and role-play. Students use their everyday literacies to learn the new literacies of science. Science provides authentic contexts and meaningful purposes for literacy learning, and also provides opportunities to develop a wider range of literacies. Teaching science with literacy improves learning outcomes in both areas.

Assessment

Science is ongoing and embedded in Primary**Connections** units. Assessment is linked to the development of literacy practices and products. Relevant understandings and skills are highlighted at the beginning of each lesson. Different types of assessment are emphasised in different phases:

Diagnostic assessment occurs in the *Engage* phase. This assessment is to elicit students' prior knowledge so that the teacher can take account of this when planning how the *Explore* and *Explain* lessons will be implemented.

Formative assessment occurs in the *Explore* and *Explain* phases. This enables the teacher to monitor students' developing understanding and provide feedback that can extend and deepen students' learning.

Summative assessment of the students' achievement developed throughout the unit occurs in the *Elaborate* phase for the Science Inquiry Skills, and in the *Evaluate* phase for the Science Understanding.

Rubrics are available at the end of this unit to help you to make judgements against the relevant achievement standards of the Australian Curriculum.

SAFETY

Safety

Learning to use materials and equipment safely is central to working scientifically. It is important, however, for teachers to review each lesson before teaching to identify and manage safety issues specific to a group of students. A safety icon SAFETY is included in lessons where there is a need to pay particular attention to potential safety hazards. The following guidelines will help minimise risks:

- Be aware of the school's policy on safety in the classroom and for excursions.
- Check students' health records for allergies or other health issues.
- Be aware of potential dangers by trying out activities before students do them.
- Caution students about potential dangers before they begin an activity.
- Clean up spills immediately as slippery floors are dangerous.
- Instruct students never to smell, taste or eat anything unless they are given permission.
- Discuss and display a list of safe practices for science activities.

Teaching to the Australian Curriculum: Science

The Australian Curriculum: Science has three interrelated strands—Science Understanding, Science as a Human Endeavour and Science Inquiry Skills—that together 'provide students with understanding, knowledge and skills through which they can develop a scientific view of the world'.

The content of these strands is described by the Australian Curriculum as:

Science Understanding	
Biological sciences	Understanding living things
Chemical sciences	Understanding the composition and behaviour of substances
Earth and space sciences	Understanding Earth's dynamic structure and its place in the cosmos
Physical sciences	Understanding the nature of forces and motion, and matter and energy
Science as a Human Endeavour	
Nature and development of science	An appreciation of the unique nature of science and scientific knowledge
Use and influence of science	How science knowledge and applications affect people's lives and how science is influenced by society and can be used to inform decisions and actions
Science Inquiry Skills	
Questioning and predicting	Identifying and constructing questions, proposing hypotheses and suggesting possible outcomes
Planning and conducting	Making decisions regarding how to investigate or solve a problem and carrying out an investigation, including the collection of data
Processing and analysing data and information	Representing data in meaningful and useful ways, identifying trends, patterns and relationships in data, and using evidence to justify conclusions
Evaluating	Considering the quality of available evidence and the merit or significance of a claim, proposition or conclusion with reference to that evidence
Communicating	Conveying information or ideas to others through appropriate representations, text types and modes

Above material is sourced from the Australian Curriculum: Australian Curriculum Assessment and Reporting Authority (ACARA). (2014). *Australian Curriculum: Science*. www.australiancurriculum.edu.au

Primary**Connections** has units to support teachers to teach each Science Understanding detailed in the Australian Curriculum: Science from Foundation to Year 6. Units also develop students' skills and knowledge of the Science as a Human Endeavour and Science Inquiry Skills sub-strands, as well as specific sub-strands within the Australian Curriculum: English and Mathematics. Detailed information about its alignment with the Australian Curriculum is provided in each unit.

Unit at a glance

Magnetic moves

Phase	Lesson	At a glance
ENGAGE	**Lesson 1** Mystery moves	To capture students' interest and find out what they think they know about how forces can be exerted by one object on another through direct contact or from a distance. To elicit students' questions about magnetic force.
EXPLORE	**Lesson 2** A magnetic attraction	To provide students with hands-on, shared experiences of how magnets exert a pull on objects at a distance.
	Lesson 3 Feeling the force ***Session 1*** Bumping along ***Session 2*** Very gripping	To provide students with hands-on, shared experiences of how a magnetic force attracts objects through different materials, and the effect of friction on the movement of a paperclip.
	Lesson 4 Pushed and pulled	To provide students with hands-on, shared experiences of how magnets attract and repel each other.
	Lesson 5 From a distance	To provide students with hands-on, shared experiences of how gravity and magnetic forces act from a distance.
EXPLAIN	**Lesson 6** Do you agree?	To support students to represent and explain their understanding about forces that can be exerted by one object on another through direct contact or from a distance. To introduce current scientific views.
ELABORATE	**Lesson 7** Forces at work ***Session 1*** What's the plan? ***Session 2*** In production	To support students to design and make a game that uses forces, including magnetic force, to work.
EVALUATE	**Lesson 8** All together	To provide opportunities for students to represent what they know about how forces can be exerted by one object on another through direct contact or from a distance, and to reflect on their learning.

A unit overview can be found in Appendix 7, page 68.

Magnetic moves—Alignment with the Australian Curriculum

Magnetic moves is written to align to the Year 4 level of the Australian Curriculum: Science. The Science Understanding, Science Inquiry Skills, and Science as a Human Endeavour strands are interrelated and embedded throughout the unit (see page xii for further details). This unit focuses on the Physical sciences sub-strand.

Year 4 Science Understanding for the Physical Sciences:	**Forces can be exerted by one object on another through direct contact or from a distance (AUSSSU076)**
Incorporation in *Magnetic moves*:	Students formulate investigable questions and make predictions to investigate the forces that are exerted by magnets on other objects. They make claims with supporting evidence and represent their understanding in a variety of ways.

All the material in the first row of this table is sourced from the Australian Curriculum.

Year 4 Achievement Standard

The Australian Curriculum: Science Year 4 achievement standard indicates the quality of learning that students should demonstrate by the end of Year 4.

By the end of Year 4, students apply the observable properties of materials to explain how objects and materials can be used. **They use contact and non-contact forces to describe interactions between objects.** They discuss how natural and human processes cause changes to the Earth's surface. They describe relationships that assist the survival of living things and sequence key stages in the life cycle of a plant or animal. **They identify when science is used to ask questions and make predictions.** They describe situations where science understanding can influence their own and others' actions.

Students follow instructions to identify investigable questions about familiar contexts and predict likely outcomes from investigations. They discuss ways to conduct investigations and safely use equipment to make and record observations. They use provided tables and simple column graphs to organise their data and identify patterns in data. Students suggest explanations for observations and compare their findings with their predictions. They suggest reasons why their methods were fair or not. They complete simple reports to communicate their methods and findings.

The sections relevant to *Magnetic moves* are bolded above. By the end of the unit, teachers will be able to make evidence-based judgements on whether the students are achieving below, at or above the achievement standard for the sections bolded above.

Magnetic moves—Australian Curriculum Key ideas

In the Australian Curriculum: Science, there are six key ideas that represent key aspects of a scientific view of the world and bridge knowledge and understanding across the disciplines of science. The below table explains how these are represented in *Magnetic moves.*

Overarching idea	Incorporation in *Magnetic moves*
Patterns, order and organisation	Students recognise and group materials that are attracted to magnets or not. They discern differences in strengths of magnets and discuss what factors can be used to identify strong magnets.
Form and function	Students explore how the form of the magnet can affect its strength and the nature of the magnetic field it produces.
Stability and change	Students recognise that some magnets produce constant magnetic fields that objects, including other magnets, react to in predictable patterns depending on the material they are made of.
Scale and measurement	Students measure the strength of a magnet by measuring the distance from which it attracts objects. They use formal measurements and describe their results. Students explore how to represent their understanding of different-sized forces using scaled arrows.
Matter and energy	Students explore how magnetic material can exert a force on iron objects, and other magnets, that can cause them to move (kinetic energy).
Systems	Students identify and describe simple systems of forces acting on objects and explain them with force-arrow diagrams.

Magnetic moves—Australian Curriculum: Science

Magnetic moves embeds all three strands of the Australian Curriculum: Science. For ease of reference, the table below outlines the sub-strands covered in *Magnetic moves*, the content descriptions for Year 4 and their aligned lessons.

Strand	Sub-strand	Code	Year 4 content descriptions	Lessons
Science Understanding	**Physical Sciences**	ACSSU076	Forces can be exerted by one object on another through direct contact or from a distance	1–8
Science as a Human Endeavour	**Nature and development of science**	ACSHE061	Science involves making predictions and describing patterns and relationships	1–8
	Use and influence of science	ACSHE062	Science knowledge helps people to understand the effect of their actions	1–8
Science Inquiry Skills	**Questioning and predicting**	ACSIS064	With guidance, identify questions in familiar contexts that can be investigated scientifically and predict what might happen based on prior knowledge	1–5, 7
	Planning and conducting	ACSIS065	With guidance, plan and conduct scientific investigations to find answers to questions, considering the safe use of appropriate materials and equipment	2–5, 7
		ACSIS066	Consider the elements of fair tests and use formal measurements and digital technologies as appropriate, to make and record observations accurately	2–5, 7
	Processing and analysing data and information	ACSIS068	Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends	2–5, 7
		ACSIS216	Compare results with predictions, suggesting possible reasons for findings	2–5
	Evaluating	ACSIS069	Reflect on the investigation; including whether a test was fair or not	2–5, 7, 8
	Communicating	ACSIS071	Represent and communicate observations, ideas and findings using formal and informal representations	1–8

General capabilities

The skills, behaviours and attributes that students need to succeed in life and work in the 21st century have been identified in the Australian Curriculum as general capabilities. There are seven general capabilities and they are embedded throughout the units. For further information see: www.australiancurriculum.edu.au

For examples of our unit-specific general capabilities information see the next page.

Magnetic moves—Australian Curriculum general capabilities

General capabilities	Australian Curriculum description	*Magnetic moves* examples
Literacy	Literacy knowledge specific to the study of science develops along with scientific understanding and skills. Primary**Connections** learning activities explicitly introduce literacy focuses and provide students with the opportunity to use them as they think about, reason and represent their understanding of science.	In *Magnetic moves* the literacy focuses are: • science journals • TWLH charts • word walls • tables • force-arrow diagrams • procedural texts • labelled diagrams • annotated drawings • factual texts • ideas maps.
Numeracy	Elements of numeracy are particularly evident in Science Inquiry Skills. These include practical measurement and the collection, representation and interpretation of data.	Students: • Collect data and record information on the distance of the magnetic field of a magnet and the strength of different sized and shaped magnets.
Information and communication technology (ICT) competence	ICT competence is particularly evident in Science Inquiry Skills. Students use digital technologies to investigate, create, communicate, and share ideas and results.	Students are given optional opportunities to: • Use interactive resource technology to view, record and discuss information. • Use digital technologies to assist in their investigations.
Critical and creative thinking	Students develop critical and creative thinking as they speculate and solve problems through investigations, make evidence-based decisions, and analyse and evaluate information sources to draw conclusions. They develop creative questions and suggest novel solutions.	Students: • Formulate, pose and respond to questions • Consider different ways of thinking • Develop evidence-based claims.
Ethical behaviour	Students develop ethical behaviour as they explore principles and guidelines in gathering evidence and consider the implications of their investigations on others and the environment.	Students: • Ask questions of others respecting each other's point of view.
Personal and social competence	Students develop personal and social competence as they learn to work effectively in teams, develop collaborative methods of inquiry, work safely, and use their scientific knowledge to make informed choices.	Students: • work collaboratively in teams • listen to and follow instructions to safely complete investigations • participate in discussions.
Intercultural understanding	Intercultural understanding is particularly evident in Science as a Human Endeavour. Students learn about the influence of people from a variety of cultures on the development of scientific understanding.	• 'Cultural perspectives' opportunities are highlighted. • Important contributions made to science by people from a range of cultures are highlighted.

All the material in the first two columns of this table is sourced from the Australian Curriculum.

Magnetic moves—Australian Curriculum: English

Strand	Sub-strand	Code	Year 4 content descriptions	Lessons
Language	**Language for interaction**	ACELA1488	Understand that social interactions influence the way people engage with ideas and respond to others for example when exploring and clarifying the ideas of others, summarising students' own views and reporting them to a larger group	1–8
	Expressing and developing ideas	ACELA1498	Incorporate new vocabulary from a range of sources into students' own texts including vocabulary encountered in research	1–8
Literacy	**Interacting with others**	ACELY1688	Use interaction skills such as acknowledging another's point of view and linking students' response to the topic, using familiar and new vocabulary and a range of vocal effects such as tone, pace, pitch and volume to speak clearly and coherently	1–8
		ACELY1689	Plan, rehearse and deliver presentations incorporating learned content and taking into account particular purposes and audiences	8

AC All the material in the first four columns of this table is sourced from the Australian Curriculum.

Magnetic moves—Australian Curriculum: Mathematics

Strand	Sub-strand	Code	Year 4 content descriptions	Lessons
Measurement and Geometry	**Using units of measurement**	ACMMG084	Use scaled instruments to measure and compare lengths, masses, capacities and temperatures	2, 4
Statistics and Probability	**Data representation and interpretation**	ACMSP096	Construct suitable data displays, with and without the use of digital technologies, from given or collected data. Include tables, column graphs and picture graphs where one picture can represent many data values	2–4

AC All the material in the first four columns of this table is sourced from the Australian Curriculum.

Magnetic moves—Australian Curriculum: Design and Technologies

Strand	Code	Year 4 content descriptions	Lessons
Knowledge and understanding	ACTDEK010	Recognise the role of people in design and technologies occupations and explore factors, including sustainability that impact on the design of products, services and environments to meet community needs	2, 4
	ACTDEK011	Investigate how forces and the properties of materials affect the behaviour of a product or system	1–5
	ACTDEK013	Investigate the suitability of materials, systems, components, tools and equipment for a range of purposes	1–5
Processes and production skills	ACTDEP014	Critique needs or opportunities for designing and explore and test a variety of materials, components, tools and equipment and the techniques needed to produce designed solutions	7
	ACTDEP015	Generate, develop, and communicate design ideas and decisions using appropriate technical terms and graphical representation techniques	7
	ACTDEP016	Select and use materials, components, tools and equipment using safe work practices to make designed solutions	7
	ACTDEP017	Evaluate design ideas, processes and solutions based on criteria for success developed with guidance and including care for the environment	8
	ACTDEP018	Plan a sequence of production steps when making designed solutions individually and collaboratively	7

AC All the material in this table is sourced from the Australian Curriculum.

Cross-curriculum priorities

There are three cross-curriculum priorities identified by the Australian Curriculum:

- Aboriginal and Torres Strait Islander histories and cultures
- Asia and Australia's engagement with Asia
- Sustainability.

Two of these are embedded within *Magnetic moves*, as described below.

Aboriginal and Torres Strait Islander histories and cultures

The Primary**Connections** Indigenous perspectives framework supports teachers' implementation of Aboriginal and Torres Strait Islander histories and cultures in science. The framework can be accessed at: www.primaryconnections.org.au

Magnetic moves focuses on the Western science way of making evidence-based claims about how objects are subjected to forces in their environment, including magnetic forces, friction, gravity and air resistance, and how the sum of those forces can be used to explain changes in the movement or form of objects.

Aboriginal and Torres Strait Islander Peoples might have other explanations for their observations of objects changing speed, direction or form. This is particularly true of the claims about forces that act at a distance, such as gravity and magnetic forces, as they are not tangible in themselves (e.g. they cannot be seen or touched). They are working theories based on the predictable behaviour of objects.

Primary**Connections** recommends working with Aboriginal and Torres Strait Islander community members to access local and relevant cultural perspectives. Protocols for engaging with Aboriginal and Torres Strait Islander community members are provided in state and territory education guidelines. Links to these are provided on the Primary**Connections** website.

Sustainability

The *Magnetic moves* unit provides opportunities for students to develop an understanding of how forces act upon objects on Earth, including direct forces, such as pushes and pulls, as well as forces which act at a distance such as gravity. Through investigating how the available surface area of an object affects the amount of friction an object experiences, students describe how well designed machines are more efficient. Students also experience the effect of gels on reducing friction. This can assist them to develop knowledge, skills and values for making decisions about individual and community actions that contribute to sustainable and conservative patterns of energy use, for example, keeping machinery well oiled to reduce friction and therefore wear and tear, and maintain efficiency.

Teacher background information

This information is intended as teacher information only. It provides teachers with information relevant to the science concept so they can feel more confident and competent to teach each lesson. The content and vocabulary of this information is at a more detailed and advanced level than what is required for students.

Introduction to forces

A force is an external influence that can change the motion, direction or shape of objects.

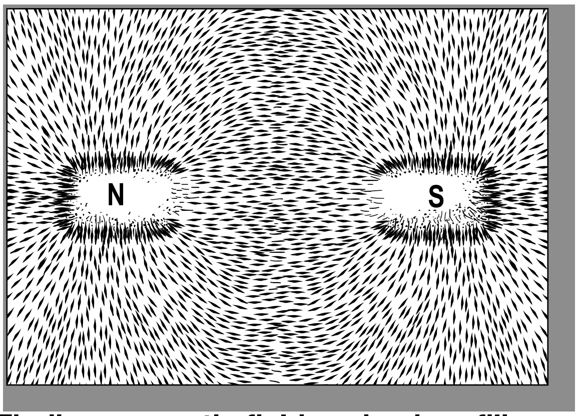
Examples of forces include mechanical forces such as pushes, pulls and friction, as well as gravity and magnetic forces. A force can be applied to an object but is not a property of the object itself. All living and non-living things can apply, and be affected by, forces. A force can cause an object to start or stop moving and change its speed and/or direction of movement. Forces can also change the shape of objects.

Force has two aspects: magnitude and direction. The magnitude of the force refers to the size or amount of force exerted, for example, if it is a strong or weak push.

More than one force can act on an object at any one time, for example, our standing body is pulled down to the ground and the ground pushes back. We are stationary because even though there are two forces acting on us, these forces are of equal magnitude in opposite directions. It is the sum of the forces acting on an object, its shape and the nature of the materials it is made of that determine what happens to an object.

Forces can act through direct contact, such as physical pushes and pulls, friction, and air or water resistance. The force exerted by a magnet acts at a distance. This means that a magnet does not have to touch an object to exert a force on it. There are other forces that act at a distance, including gravity and static electric force. Magnets cannot exert a force on an object that is too far away.

A magnetic field is the region around a magnet in which the magnet exerts force. Many small pieces of iron, called iron filings, are used to show the magnetic field around a magnet. The iron filings form a pattern of lines called magnetic field lines. The arrangement of the magnetic field lines depends on the shape of the magnet, but the lines always extend from one pole to the other pole. The force is weaker farther away from the magnet.



Finding magnetic fields using iron filings

Students' conceptions

Taking account of students' existing ideas is important in planning effective teaching approaches which help students learn science. Students develop their own ideas during their experiences in everyday life and might hold more than one idea about an event or phenomenon.

For many students, the idea of force might be limited to those forces involving physical contact. Though we experience many forces that have direct contact, there are also forces that act at a distance, such as gravity, magnetic and electrical forces.

Students often associate forces and motion with living things, particularly humans and animals. Forces act on all objects regardless of whether they are living or non-living.

Students may think that if an object is not moving there is no force acting on it and if a body is moving there is force acting on it only in the direction of motion. A paperclip resting on a table may be still, but it has two forces acting upon it: the pull of gravity balanced by the push of the table. It takes an unbalanced force to create movement, for example the addition of a magnetic force pulling in one direction below the table.

SAFETY

Important

Rare-earth magnets are very powerful and can move at great speeds toward each other and toward ferrous material. When these magnets come together quickly, they can shatter and break sending fragments at high speed. These magnets can also pinch strongly if allowed to come together against the skin.

For safety reasons, common magnets should be used throughout this unit and not rare-earth magnets.

Iron filings have splinters that can enter students' hands or eyes. If using them, give them to students in a sealed container made of a clear material so they can still see the patterns without touching the filings themselves.

References

Skamp, K. (Ed.). (2012). *Teaching primary science constructively* (4th Edn). South Melbourne: Cengage Learning Australia.

To access more in-depth science information in the form of text, diagrams and animations, refer to the Primary**Connections** Science Background Resource available on the Primary**Connections** website:
www.primaryconnections.org.au

Lesson 1 Mystery moves

ENGAGE

AT A GLANCE

To capture students' interest and find out what they think they know about how forces can be exerted by one object on another through direct contact or from a distance.

To elicit students' questions about magnetic force.

Students:

- observe an object moving without an obvious push or pull
- list ideas about magnets and magnetic force.

Lesson focus

The focus of the Engage phase is to spark students' interest, stimulate their curiosity, raise questions for inquiry and elicit their existing beliefs about the topic. These existing ideas can then be taken account of in future lessons.

Assessment focus

Diagnostic assessment is an important aspect of the *Engage* phase. In this lesson you will elicit what students already know and understand about how:

- forces can be exerted by one object on another through direct contact or from a distance.

Key lesson outcomes

Science

Students will be able to represent their current understanding as they:

- discuss ideas about why objects move
- suggest how an object can move without direct contact
- list ideas about magnets and magnetic force.

Literacy

Students will be able to:

- understand the purpose and features of a science journal
- understand the purpose and features of a TWLH chart
- understand the purpose and features of a word wall
- contribute to discussions about magnets and magnetic force.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page xii).

ENGAGE

Teacher background information

Magnets exert a force, a 'push' or a 'pull', on other magnets and some metals. As these forces act over a distance (for example, a magnet can attract a paperclip over a distance of some centimetres), scientists describe the magnet as exerting a magnetic field. The magnetic field can be described as a region around the magnet that will attract/repel other magnets and some metals (iron, nickel and cobalt).

Students' conceptions

Some students might think that there is a large magnet inside the Earth. The Earth does produce a magnetic field which is why compasses point to the magnetic North pole. However there is no actual 'magnet'. Scientists claim that currents in the Earth's molten iron core give rise to the magnetic field that the Earth produces.

Equipment

FOR THE CLASS

- class science journal
- TWLH chart
- word wall
- 1 small table
- 1 cloth to cover table
- 1 large magnet
- 1 large paperclip or magnetic object

FOR EACH STUDENT

- science journal
- 1 large magnet per pair of students
- 1 large paperclip or magnetic object per pair of students

Preparation

- Prepare a small table and a large magnet that is strong enough to attract a paperclip from under the table.
- Read 'How to use a science journal' (Appendix 2).
- Read 'How to use a word wall' (Appendix 3).
- Read 'How to use a TWLH chart' (Appendix 4) and prepare a large four-column chart as follows:

Magnetic moves TWLH chart

What we **T**hink we know	What we **W**ant we know	What we **L**earned	**H**ow we know

Lesson steps

1 Set up a small table where the students can't see what is happening underneath. Ask students to stand where they can see the top of the table.

2 Use the magnet underneath the table to move the paperclip or magnetic object.

Optional: Have an accomplice move the magnet under the table, so that you can stand next to the table and 'command' the paperclip or magnetic object to move.

3 Ask students to think like scientists about what was happening. Ask students questions such as:

- What did you see happening?
- What do you think was pushing or pulling the paperclip?
- What do we mean by a force?
- What other forces do you think were at work on the paperclip?

Note: In the *Engage* phase, do not provide any formal definitions or correct students' answers as the purpose is to elicit students' prior knowledge and possible alternative conceptions.

4 Discuss the purpose and features of a science journal.

Literacy focus

Why do we use a science journal?

We use a **science journal** to record what we see, hear, feel and think so that we can look at it later to help us with our claims and evidence.

What does a science journal include?

A **science journal** includes dates and times. It might include written text, drawings, measurements, labelled diagrams, photographs, tables and graphs.

5 Record students' responses in the class science journal.

6 Allow time for students to work in pairs and use their chairs to conduct the magnet and paperclip activity.

Exploring the force of a magnet through a chair

7 Ask students to write three things in their science journal that they think they know about magnets and magnetic force. Ask students to share their ideas with a partner.

8 Introduce the TWLH chart and discuss its purpose and features.

Literacy focus

Why do we use a TWLH chart?

We use a **TWLH chart** to show our thoughts and ideas about a topic before, during and after an investigation or activity.

What does a TWLH chart include?

A **TWLH chart** includes four sections with the headings: What we **T**hink we know, What we **W**ant to learn, What we **L**earned, and **H**ow we know. Words or pictures can be used to show our thoughts and ideas.

9 Introduce the title and first column of the TWLH cart ('What we **T**hink we know'). Invite students to contribute ideas about magnets and magnetic force. Ask students questions, such as:

- What do you know about magnets?
- What are some things that magnets are used for?
- What materials can magnets exert a force on?

10 Introduce the second column of the TWLH chart ('What we **W**ant to learn') and ask students to suggest questions that they have about magnets and magnetic force. Record students' questions in the second column.

11 Introduce the word wall. Discuss its purpose and features.

Literacy focus

Why do we use a word wall?

We use a **word wall** to record words we know or learn about a topic. We display the **word wall** in the classroom so that we can look up words we are learning about and see how they are spelt.

What does a word wall include?

A **word wall** includes a topic title or picture and words which we have seen or heard about the topic.

12 Ask students what words from today's lesson they would like placed on the word wall.

Lesson 2 A magnetic attraction

EXPLORE

AT A GLANCE

To provide students with hands-on, shared experiences of how magnets exert a pull on objects at a distance.

Students:

- explore whether objects made of different materials are attracted to a magnet
- measure how close an object is before it is attracted to a magnet
- find objects around the house which are attracted to a magnet.

Lesson focus

The *Explore* phase is designed to provide students with hands-on experiences of the science phenomenon. Students explore ideas, collect evidence, discuss their observations and keep records such as science journal entries. The *Explore* phase ensures all students have a shared experience that can be discussed and explained in the *Explain* phase.

Assessment focus

Formative assessment is an ongoing aspect of the *Explore* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning. In this lesson you will monitor students' developing understanding of how:

- forces can be exerted by one object on another through direct contact or from a distance.

Key lesson outcomes

Science

Students will be able to:

- predict which materials will be attracted to a magnet and give reasons for their predictions.
- observe and explain which objects a magnet attracts
- observe the distance of attraction between different objects and a magnet
- identify how people use magnets in their work.

Literacy

Students will be able to:

- understand the purpose and features of a table
- make a list of objects attracted to a magnet
- discuss and compare results to form common understandings.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page xii).

Teacher background information

A magnet is a material that generates a magnetic field. Magnets only attract materials composed of iron, nickel and cobalt. These materials are described as being 'magnetic'. Steel is attracted to magnets as it is mostly made of iron. Most other materials such as wood, plastic, aluminium, silver and copper are not attracted to magnets and are called 'non-magnetic'.

Large magnets are generally stronger than smaller ones made of the same material and shaped in the same way. However, magnets made of different materials have differing degrees of magnetic force. Rare-earth magnets are strong permanent magnets made from alloys of rare earth elements. They produce significantly stronger magnetic fields than other types of magnets so a smaller rare-earth magnet will have stronger pull than a larger 'common' magnet.

A magnet produces a field that attracts/repels other magnets and certain objects. If strong enough, the two objects will move together. A magnet attracts the fridge but as the fridge's mass is much heavier the magnet 'moves' towards it (you can feel the pull).

Magnets play an important yet often unseen role in many everyday objects, such as:

- Vacuum cleaners use powerful magnets in their motors to give high suction.
- Telephones use small magnets in their microphones and speakers to capture and emit sound.
- Smart phones use small magnets to interact with a coil of wire to create the vibrate function.
- Kitchen cupboards have magnetic catches to keep the doors closed.
- Microwaves usually have two magnets in their Magnetron to guide the electrons to heat the food.
- Electric can openers use a magnet to hold onto the lid as the can is opened.
- Recycling plants use huge magnets to sort scrap metal.

Students' conceptions

Some students might think that all metals or all silver coloured items are attracted to a magnet. There are only three naturally occurring metals that are magnetic: iron, cobalt, and nickel. The colour or amount of shine an object has is in no way related to whether or not it is magnetic. For instance, aluminium foil is shiny and it is not magnetic.

Students might think that larger magnets are stronger than smaller magnets. The size of the magnet is not necessarily directly related to the strength of the magnet. Neodymium magnets (rare-earth magnets), made of a combination of neodymium, iron, and boron are much stronger than the same-sized iron magnet.

Equipment

FOR THE CLASS

- class science journal
- TWLH chart
- word wall
- team roles chart
- team skills chart
- 1 bar magnet
- 1 paperclip
- 1 enlarged copy of 'A strong attraction' (Resource sheet 1)
- 1 enlarged copy of 'Information note for families' (Resource sheet 2)
- collection of objects made from different magnetic and non-magnetic materials (see 'Preparation')
- collection of different sized and shaped magnets

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's science journal
- 1 magnet (bar, ring or horseshoe)
- 1 ruler
- 1 copy of 'A strong attraction' (Resource sheet 1) per student
- 1 copy of 'Information note for families' (Resource sheet 2)
- 1 magnet for home task (see 'Preparation')

Preparation

- Read 'How to organise collaborative learning teams' (Appendix 1).
- Read 'How to facilitate evidence-based discussions' (Appendix 5).
- Collect objects made of different magnetic and non-magnetic materials, such as a pencil, wooden spoon, metal spoon, metal paperclip, kitchen foil, plastic object, nail, key, different coins, stone, a soft drink can, a metal can, CD, steel wool, plastic covered paperclip.
- Find appropriate magnets for home task. For example, large magnetic buttons used on whiteboards.
- Prepare an enlarged copy of 'A strong attraction' (Resource sheet 1).
- Decide when students need to complete the home task and write this information on the 'Information note for families' (Resource sheet 2).

  Note: Students' lists will be required in Lesson 3.
- Prepare an enlarged copy of 'Information note for families' (Resource sheet 2).
- *Optional:* Display 'A strong attraction' (Resource sheet 1) and 'Information note for families' (Resource sheet 2) in a digital format.

Lesson steps

1. Review the previous lesson using the class science journal and word wall. Revisit the 'What we **T**hink we know' and 'What we **W**ant to learn' columns of the TWLH chart.
2. Revise the activity in the previous lesson using the paperclip and the magnet. Discuss how the paperclip moved towards the magnet, as if it were pulled. Explain that scientists say that the paperclip was attracted to the magnet.
3. Discuss and write an agreed definition of 'attract' in the class science journal.
4. Introduce the objects on the equipment table (see 'Preparation'). Explain that students will be working in collaborative learning teams to explore which of these objects might be attracted by a magnet.
5. Explain that teams will then explore the strength of a magnet by measuring how close the object can get before it is attracted to the magnet. Discuss how students might measure this, for example, placing the object at the beginning of a ruler and sliding the magnet along the ruler towards the object until the object is attracted to the magnet.
6. Introduce the enlarged copy of 'A strong attraction' (Resource sheet 1). Read through and discuss with students.
7. Discuss the Predict, Observe and Explain sections of the resource sheet.
8. Discuss the purpose and features of a table.

> ### Literacy focus
> **Why do we use a table?**
>
> We use a **table** to organise information so that we can understand it more easily.
>
> **What does a table include?**
>
> A **table** includes a title, columns with headings and information organised under each heading.

9. Model how to complete the activities for 'A strong attraction' (Resource sheet 1) using a paperclip.

   Optional: Ask teams to compare the difference in attraction between different types of magnets, such as bar, ring and horseshoe magnets.
10. Discuss the use of the equipment table. Explain that this is where the Manager from each team will collect the team's equipment.

    Form teams and allocate roles. Ask Managers to collect the equipment from the equipment table.

    If students are using collaborative learning teams for the first time, introduce and explain the team skills chart and the team roles chart. Explain that students will wear role wristbands or a badge to help them (and you) know which role each team member has.
11. Allow time for teams to complete the activity.

EXPLORE

Exploring the attraction of objects to magnets

12 Ask Speakers to share their team's findings with the class. Encourage students to discuss each team's findings. Ask questions such as:

- Which objects were attracted to the magnet? Which were not?
- How did that compare to your prediction? Why?
- What happened that surprised you? Why?
- Were all metals attracted to the magnet? Why do you think that happened?
- Did the magnet need to touch the object to attract it? Why?
- Were all objects attracted to the magnet at the same distance? Why do you think that is?
- What happened to the distance at which objects were attracted to a magnet when you changed the magnet size or shape?

Record teams' findings in the class science journal.

13 Ask students what claims they think they can make about objects that are attracted to a magnet. Add claims to the 'What we **L**earned' column of the TWLH chart, such as:

- 'Objects that are made from steel are attracted to a magnet.'
- 'Magnets can't attract objects that are far away.'
- 'Smaller magnets can be stronger than larger magnets.'

14 Ask students what evidence they have to support the claims and add to the '**H**ow we know' column of the TWLH chart. For example:

- 'We put different objects close to a magnet and saw that objects made from steel were attracted to the magnet and objects made from other materials like wood and plastic were not attracted to the magnet.'
- 'We measured how far each object was before it was attracted by different types of magnets. The small bar magnet was stronger than the large horseshoe magnet.'

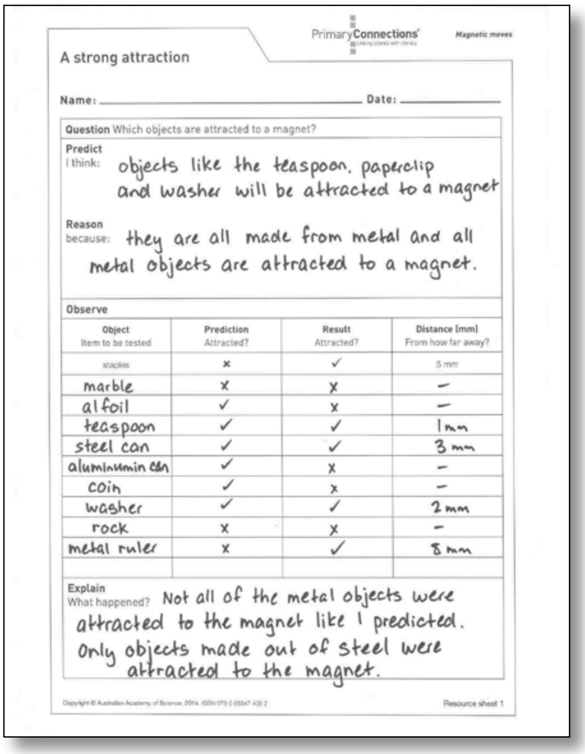
15 Introduce an enlarged copy of 'Information note for families' (Resource sheet 2). Read through and discuss with students.

16 Ask students what examples of magnetic objects they think that they might find at home. Record students' ideas in the class science journal.

17 Discuss places where magnets are used at home. Explain that students will ask parents or caregivers if and where they use magnets in their work.

18 Draw students' attention to the date that the home activity needs to be completed by.

19 Update the word wall with words and images.


PrimaryConnections

Magnetic moves

A strong attraction

Name: ______ Date: ______

Question Which objects are attracted to a magnet?

Predict
I think: objects like the teaspoon, paperclip and washer will be attracted to a magnet

Reason
because: they are all made from metal and all metal objects are attracted to a magnet.

Observe

Object Item to be tested	Prediction Attracted?	Result Attracted?	Distance (mm) From how far away?
staples	✗	✓	5 mm
marble	✗	✗	–
al foil	✓	✗	–
teaspoon	✓	✓	1 mm
steel can	✓	✓	3 mm
aluminumin can	✓	✗	–
coin	✓	✗	–
washer	✓	✓	2 mm
rock	✗	✗	–
metal ruler	✗	✓	8 mm

Explain
What happened? Not all of the metal objects were attracted to the magnet like I predicted. Only objects made out of steel were attracted to the magnet.

Copyright © Australian Academy of Science, 2014. ISBN 978 0 85847 406 2

Resource sheet 1

Work sample of 'A strong attraction' (Resource sheet 1)

EXPLORE

Curriculum links

Science

- Use magnets to investigate iron fortified breakfast cereal.
- Explore how to make temporary magnets.
- Research innovative ways that people use magnetic forces, such as Maglev trains, recycling materials.
- Visit a recycling plant where magnets are used to sort items.

A strong attraction

Name: ______________________ **Date:** ______________

Question Which objects are attracted to a magnet?

Predict
I think:

Reason
because:

Observe

Object Item to be tested	**Prediction** Attracted?	**Result** Attracted?	**Distance (mm)** From how far away?
staples	✗	✓	5 mm

Explain
What happened?

Information note for families

Name: ________________________________ **Date:** ______________

Introducing the 'Magnetic moves' home task

This term our class is finding out how magnetism is a force that enacts on objects at a distance.

As part of the unit, students are asked to use a magnet, such as a fridge magnet, to find what objects around the house 'stick' to or are attracted to the magnet.

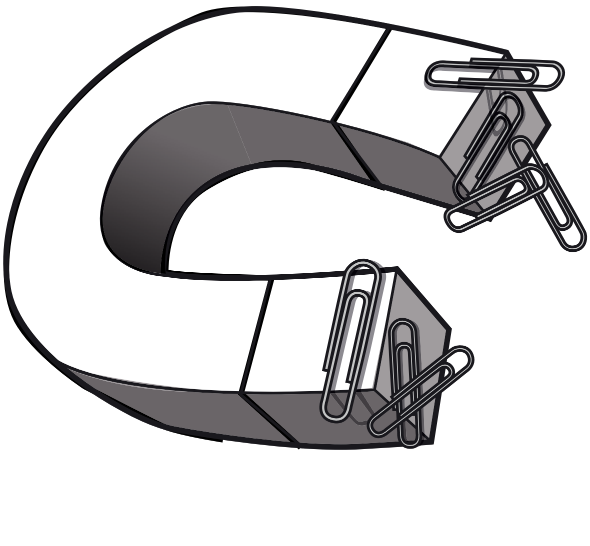
Students are asked to list and/or draw the objects that the magnet 'sticks' to or that are attracted by the magnet.

Students will be invited to share their objects with the class on

____.

Thank you for your assistance.

Class teacher



Information note for families

Name: ______________________ **Date:** ______________

Objects I found that are attracted to a magnet:
Where and how magnets are used at home:

Lesson 3 Feeling the force

AT A GLANCE

To provide students with hands-on, shared experiences of how a magnetic force attracts objects through different materials, and the effect of friction on the movement of a magnet.

Session 1 Bumping along

Students:

- explore moving a paperclip across sheets made of different materials
- relate their observations to the force of friction.

Session 2 Very gripping

Students:

- represent their understanding of friction through force-arrow diagrams
- explore everyday examples of friction at work in the school.

Lesson focus

The *Explore* phase is designed to provide students with hands-on experiences of the science phenomenon. Students explore ideas, collect evidence, discuss their observations and keep records such as science journal entries. The *Explore* phase ensures all students have a shared experience that can be discussed and explained in the *Explain* phase.

Assessment focus

Formative assessment is an ongoing aspect of the *Explore* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning. In this lesson you will monitor students' developing understanding of how:

- forces can be exerted by one object on another from a distance.

Key lesson outcomes

Science

Students will be able to:

- identify how a magnetic force attracts objects through sheets made of different materials
- discuss how the thickness of the sheet affects whether the magnetic force affects the paperclip
- describe how friction affects the movement of objects across different surfaces.

Literacy

Students will be able to:

- represent forces, including the force of friction, using a force-arrow diagram
- record their observations in a table
- discuss and compare ideas about friction.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page xii).

Teacher background information

What materials can magnetic fields pass through?

Magnetic fields can pass through most non-magnetic materials, such as paper, plastic, glass and non-magnetic metals. However whether the magnetic field can be detected on the other side of a sheet of material depends on how thick it is relative to the strength of the magnetic field. Magnetic fields weaken over distance.

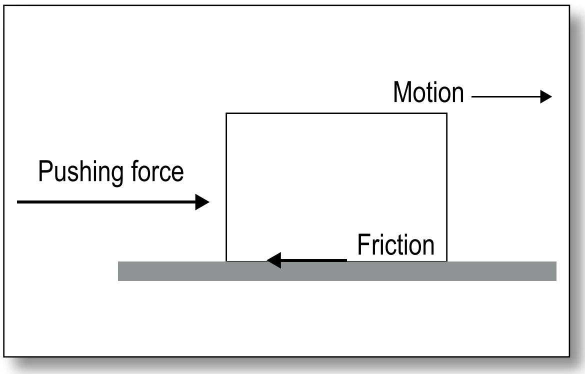
What is friction?

When an object is moving over a surface, the contact between it and the surface creates friction. The friction force opposes the direction of the movement of the object, slowing it down.

Friction occurs between all types of materials whether they are solids, liquids or gases. Friction is caused by the interaction between two surfaces causing them to 'stick' together and oppose the movement between them.

Scientists and engineers try to find ways to both increase and decrease friction. This is because there are situations where friction is helpful and other situations where friction is a problem for us. An everyday use of friction is to slow things down, for example the brakes on a bicycle rub against the tyre, transforming the movement energy of the wheel into heat and sound energy and therefore slowing it down. Brake material is chosen to create high friction when pushed against the rubber of tyres. Bike brakes work less efficiently when the tyre is wet since water lubricates the wheel.

A friction force opposes the direction of movement, so when depicting friction on force-arrow diagrams the friction force-arrow is drawn in the direction opposing the motion, along the surface where friction is considered to be strongest.



A simple force-arrow diagram of friction

Session 1 Bumping along

EXPLORE

Equipment

FOR THE CLASS

- class science journal
- TWLH chart
- word wall
- team roles chart
- team skills chart
- 1 enlarged copy of ‘Passing through’ (Resource sheet 3)

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member’s science journal
- 1 magnet (bar, ring or horseshoe)
- 1 paperclip
- sheets of different material (see ‘Preparation’)
- 1 copy of ‘Passing through’ (Resource sheet 3) per student

Preparation

- Gather flat sheets made of different materials such as cloth, paper (magazines, paper plate) felt, cardboard, coarse sandpaper, plastic ice cream container lid, wood. The sheets need to be thin enough for a magnetic field from a common magnet to pass through.
- Prepare an enlarged copy of ‘Passing through’ (Resource sheet 3).
- *Optional:* Display ‘Passing through’ (Resource sheet 3) in a digital format.

Lesson steps

1 Review the previous lesson using the TWLH chart, class science journal and word wall.

2 Review Lesson 1 where a magnet was placed under a desk and it attracted a paperclip which was on top of the desk. Ask students questions such as:

- Does a magnet always attract an object if something is put in between the magnet and the paperclip? How do you know?
- What did you notice about the way the paperclip moved over the different surfaces?

Record students’ responses in the class science journal.

3 Explain that students will be working in collaborative learning teams to explore the question:

- Which materials will the force of a magnet work through?

4 Explain that students will also observe how the paperclip moves over each of the materials. (For example, did the paperclip move smoothly or not?)

5 Show students the equipment table where the different materials are placed.

6 Introduce the enlarged copy of 'Passing through' (Resource sheet 3). Read through and discuss. Revise the steps of Predict, Reason, Observe and Explain.

7 Show students the equipment table and explain that this is where Managers will collect the team's equipment. Encourage teams to also find other materials in the classroom to explore.

8 Form teams and allocate roles. Allow time for students to complete the activity.

Exploring magnetic force

9 Ask team Speakers to present their team's results. Ask students questions such as:

- Which materials did the force of a magnet work through?
- Why do you think that the magnetic force didn't work through that material?
- Could there be another reason why that happened? (The material was too thick for the magnetic force to pass through.)
- How did the movement of the paperclip change between the different materials? (Sometimes it moved smoothly, sometimes it moved in a jerky way, sometimes it was easy to move, sometimes a bit harder to move it.)

EXPLORE

10 Ask students what claim they can make to answer the question, 'Which material does the force of a magnet pass through?'

For example, 'Our class found out that the force of a magnet passes through all the non-magnetic materials that we could find in our classroom, provided the sheet of material was thin enough.' Add to the 'What we **L**earned' column of the TWLH chart.

11 Ask students what evidence they have to support the claim. For example, 'We tested sheets made of different materials and found out the magnetic force passed through glass, metal, paper, plastic and fabric. The magnetic force did not pass through thick wood but it did pass through thin wood and paper.' Add to the '**H**ow we know' column of the TWLH chart.

12 Ask some students to present their home task.

13 Update the TWLH chart and word wall with words and images.

Passing through

Name: ______________________ **Date:** ______________

Question Which materials does the force of a magnet pass through?

Predict
I think:

Reason
because:

Observe

What was put between the magnet and the paperclip? What was it made of?	Was the paperclip still attracted to the magnet?	How did the paperclip move over the surface?
plastic lid	yes	It moved easily and smoothly

Explain
What happened?

Session 2 Very gripping

Equipment

FOR THE CLASS

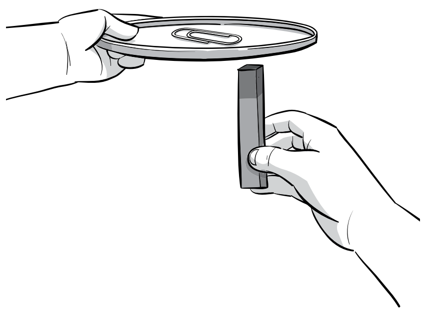
- class science journal
- TWLH chart
- word wall
- team roles chart
- team skills chart

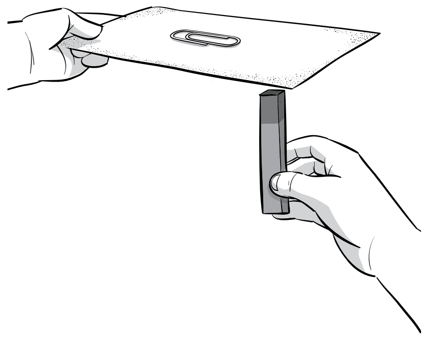
FOR EACH TEAM

- role wristbands or badges for Manager and Speaker
- each team member's science journal

Preparation

- Prepare diagrams in the class science journal as follows:


Paperclip on plastic


Paperclip on sandpaper

Lesson steps

1 Review the previous lesson using the TWLH chart, class science journal and word wall.

2 Discuss with students how the feel of the movement of the paperclip changed depending on the surface. Ask questions such as:

- What did you notice about the way the paperclip moved over the different sheets of material? What differences did you observe in the way it moved?
- Which sheets of material did the paperclip glide over quickly and smoothly? How would you describe their surfaces?
- Which sheets of material did the paperclip move over with difficulty and/or slowly? How would you describe their surfaces?

3 Ask students what forces were at work on the paperclip when it moved across the sheets of material (the pull of the magnet, friction opposing the movement, the pull of gravity, the push of the sheet of material countering the pull of gravity). Encourage students to think of non-magnetic forces.

4 Introduce and discuss the term 'friction'. Discuss with students how friction is a force that occurs when two surfaces slide over one another and slows things down.

5 Explain that the arrow that represents the force of friction always goes in the opposite direction to the movement of the object.

6 Introduce the prepared page in the class science journal (see 'Preparation'). Introduce the purpose and features of a force-arrow diagram.

Literacy focus

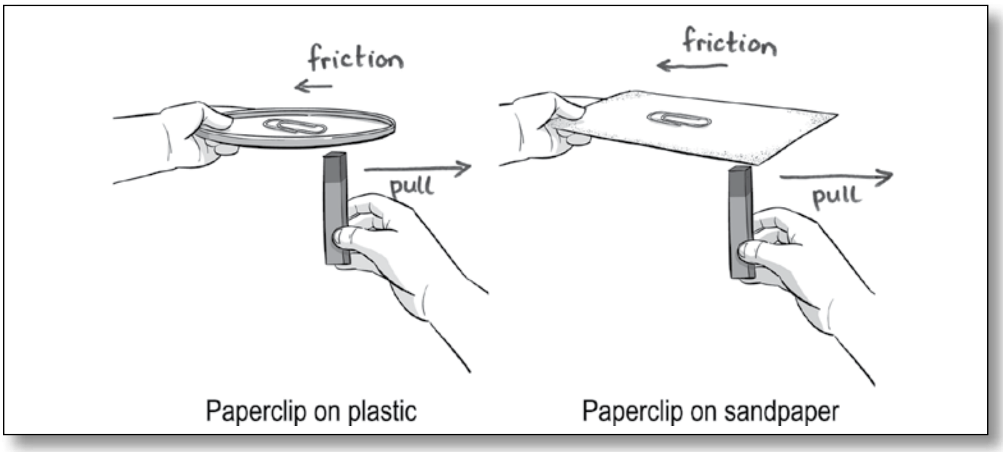
Why do we use a force-arrow diagram?

We use a **force-arrow diagram** to show push and pull forces.

What does a force-arrow diagram include?

A **force-arrow diagram** uses arrows to show the direction of forces. A pull is shown by an arrow pointing away from the object. A push is shown by an arrow pointing towards the object. The length of the arrow represents the strength of the force.

7 Add force-arrows to the prepared diagrams in the class science journal.



Force-arrow diagram of friction on a smooth and rough surface

8 Discuss the force-arrow diagrams asking questions such as:

- What is similar about the two diagrams?
- What is different about the two diagrams? (the size of the friction arrows)
- How would you describe the surfaces of each sheet of material? Which sheet of material had more friction? (the sandpaper) How do we know? (the paperclip moved slower)

9 Ask students for other examples of where friction occurs, such as going down a slide, catching a ball with a mitt, pushing a box over carpet, playing marbles on grass. Record students' responses in the class science journal.

10 Explain that students will work in their collaborative learning teams to look for examples of friction that occur in the classroom or school grounds. Ask teams to then draw annotated diagrams with force-arrows to represent the force of friction that they observed.

11 Reform teams and roles. Allow time for teams to complete the activity.

12 Ask team Speakers to present their team's ideas. Record team's ideas in the class science journal. Encourage students to ask questions using the 'Science question starters' (see Appendix 5).

13 Discuss what claim from today's lesson can be added to the 'What we **L**earned' column of the TWLH chart. For example:

'The movement of objects is slowed down by the force of friction. Rough surfaces tend to have more friction.'

14 Discuss the evidence that can be added to the '**H**ow we know' column of the TWLH chart. For example:

'We pulled a paperclip over sheets made of different materials using a magnet. When the surface was rough the paperclip moved slower and with more difficulty.'

15 Review with students that there are many forces at work when the magnet pulls the paperclip over material, including a magnetic force that pulls it from a distance, and a friction force that slows the movement down when two surfaces are in contact.

16 Update the word wall with words and images.

Curriculum links

Science

- Discuss how friction can be useful (to allow us to walk without slipping, to slow down the wheels of a spinning bike) or a problem (wear and tear on moving parts of machines, helped by oil to lubricate/reduce friction).
- Make a friction frog. See: **https://blog.doublehelix.csiro.au/friction-frog/**
- Explore how friction is used on a bicycle, such as slip-resistant pedals, handle bar grips and braking mechanisms.

Lesson 4 Pushed and pulled

EXPLORE

AT A GLANCE

To provide students with hands-on, shared experiences of how magnets attract and repel each other.

Students:

- follow a procedural text to explore attraction and repulsion of magnets
- discuss the North and South poles of magnets.

Lesson focus

The *Explore* phase is designed to provide students with hands-on experiences of the science phenomenon. Students explore ideas, collect evidence, discuss their observations and keep records such as science journal entries. The *Explore* phase ensures all students have a shared experience that can be discussed and explained in the *Explain* phase.

Assessment focus

Formative assessment is an ongoing aspect of the *Explore* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning. In this lesson you will monitor students' developing understanding of how:

- forces can be exerted by one magnet on another from a distance.

Key lesson outcomes

Science

Students will be able to:

- identify the sides (poles) of each ring magnet and how they react to each other
- discuss attraction and repulsion of magnets depending on the orientation of their poles
- measure the distance between repelling magnets to observe strength of magnets.

Literacy

Students will be able to:

- understand the purpose and features of a procedural text
- follow a procedural text
- create a labelled diagram
- participate in class discussions.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page xii).

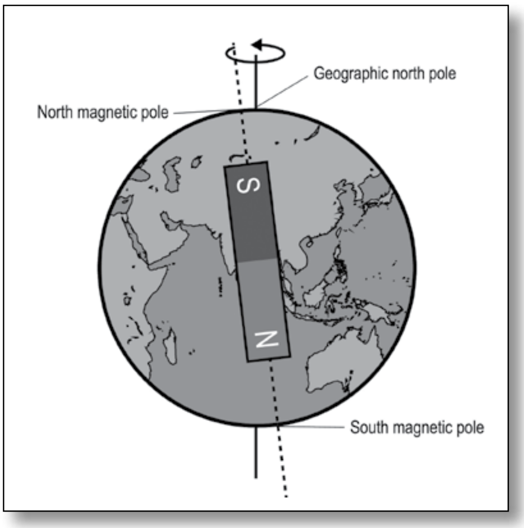
Teacher background information

Magnetic Earth

The Earth acts like a big magnet and produces a magnetic field. This is why compasses point in a predictable direction. Consequently the Earth has two types of poles:

- The geographical poles which represent the ends of the vertical axis around which the planet rotates.
- The magnetic poles which are the ends of the vertical axis through Earth's magnetic field and the points to which compasses gravitate towards.

Earth's geographical poles and the magnetic poles are not in exactly the same place, although they are near each other.



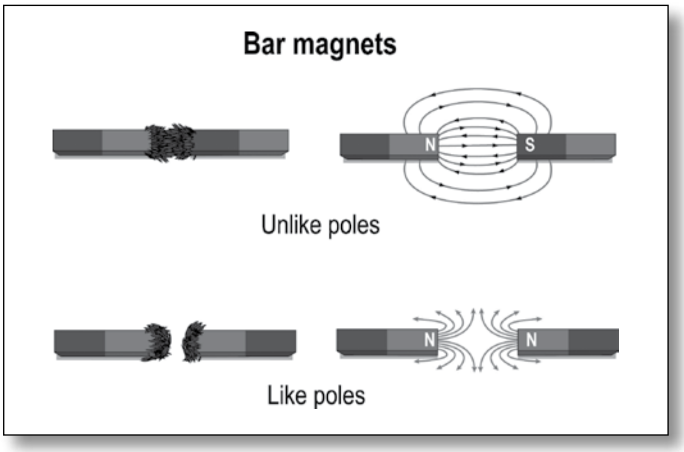
A representation of the Earth's magnetic and geographic poles

Although it behaves like one, the Earth does not actually contain a magnet. Scientists think that the Earth's magnetic field (the geomagnetic field) is generated by convection currents in the molten metal (iron alloys) deep inside the Earth (inside its outer core). The geomagnetic field is not as stable as a magnet, the poles occasionally unpredictably inverse (the North Pole becomes the South Pole and visa versa).

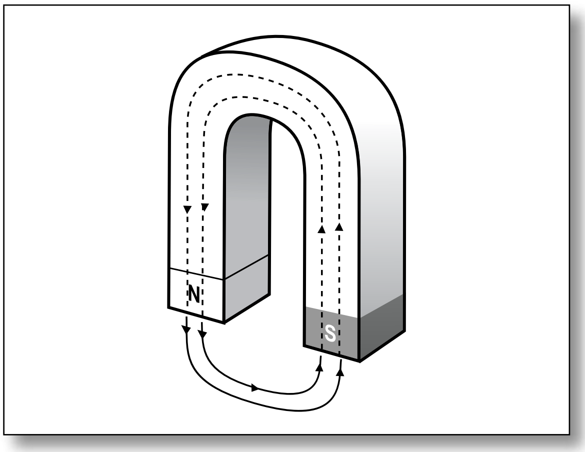
Magnetic fields

Like poles repel; unlike poles attract. When the N poles of two magnets are brought together, the magnets will be repelled—that is, they will move away from each other. The same thing happens when the S poles are brought together. When the N pole of one magnet is brought near the S pole of another, the two magnets will strongly attract each other and will move toward each other.

The area of force (magnetic field) surrounding a magnet can be represented by lines of force. When opposite or unlike poles of a magnet are brought together, the lines of force join up and the magnets pull together. When like poles of a magnet are brought together, the lines of force push away from each other and the magnets repel each other.



The horseshoe magnet has north and south poles just like a bar and ring magnets but the magnet is curved so the poles lie in the same plane. The magnetic lines of force flow from pole to pole just like in the bar magnet. However, since the poles are located closer together and a more direct path exists for the lines of flux to travel between the poles, the magnetic field is concentrated between the poles.



Horseshoe magnet

Equipment

FOR THE CLASS

- class science journal
- TWLH chart
- word wall
- team roles chart
- team skills chart
- 1 bar magnet with poles marked
- 30 cm length of cotton thread
- 1 enlarged copy of ‘All lined up’ (Resource sheet 4)
- *Optional:* magnetic compass

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member’s science journal
- 1 clothes peg
- 1 straw
- 4 ring magnets (24 mm diameter)
- 1 ruler
- 2 bar magnets with poles marked
- 1 copy of ‘All lined up’ (Resource sheet 4) per team member

Preparation

- Tie a 30 cm length of cotton thread around the middle of a magnet so that the magnet will swing freely.
- Prepare an enlarged copy of ‘All lined up’ (Resource sheet 4).
- *Optional:* Display ‘All lined up’ (Resource sheet 4) in a digital format.

Lesson steps

1 Discuss activities from previous lessons where students have observed that magnets can attract objects from a distance.

2 Introduce an enlarged copy of ‘All lined up’ (Resource sheet 4). Read through and discuss the purpose and features of a procedural text.

Literacy focus

Why do we use a procedural text?

We use a **procedural text** to describe how something is done. We can read a **procedural text** to find out how to do things.

What does a procedural text include?

A **procedural text** includes a list of materials needed to do the task and a description of the sequence of steps used. It might include annotated diagrams.

3 Explain that teams will draw labelled diagrams to record their observations. Discuss the purpose and features of a labelled diagram.

Literacy focus

Why do we use a labelled diagram?

We use a **labelled** diagram to show the shape, size and features of an object.

What does a labelled diagram include?

A **labelled diagram** might include a title, an accurate drawing, a scale to show the object’s size and labels showing the main features. A line or arrow connects the label to the feature.

4 Form teams. Ask Managers to collect team equipment. Allow teams time to complete the activity.

Measuring distance between repelling magnets

5 Ask Speakers to present their team's ideas. Ask questions such as:

- How did the arrangement of the magnets affect what happened between them?
- What did you notice about each side of the magnets and the way that they behaved?

6 Ask students if they know what the scientific word to describe magnets pushing away from each other is (repel). Add 'repel' to the class science journal.

7 Tie the cotton to the magnet and ask students to observe what happens when you suspend the magnet freely. (The North side of the magnet will face in one direction).

Optional: Check the direction with a magnetic compass.

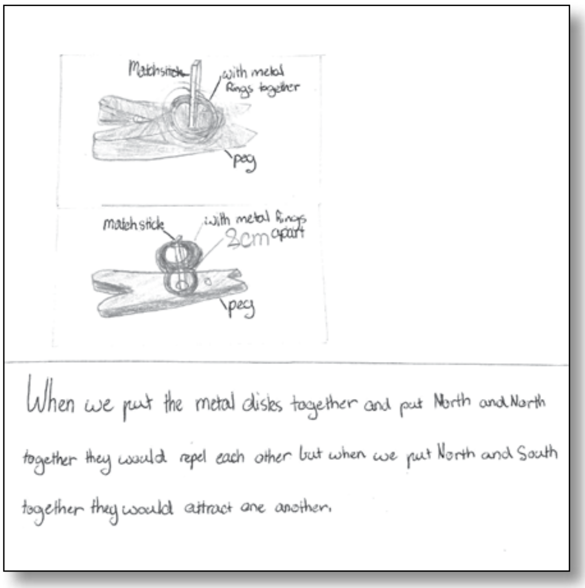
8 Ask students if they know what scientists call the two sides of a magnet (North and South poles). Explain that the north side of the magnet turns towards the magnetic north pole because it is affected by the Earth, which itself acts like a very big magnet.

Optional: Allow time for teams to use cotton and magnets to find North.

9 Ask students to review their diagrams on 'All lined up' (Resource sheet 4) and add additional information that they have learned about the poles of magnets to explain the forces that they observed during the activity.

10 Re-form teams. Allow time for teams to complete the activity.

EXPLORE



Work sample of labelled diagrams of ring magnets

EXPLORE

11 Ask teams what claims they can make about how magnets behave after completing today's lesson. Add claims to the 'What we **L**earned' column of the TWLH chart, such as:

- 'North and South poles attract each other and North and North or South and South Poles repel each other (opposite sides attract and like sides repel)'.
- 'Magnets can affect other magnets without touching them.'

12 Ask students what evidence they have to support the claims. Add the claims to the 'How we **K**now' column of the TWLH chart. For example,

- 'We put ring magnets on a straw and found out that when North and North poles or South and South poles were together there was a space between the magnets and when North and South poles were together the magnets stuck to each other.'

13 Update the word wall with words and images.

Curriculum links

Science

- Watch a video on maglev trains. See: http://www.discovery.com TV shows
- Make a floating compass using a pin and a leaf to find North. See www.csiro.au/helix/sciencemail/activities/navigation.html
- Explore magnetic fields with steel wool. See: www.csiro.au/helix/sciencemail/activities/magnets.html

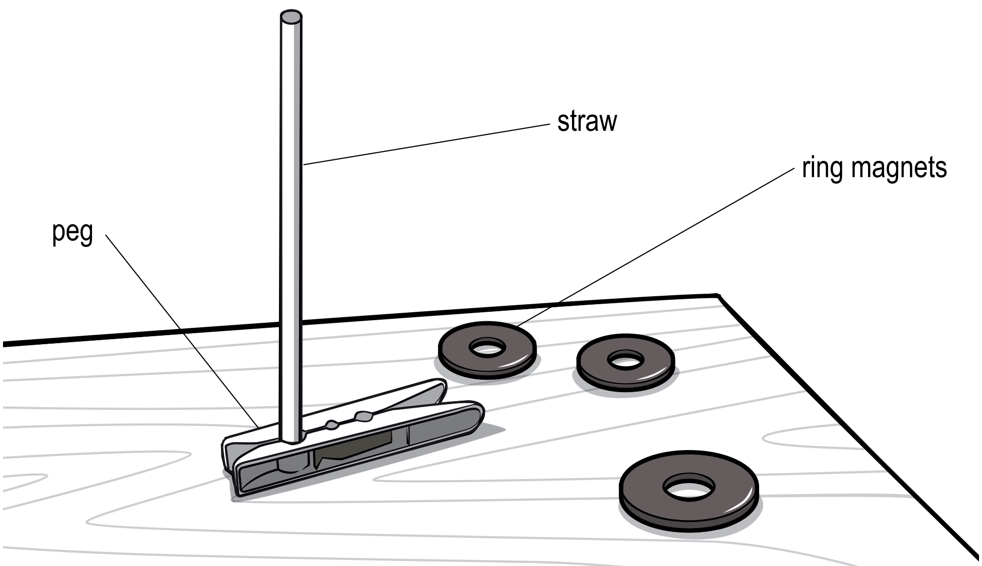
All lined up

Team members: ______________________ **Date:** ____________

Question Magnets attract other magnets. How else do magnets behave?
Equipment • 1 clothes peg • 3 ring magnets • 1 pencil • 1 ruler

Activity steps

1. Clamp the clothes peg on the pencil and place the peg flat on the desk so that it makes a stand for the magnets.
2. Place the three ring magnets on the pencil. Draw a labelled diagram of what you observe.
3. If there is a space between pairs of magnets, measure and record the distance between them and add the information to your labelled diagram.
4. Remove the top magnet, turn it over, and replace it on the pencil. Record your observations.
5. Explore other arrangements of the magnets and record your observations.



All lined up

Team members: ______________________________ **Date:** ______________

Observations

Draw labelled diagrams of your observations

Explain your observations

When ______________________________ were put together they

______________________________ each other.

When ______________________________ were put together they

______________________________ each other.

Lesson 5 From a distance

AT A GLANCE

To provide students with hands-on, shared experiences of how gravity and magnetic forces act from a distance.

Students:

- create a floating paperclip model
- represent their understanding through force-arrow diagrams.

EXPLORE

Lesson focus

The *Explore* phase is designed to provide students with hands-on experiences of the science phenomenon. Students explore ideas, collect evidence, discuss their observations and keep records such as science journal entries. The *Explore* phase ensures all students have a shared experience that can be discussed and explained in the *Explain* phase.

Assessment focus

Formative assessment is an ongoing aspect of the *Explore* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning. In this lesson you will monitor students' developing understanding of how:

- forces can be exerted by one object on another through direct contact or from a distance.

Key lesson outcomes

Science

Students will be able to:

- describe the different forces acting on a paperclip
- identify that the paperclip's movement changes (it falls) when the magnetic force is removed.
- identify that gravity pulls objects to the Earth.

Literacy

Students will be able to:

- understand the purpose and features of an annotated drawing
- record their thinking in an annotated drawing
- discuss and compare ideas to form common understandings.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page xii).

Teacher background information

Gravity

When we drop things, we see that the Earth's gravitational force (gravity) 'pulls' them down to the ground. We see magnets 'push' and 'pull' other magnets, and pull things made of iron (or steel) towards them (or be pulled towards them depending on their respective masses). Both gravitational and magnetic forces act at a distance rather than through direct contact. Though we cannot see the force, we can see and feel the effect it has on objects.

Every object exerts a gravitational force on other objects but it can be hard to detect unless at least one of the objects has a large mass. 'Mass' is a measure of the amount of matter an object has while 'weight' is the measure of gravitational pull that acts on an object.

The Earth has such as large mass that the gravitational attraction between it and most things is very noticeable. When we jump into the air, the Earth's gravitational force pulls us back towards the Earth's centre very quickly. We can also feel the pull of the Earth's gravity when we try to lift things: the more mass something has, the greater the pull of gravity and the greater the lifting force we need to use. Gravity acts on objects regardless of whether or not the object is moving. It does not require the object to be surrounded by air or water or anything else and can therefore act in the vacuum of space.

Students' conceptions

Some students might think that falling is a property of an object itself rather than the effect of gravity acting between the Earth and the object. As with all forces, gravity is an external influence which acts between objects, causing them to come together.

Some students might have the conception that gravity affects things while they are falling but stops when they reach the ground. They may also believe that gravity does not pull on things that are moving upwards. All objects on Earth, whether they are in the air or on the ground, are affected by gravity.

Students might not understand that gravitational attraction is a general phenomenon that constantly acts on all objects. They might believe that gravity is related to air pushing down on an object. Air pressure and resistance are forces which are quite different from gravity and affect objects in different ways.

Equipment

FOR THE CLASS

- class science journal
- TWLH chart
- word wall
- team roles chart
- team skills chart
- 1 enlarged copy of 'A floating paperclip?' (Resource sheet 5)

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's science journal
- 30 cm length of cotton thread
- 1 paperclip
- adhesive tape
- 1 large bar magnet
- 1 copy of 'A floating paperclip?' (Resource sheet 5) per student

EXPLORE

Preparation

- Prepare an enlarged copy of 'A floating paperclip?' (Resource sheet 5)
- *Optional:* Display 'A floating paperclip?' (Resource sheet 5) in a digital format.

Lesson steps

1. Review the previous lesson using the TWLH chart and word wall.
2. Review the activity in Lesson 1 where the magnet pushed the paperclip along the desk. Ask students if magnets need to touch an object to have an effect on it.
3. Explain that students will be working in their collaborative learning teams to use the equipment on the equipment table to make a paperclip 'float' in the air without being touched by a magnet. Discuss how to stop the paperclip from touching the magnet, for example by tying it to a piece of string that is attached to the table.

'Floating' paperclip

4 Introduce the enlarged copy of ‘A floating paperclip?’ (Resource sheet 5). Ask teams to draw two annotated diagrams. These might include force-arrows, to represent their ideas about the forces acting to keep the paperclip in the air. Ask students to include what happens when the magnet is removed and the paperclip falls to the table.

5 Discuss the purpose and features of an annotated drawing.

Literacy focus

Why do we use an annotated drawing?

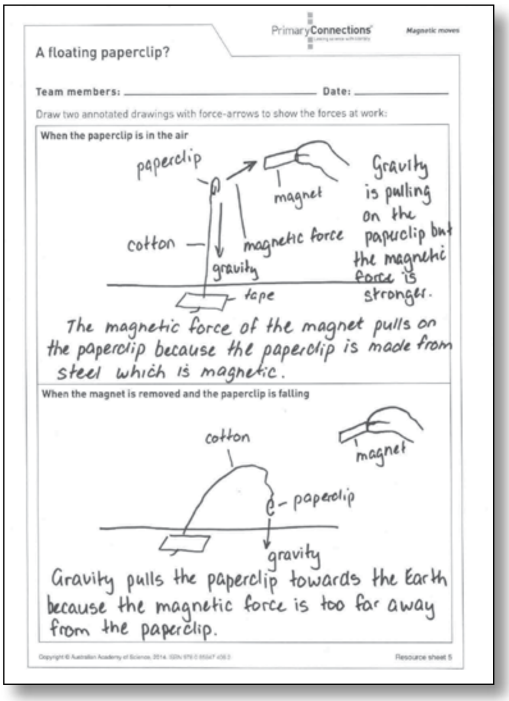
We use an **annotated drawing** to show an idea or an object.

What does an annotated drawing include?

An **annotated drawing** includes a picture and words or descriptions about the idea or object.

Revise the purpose and features of a force-arrow diagram.

6 Re-form teams. Ask Managers to collect team equipment. Allow teams time to complete the activity.



Work sample of ‘A floating paperclip?’ (Resource sheet 5)

7 Ask team Speakers to present their team’s annotated drawings.

8 Ask students questions such as:

- What forces were being exerted on the paperclip from a distance? (Gravity and magnetic forces)
- What forces were being exerted on the paperclip through contact? (The pull of the string against the magnetic force)
- Why did the paperclip stay up in the air? (The magnetic force was stronger than the force of gravity)

- Why did the paperclip fall down? (The magnetic force was no longer close enough to the paperclip to counteract the pull of the force of gravity).

9 Create an agreed annotated drawing of the forces enacting on the paperclip in each scenario on the enlarged copy of ‘A floating paperclip’ (Resource sheet 6).

10 Ask students what claims they can make about forces that act at a distance after completing today’s lesson. Add claims to the ‘What we **L**earned’ column of the TWLH chart. For example,

- ‘Gravity is a force that pulls things towards the Earth.’

11 Ask students what evidence they have to support the claims. Add the claims to the ‘**H**ow we know’ column of the TWLH chart. For example:

- ‘When we took the magnet away from the floating paperclip the paperclip fell down onto the desk.’

12 Update the word wall with words and images.

A floating paperclip?

Team members: ______________________________ **Date:** ______________

Draw two annotated drawings with force-arrows to show the forces at work:

When the paperclip is in the air
When the magnet is removed and the paperclip is falling

Lesson 6 Do you agree?

AT A GLANCE

To support students to represent and explain their understanding about forces that can be exerted by one object on another through direct contact or from a distance.

To introduce current scientific views.

Students:

- discuss their thoughts on different claims about forces
- read a factual text on contact and non-contact forces.

EXPLAIN

Lesson focus

In the *Explain* phase students develop a literacy product to represent their developing understanding. They discuss and identify patterns and relationships within their observations. Students consider the current views of scientists and deepen their own understanding.

Assessment focus

Formative assessment is an ongoing aspect of the *Explore* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning. In this lesson you will monitor students' developing understanding of how:

- forces can be exerted by one object on another through direct contact or from a distance.

Key lesson outcomes

Science

Students will be able to:

- support with evidence claims about forces
- explain their ideas about friction, gravity and magnetic forces.

Literacy

Students will be able to:

- represent their ideas through movement and discussion
- understand the purpose and features of a factual text
- read and discuss a factual text.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page xii).

Teacher background information

A force is a push or pull upon an object resulting from the object's interaction with another object. When the interaction ceases, the two objects no longer experience the force. Forces can be exerted by one object on another through direct contact or from a distance.

Contact forces result from two objects being in physical contact with each other. Friction is an example of a contact force. Other contact forces include normal force (the upward force of a desk on a book resting upon it) and applied force (the force exerted on a shopping trolley as it is pushed).

Other forces act a distance; the objects interact with each other but are not necessarily in physical contact with each other. Examples of forces at a distance include gravitational force and magnetic force. The key difference with contact forces is that the objects are not required to be in contact in order to interact. These forces do not cease when the two objects are in contact; we continue to be pulled towards the centre of the Earth while standing on it.

Equipment

FOR THE CLASS

- class science journal
- TWLH chart
- word wall
- 1 enlarged copy of 'Forces all around' (Resource sheet 6)

FOR EACH STUDENT

- student science journal
- 1 copy of 'Forces all around' (Resource sheet 6)

Preparation

- Prepare a page in the class science journal with the following statements:
  1. Forces are pushes and pulls.
  2. All metals are attracted to magnets.
  3. Larger magnets are stronger than smaller magnets.
  4. Magnetic force can pass through all materials.
  5. Gravity is not a force.
  6. Magnets can move objects without touching them.
  7. It is easier to push things across a surface when there is lots of friction.
  8. Even when we are standing still gravity is pulling us towards the Earth.
- Prepare four large labels, 'Agree', 'Disagree', 'It depends' and 'Unsure'.
- Prepare an enlarged copy of 'Forces all around' (Resource sheet 6)
- *Optional:* Display 'Forces all around' (Resource sheet 6) in a digital format.

Lesson steps

1 Review the previous lessons using the TWLH chart and word wall.

2 Explain that in this lesson students will be able to review their understanding about magnetic forces and other forces that they have been learning about.

3 Show students the four corners of the classroom with the labels, 'Agree', 'Disagree', 'It depends', and 'Unsure'.

4 Explain that they are going to take part in an activity called 'Four corners':

i. Students will start in the centre of the classroom.

ii. You will read out a claim.

iii. Students will go to the corner of the room that matches their response to the claim.

iv. Students talk to others in the corner about why they have chosen that response, what evidence they have and the reason they think it supports their choice.

v. You will ask some students in each corner to explain to the whole class why they have chosen that response.

vi. You will ask if anyone wants to move corners if they have changed their ideas.

vii. Students will move back to the centre of the classroom ready to hear the next claim.

5 Conduct the activity with students. Record students' thoughts in the prepared pages of the class science journal (see 'Preparation').

Optional: Ask students to think of more claims for the activity.

6 Introduce the enlarged copy of 'Forces all around' (Resource sheet 6). Discuss the purpose and features of a factual text.

Literacy focus

Why do we use a factual text?

We use a **factual text** to inform, teach or persuade someone reading it. We can read a **factual text** to collect information.

What does a factual text include?

A **factual text** includes a title, text and pictures. It might include labels, diagrams, maps and photographs.

7 Read and discuss the information in the factual text with the class. Ask questions, such as:

- Do our experiences and observations support this information about each of the forces? Why do you think that?
- What force would you like more information about? Why?

8 Review the pages in the class journal with statements from the 'Four corners' activity. Ask students what information from the factual text helps to confirm or change their ideas.

9 *Optional:* Ask students to write their final responses to each of the statements in their science journal and share with a partner.

EXPLAIN

10 Update the TWLH chart and word wall with words and images.

Curriculum links

English

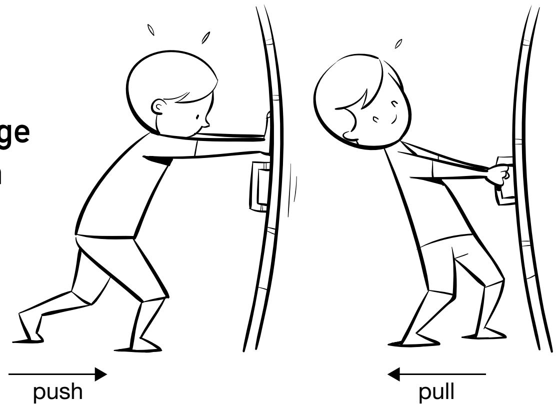
- Write a PMI (Plus, Minus, Interesting) about magnetic, friction and/or gravity forces.

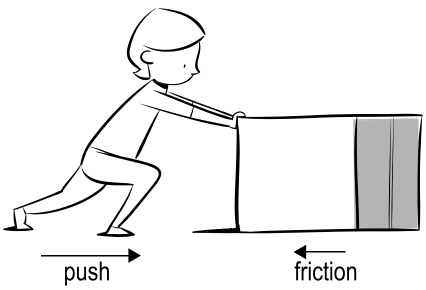
EXPLAIN

Forces all around

Forces include pushes, pulls, friction, gravity and magnetic force. A force can cause an object to start moving, stop moving or change its speed or direction.

Pushes and pulls are actions you can use to make things move, such as pulling a door open or pushing a door shut. The force of a push or pull can also change the shape of an object, such as pushing on playdough or pulling on chewing gum. You need to be in contact with the object to push or pull it.

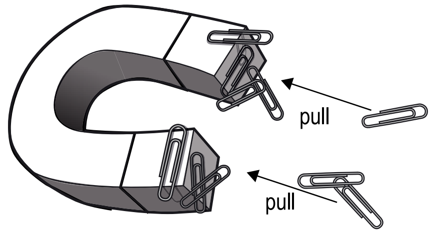


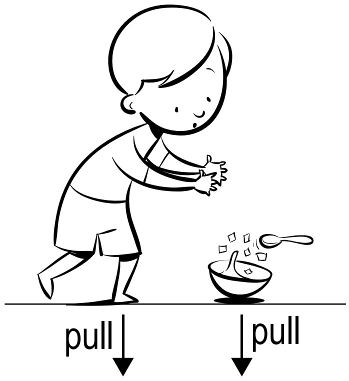


Friction is a force that happens between two surfaces when they come together and 'grip'. Two rough surfaces, like sport shoes on a brick path, have more grip than two smooth surfaces like a cardboard box on a polished wooden floor.

Magnetism is a force that acts at a distance. This means that a magnet does not have to touch an object to attract it. Magnets also react to other magnets from a distance when they either pull towards each other (attract) or push apart (repel).

However, magnets cannot exert a force (push or pull) on an object that is too far away.





Gravity is another force that acts on things at a distance. When we drop something, it doesn't float away, we see gravity pull it down to the ground.

Both magnetism and gravity are forces that act at a distance. Though we cannot see the forces, we can see the effect they have on objects.

Lesson 7 Forces at work

AT A GLANCE

To support students to design and make a game that uses forces, including magnetic force, to work.

Session 1 Game plan

Students:

- plan and develop a procedure to make a game that uses magnetic force to work.

Session 2 Game production

Students:

- follow their procedure to construct a game that meets agreed criteria.

Lesson focus

In the *Elaborate* phase students plan and conduct an open investigation to apply and extend their new conceptual understanding in a new context. It is designed to challenge and extend students' Science Understanding and Science Inquiry skills.

ELABORATE

Assessment focus

Summative assessment of the Science Inquiry Skills is an important focus of the Elaborate phase.

Key lesson outcomes

Science

Students will be able to:

- generate and develop ideas to make a game
- produce a game that uses magnetic force to work
- make changes to the game based on shared ideas and feedback.

Literacy

Students will be able to:

- record ideas as an ideas map
- create an annotated drawing of their ideas
- develop a procedure and labelled diagram of how to make their game
- engage in discussions to compare ideas.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page xii).

Session 1 Game plan

Equipment

FOR THE CLASS

- class science journal
- TWLH chart
- word wall
- team roles chart
- team skills chart
- 1 enlarged copy of 'Making plans' (Resource sheet 7)

FOR EACH TEAM

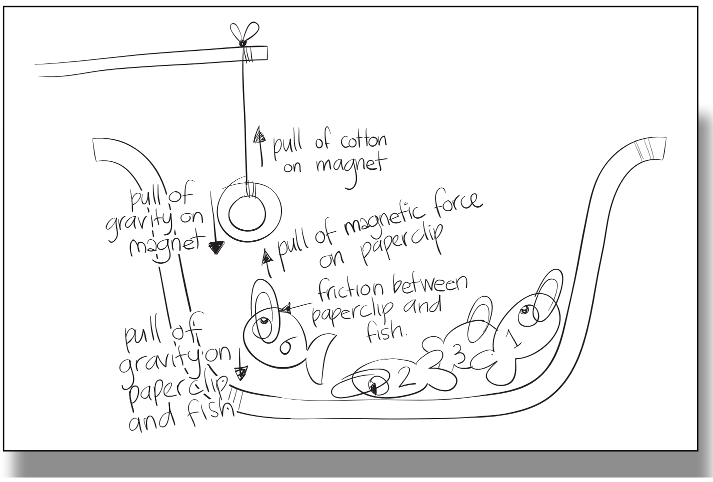
- role wristbands or badges for Director, Manager and Speaker
- each team member's science journal
- 1 copy of 'Making plans' (Resource sheet 7) per student

Preparation

- Prepare an enlarged copy of 'Making plans' (Resource sheet 7).
- *Optional:* Display 'Making plans' (Resource sheet 7) in a digital formant.

Lesson steps

1. Review the previous lesson using the class science journal, TWLH chart and word wall.
2. Describe the game of 'Magnetic fish' where paper fish shapes with paperclips attached are caught with a magnet on the end of a fishing line. Each fish has a number on it and the goal of the game is to 'catch' the highest total.
3. Discuss the forces that are at work in the game 'Magnetic fish' using an annotated drawing and force-arrows.



Annotated force-arrow diagram of 'Magnetic fish' game

Optional: Students play the game 'Magnetic fish'.

ELABORATE

4 Explain that students will work in their collaborative learning teams to design, produce and evaluate a game or useful device that uses magnetic force to work.

5 Explain that teams will present the game or device to the rest of the class and explain what is happening in terms of forces (magnetic force, gravity or friction). Ideas might include:

- A car race track with a magnet under the board to use to guide the car
- A skier with paperclips for skis that goes down a ski slope without hitting the trees.

6 Explain to teams that they need to consider and include safety in the planning and production of their design. Discuss examples of possible safety issues, for example the use of trimmers.

7 Discuss how the class will decide if each team has completed the task successfully. For example, the class might decide that the game will:

- Use magnetic force
- Be interesting or fun to play
- Be sturdy (won't fall apart when being played)
- Be safe to use or play with
- Have a low impact on the environment.

Explain that this is called the 'criteria' that their game will be assessed on.

8 Ask teams to use an ideas map to record their ideas about games that they might produce. Discuss the purpose and features of an ideas map.

Literacy focus

Why do we use an ideas map?

We use an **ideas map** to show our thoughts about a topic

What does an ideas map include?

An **ideas map** includes a title in the centre. Ideas are written around it and arrows are drawn between similar ideas. An **ideas map** might include pictures and symbols.

ELABORATE

9 Explain that teams will use an ideas map to record all their ideas about different games and discuss each before selecting one. Ask teams to then draw an annotated drawing of what the game might look like.

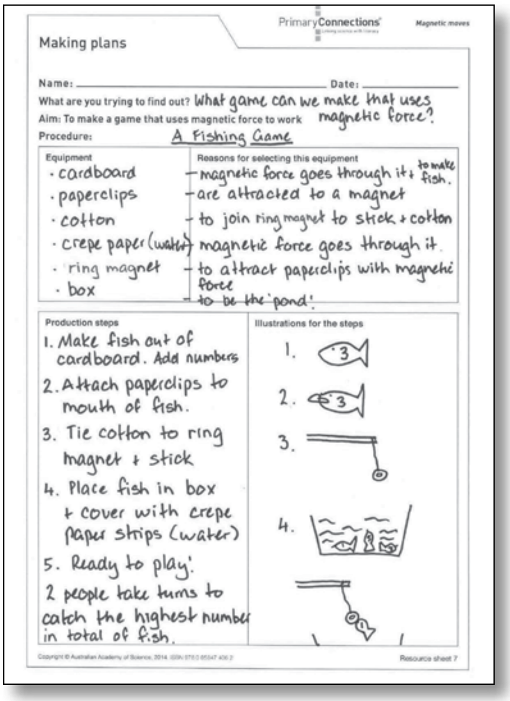
10 Form teams and allocate roles. Allow time for teams to complete the activity. Ask questions such as:

- What forces will be at work in your game?
- How does that force help your game to work?
- How does that force hinder your game from working? (for example, friction might make the movement difficult).

11 Introduce the enlarged copy of 'Making plans' (Resource sheet 7). Read through and discuss.

12 Explain that students will be working in their collaborative learning teams to plan the equipment and procedure for making their game. Revise the purpose and features of a procedural text.

13 Model how to complete the resource sheet using a prepared annotated drawing (see 'Preparation').


PrimaryConnections — Magnetic moves

Making plans

Name: ______ Date: ______

What are you trying to find out? What game can we make that uses magnetic force?

Aim: To make a game that uses magnetic force to work

Procedure: A Fishing Game

Equipment	Reasons for selecting this equipment
· cardboard	magnetic force goes through it + to make fish.
· paperclips	are attracted to a magnet
· cotton	to join ring magnet to stick + cotton
· crepe paper (water)	magnetic force goes through it.
· ring magnet	to attract paperclips with magnetic force
· box	~~to be the 'pond'.~~

Production steps	Illustrations for the steps
1. Make fish out of cardboard. Add numbers	1.
2. Attach paperclips to mouth of fish.	2.
3. Tie cotton to ring magnet + stick	3.
4. Place fish in box + cover with crepe paper strips (water)	4.
5. Ready to play! 2 people take turns to catch the highest number in total of fish.	

Copyright © Australian Academy of Science, 2014. — Resource sheet 7

Work sample of 'Making plans' (Resource sheet 7)

14 Re-form teams. Allow time for teams to complete the activity.

15 Update the word wall with words and images.

ELABORATE

Making plans

Name: ______________________ **Date:** ____________

What are you trying to find out? ______________________

____

Aim: To make a game that uses magnetic force to work

Procedure:

Equipment	Reasons for selecting this equipment

Production steps	Illustrations for the steps

Session 2 Game production

Equipment

FOR THE CLASS

- class science journal
- TWLH chart
- word wall
- team roles chart
- team skills chart
- equipment to make a game (see 'Preparation')
- collection of different sized and shaped magnets

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's science journal

Preparation

- Collect equipment for teams to create games, such as cardboard, paperclips, matchsticks, cotton wool, wire, pipe cleaners, popsticks.

Lesson steps

1. Explain that students will be working in their collaborative learning teams to make their magnetic games.
2. Ask teams to make their game and record in their science journal any necessary changes to their procedural text that will make it more effective.
3. Form teams and allocate roles. Ask Managers to collect team equipment.
4. Allow time for teams to make their games. Ask questions such as:
   - What equipment are you using to construct your game?
   - Why have you chosen that equipment?
   - What forces are at work in your game?
   - Does the magnet work from a distance or in contact with an object? How do you know?
   - Have you created more or less friction in your game? Why?
   - How will players know that they have won the game or the game is finished?
   - How will you make sure that your game is sturdy?

ELABORATE

'Cheese hunt' game

'Deep sea fishing' game

'Ski slopes' game

Lesson 8 All together

AT A GLANCE

To provide opportunities for students to represent what they know about how forces can be exerted by one object on another through direct contact or from a distance, and to reflect on their learning.

Students:

- review their understanding of contact and non-contact forces through creating an annotated force arrow-diagram of their game
- evaluate the games and their design process
- reflect on their learning during this unit.

Lesson focus

In the *Evaluate* phase students reflect on their learning journey and create a literacy product to re-represent their conceptual understanding.

Assessment focus

Summative assessment of the Science Understanding descriptions is an important aspect of the Evaluate phase. In this lesson you will be looking for evidence of the extent to which students understand how:

- forces can be exerted by one object on another through direct contact or from a distance.

EVALUATE

Key lesson outcomes

Science

Students will be able to:

- describe how gravity and magnetic force are exerted on an object from a distance
- describe how friction exerts a force on another object when in contact
- evaluate a game using established criteria
- reflect on their learning and understanding about the designing and production process of building a game.

Literacy

Students will be able to:

- create an annotated drawing of their game
- share and discuss their ideas
- reflect on their learning journey.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page xii).

Equipment

FOR THE CLASS

- class science journal
- TWLH chart
- word wall
- team roles chart
- team skills chart
- 1 enlarged copy of 'Game check' (Resource sheet 8)

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's science journal
- their completed game (see Lesson 7)
- 1 enlarged copy of 'Game check' (Resource sheet 8)

EVALUATE

Preparation

- Prepare an enlarged copy of 'Game check' (Resource sheet 8).
- *Optional:* Display 'Game check' (Resource sheet 8) in a digital format.

Lesson steps

1. Review the previous lesson using the class science journal, TWLH chart and word wall.
2. Explain that teams will test their games by giving it to another team to play and will watch for ways that they might improve the game or design.
3. Allow time for teams to work with another team to play and observe games.

4 Allow time for teams to discuss what they observed and improve the game design based on their findings.

5 Explain that teams will present their game to the class and include:

- their initial ideas using their ideas map
- an annotated diagram to show the forces at work in their game
- the equipment they chose and why
- what problems they found when they tested their game and what they did to improve the design.

6 Re-form teams. Allow time for teams to prepare their presentation.

7 Ask teams to make their presentations about their game to the class.

Optional: Review oral communication skills, such as looking at the audience and using appropriate voice, volume and pace.

A team presenting their magnetic force game

8 Introduce an enlarged copy of 'Game check' (Resource sheet 8). Read through and explain that these are the criteria that each game will be assessed on.

9 Allow time for self, peer and/or teacher evaluation of each game to be conducted.

10 Review each column of the TWLH chart focusing on evidence collected during the unit to explain '**H**ow we know'.

11 Ask students to reflect on the unit. Ask questions such as:

- What were the most interesting things that you learned about magnetic forces?
- Why do scientists say that gravity and magnetic forces act at a distance?
- Why do scientists say that friction is a force that acts through direct contact?
- Which activities did you enjoy? Why?
- How have your ideas changed?
- What are you still wondering about?

EVALUATE

Game check

Team members: ______________________________

Name of assessor: ____________________ **Date:** __________

On a scale of 1 to 5 circle the number matching each of the criteria below to assess the magnetism game (1 is low and 5 is high)

Game: ______________________________	
1. Does it use magnetic force to work?	**1 2 3 4 5**
2. Is it interesting or fun to play?	**1 2 3 4 5**
3. Is it sturdy (won't fall apart when being played)?	**1 2 3 4 5**
4. Is it safe to play, for example, does it have sharp edges?	**1 2 3 4 5**
5. Is the game well presented (nice to look at)?	**1 2 3 4 5**
6. Other comments?	

Appendix 1
How to organise collaborative learning teams (Year 3–Year 6)

Introduction

Students working in collaborative teams is a key feature of the Primary**Connections** inquiry-based program. By working in collaborative teams students are able to:

- communicate and compare their ideas with one another
- build on one another's ideas
- discuss and debate these ideas
- revise and rethink their reasoning
- present their final team understanding through multi-modal representations.

Opportunities for working in collaborative learning teams are highlighted throughout the unit.

Students need to be taught how to work collaboratively. They need to work together regularly to develop effective group learning skills.

The development of these collaborative skills aligns to descriptions in the Australian Curriculum: English. See page xiii.

Team structure

The first step towards teaching students to work collaboratively is to organise the team composition, roles and skills. Use the following ideas when planning collaborative learning with your class:

- Assign students to teams rather than allowing them to choose partners.
- Vary the composition of each team. Give students opportunities to work with others who might be of a different ability level, gender or cultural background.
- Keep teams together for two or more lessons so that students have enough time to experience working together successfully.
- If you cannot divide the students in your class into teams of three, form two teams of two students rather than one team of four. It is difficult for students to work together effectively in larger groups.
- Keep a record of the students who have worked together as a team so that by the end of the year each student has worked with as many others as possible.

Team roles

Students are assigned roles within their team (see below). Each team member has a specific role but all members share leadership responsibilities. Each member is accountable for the performance of the team and should be able to explain how the team obtained its results. Students must therefore be concerned with the performance of all team members. It is important to rotate team jobs each time a team works together so that all students have an opportunity to perform different roles.

For Year 3–Year 6, teams consist of three students: Director, Manager and Speaker. (For F–Year 2, teams consist of two students: Manager and Speaker.) Each member of the team should wear something that identifies them as belonging to that role, such as a wristband, badge, or colour-coded peg. This makes it easier for you to identify which role each student is doing and it is easier for the students to remember what they and their team mates should be doing.

Manager

The Manager is responsible for collecting and returning the team's equipment. The Manager also tells the teacher if any equipment is damaged or broken. All team members are responsible for clearing up after an activity and getting the equipment ready to return to the equipment table.

Speaker

The Speaker is responsible for asking the teacher or another team's Speaker for help. If the team cannot resolve a question or decide how to follow a procedure, the Speaker is the only person who may leave the team and seek help. The Speaker shares any information they obtain with team members. The teacher may speak to all team members, not just to the Speaker. The Speaker is not the only person who reports to the class; each team member should be able to report on the team's results.

Director (Year 3—Year 6)

The Director is responsible for making sure that the team understands the team investigation and helps team members focus on each step. The Director is also responsible for offering encouragement and support. When the team has finished, the Director helps team members check that they have accomplished the investigation successfully. The Director provides guidance but is not the team leader.

Team skills

Primary**Connections** focuses on social skills that will help students work in collaborative teams and communicate more effectively.

Students will practise the following team skills throughout the year:

- Move into your teams quickly and quietly
- Speak softly
- Stay with your team
- Take turns
- Perform your role.

To help reinforce these skills, display enlarged copies of the team skills chart (see the end of this Appendix) in a prominent place in the classroom.

Supporting equity

In science lessons, there can be a tendency for boys to manipulate materials and girls to record results. Primary**Connections** tries to avoid traditional social stereotyping by encouraging all students, irrespective of their gender, to maximise their learning potential. Collaborative learning encourages each student to participate in all aspects of team activities, including handling the equipment and taking intellectual risks.

Observe students when they are working in their collaborative teams and ensure that both girls and boys are participating in the hands-on activities.

TEAM ROLES

Manager
Collects and returns all materials the team needs

Speaker
Asks the teacher and other team speakers for help

Director
Make sure that the team understands the team investigation and completes each step

TEAM SKILLS

1. Move into your teams quickly and quietly
2. Speak softly
3. Stay with your team
4. Take turns
5. Perform your role

Appendix 2
How to use a science journal

Introduction

A science journal is a record of observations, experiences and reflections. It contains a series of dated, chronological entries. It can include written text, drawings, measurements, labelled diagrams, photographs, tables and graphs.

Using a science journal provides an opportunity for students to be engaged in a real science situation as they keep a record of their observations, ideas and thoughts about science activities. Students can use their science journals as a useful self-assessment tool as they reflect on their learning and how their ideas have changed and developed during a unit.

Monitoring students' journals allows you to identify students' alternative conceptions, find evidence of students' learning and plan future learning activities in science and literacy.

Keeping a science journal aligns to descriptions in the Australian Curriculum: Science and English. See pages xi and xiii.

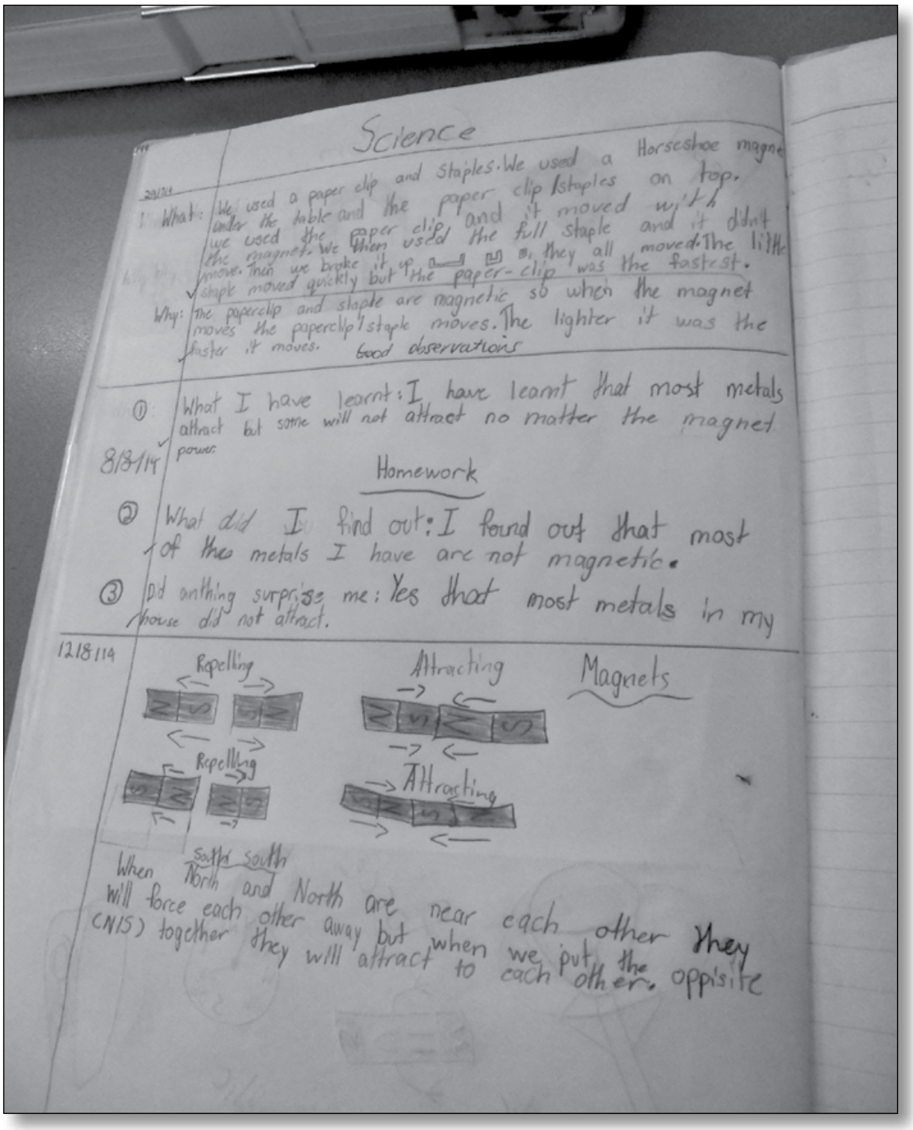
Using a science journal

1. At the start of the year, or before starting a science unit, provide each student with a notebook or exercise book for their science journal or use an electronic format. Tailor the type of journal to fit the needs of your classroom. Explain to students that they will use their journals to keep a record of their observations, ideas and thoughts about science activities. Emphasise the importance of including pictorial representations as well as written entries.
2. Use a large project book or A3 paper to make a class science journal. This can be used at all year levels to model journal entries. With younger students, the class science journal can be used more frequently than individual journals and can take the place of individual journals.
3. Make time to use the science journal. Provide opportunities for students to plan procedures and record predictions, and their reasons for predictions, before an activity. Use the journal to record observations during an activity and reflect afterwards, including comparing ideas and findings with initial predictions and reasons. It is important to encourage students to provide evidence that supports their ideas, reasons and reflections.
4. Provide guidelines in the form of questions and headings and facilitate discussion about recording strategies, such as note-making, lists, tables and concept maps. Use the class science journal to show students how they can modify and improve their recording strategies.
5. Science journal entries can include narrative, poetry and prose as students represent their ideas in a range of styles and forms.
6. In science journal work, you can refer students to display charts, pictures, diagrams, word walls and phrases about the topic displayed around the classroom. Revisit and revise this material during the unit. Explore the vocabulary, visual texts and ideas that have developed from the science unit, and encourage students to use them in their science journals.

7 Combine the use of resource sheets with journal entries. After students have pasted their completed resource sheets in their journal, they might like to add their own drawings and reflections.

8 Use the science journal to assess student learning in both science and literacy. For example, during the *Engage* phase, use journal entries for diagnostic assessment as you determine students' prior knowledge.

9 Discuss the importance of entries in the science journal during the *Explain* and *Evaluate* phases. Demonstrate how the information in the journal will help students develop literacy products, such as posters, brochures, letters and oral or written presentations.



Student science journal entry

Appendix 3
How to use a word wall

Introduction

A word wall is an organised collection of words and images displayed in the classroom. It supports the development of vocabulary related to a particular topic and provides a reference for students. The content of the word wall can be words that students see, hear and use in their reading, writing, speaking, listening and viewing.

Creating a class word wall, including words from different dialects and languages, aligns to descriptions in the Australian Curriculum: English. See page xiii.

Goals in using a word wall

A word wall can be used to:

- support science and literacy experiences of reading, viewing, writing and speaking
- provide support for students during literacy activities across all key learning areas
- promote independence in students as they develop their literacy skills
- provide a visual representation to help students see patterns in words and decode them
- develop a growing bank of words that students can spell, read and/or use in writing tasks
- provide ongoing support for the various levels of academic ability in the class
- teach the strategy of using word sources as a real-life strategy.

Organisation

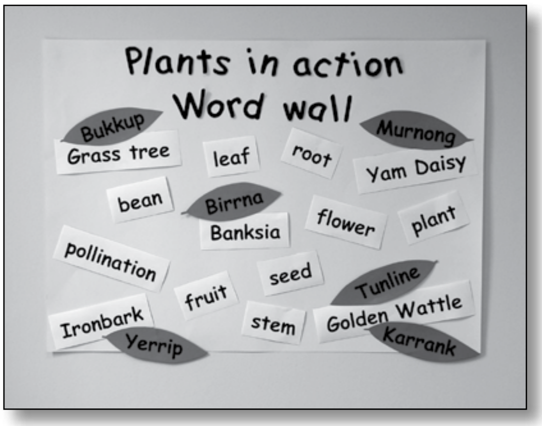
Position the word wall so that students have easy access to the words. They need to be able to see, remove and return word cards to the wall. A classroom could have one main word wall and two or three smaller ones, each with a different focus, for example, high-frequency words.

Choose robust material for the word cards. Write or type words on cardboard and perhaps laminate them. Consider covering the wall with felt-type material and backing each word card with a self-fastening dot to make it easy for students to remove and replace word cards.

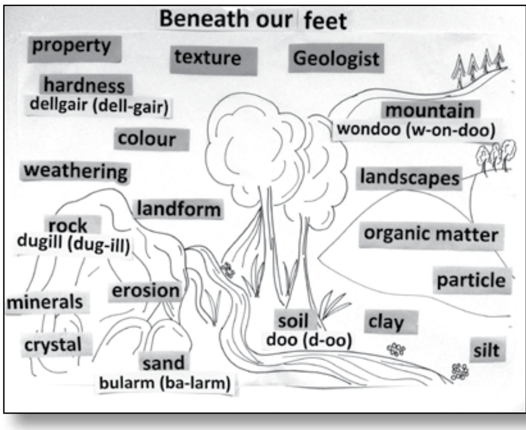
Word walls do not need to be confined to a wall. Use a portable wall, display screen, shower curtain or window curtain. Consider a cardboard shape that fits with the unit, for example, an animal silhouette for an animal characteristics unit. The purpose is for students to be exposed to a print-rich environment that supports their science and literacy experiences.

Organise the words on the wall in a variety of ways. Place them alphabetically, or put them in word groups or groups suggested by the unit topic, for example, words for a *Magnetic moves* unit might be organised under headings, such as Magnetic force, Friction and Gravity.

Invite students to contribute words from different languages to the word wall. Group words about the same thing, for example, different names of the same animal, on the word wall so that students can make the connections. Identify the different languages used, for example, by using different-coloured cards or pens to record the words.



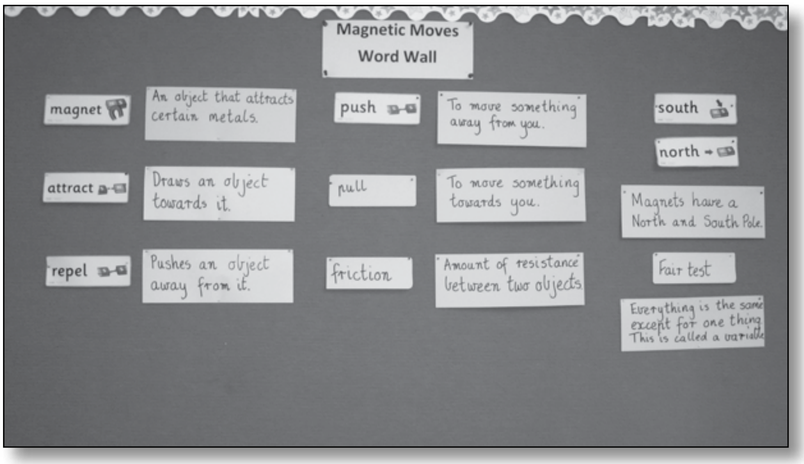
***Plants in action* word wall**



***Beneath our feet* word wall**

Using a word wall

1. Limit the number of words to those needed to support the science and literacy experiences in the classroom.
2. Add words gradually, and include images where possible, such as drawings, diagrams or photographs. Build up the number of words on the word wall as students are introduced to the scientific vocabulary of the unit.
3. Encourage students to interact with the word wall. Practise using the words with students by reading them and playing word games. Refer to the words during science and literacy experiences and direct students to the wall when they need a word for writing. Encourage students to use the word wall to spell words correctly.
4. Use the word wall with the whole class, small groups and individual students during literacy experiences. Organise multi-level activities to cater for the individual needs of students.



***Magnetic moves* word wall**

Appendix 4
How to use a TWLH chart

Introduction

A learning tool commonly used in classrooms is the KWL chart. It is used to elicit students' prior **K**nowledge, determine questions students **W**ant to know answers to, and document what has been **L**earned.

Primary**Connections** has developed an adaptation called the **TWLH** chart.

T—'What we **think** we know' is used to elicit students' background knowledge and document existing understanding and beliefs. It acknowledges that what we 'know' might not be the currently accepted scientific understanding.

W—'What we **want** to learn' encourages students to list questions for investigation. Further questions can be added as students develop their understanding.

L—'What we **learned**' is introduced as students develop explanations for their observations. These become documented as 'claims'.

H—'**How** we know' or 'How we came to our conclusion' is used in conjunction with the third column and encourages students to record the evidence and reasoning that lead to their new claim, which is a key characteristic of science. This last question requires students to reflect on their investigations and learning, and to justify their claims.

As students reflect on their observations and understandings to complete the third and fourth columns, ideas recorded in the first column should be reconsidered and possibly confirmed, amended or discarded, depending on the investigation findings.

Magnetic moves TWLH chart

What we **think** we know	What we **want** to learn	What we **learned** (What are our claims)	**How** we know (What is our evidence)
We think that magnets stick to all metal things. →	Do magnets stick to all metal things? →	Magnets attract iron and steel which is made from iron. →	We explored lots of different objects made out of lots of different materials and found out that only the iron and steel materials were attracted to the magnet.

Appendix 5
How to facilitate evidence-based discussions

Introduction

Argumentation is at the heart of what scientists do; they pose questions, make claims, collect evidence, debate with other scientists and compare their ideas with others in the field.

In the primary science classroom, argumentation is about students:

- articulating and communicating their thinking and understanding to others
- sharing information and insights
- presenting their ideas and evidence
- receiving feedback (and giving feedback to others)
- finding flaws in their own and others' reasoning
- reflecting on how their ideas have changed.

It is through articulating, communicating and debating their ideas and arguments that students are able to develop a deep understanding of science content.

Establish norms

Introduce norms before starting a science discussion activity. For example:

- Listen when others speak.
- Ask questions of each other.
- Criticise ideas not people.
- Listen to and discuss all ideas before selecting one.

Claim, Evidence and Reasoning

In science, arguments that make claims are supported by evidence. Sophisticated arguments follow the QCER process:

Q – What **question** are you trying to answer? For example, 'What do magnets attract?'

C – The **claim**, for example, 'Magnets only attract objects made from iron and steel and other magnets'.

E – The **evidence**, for example, 'We put different objects close to a magnet and saw that objects made from iron and steel moved towards the magnet (or the magnet moved towards them). Objects made from other materials like wood and plastic were not attracted to the magnet.'

R – The **reasoning**. How the evidence supports the claim. 'Our evidence supports our claim because in our investigation we trialled objects made from a lot of different materials and only those that made out of iron and steel were attracted to the magnet.'

Students need to be encouraged to move from making claims only, to citing evidence to support their claims. Older students develop full conclusions that include a claim, evidence and reasoning. This is an important characteristic of the nature of science and an aspect of scientific literacy. Using science question starters (see next section) helps to promote evidence-based discussion in the classroom.

Science question starters

Science question starters can be used to model the way to discuss a claim and evidence for students. Teachers encourage team members to ask these questions of each other when preparing their claim and evidence. They might also be used by audience members when a team is presenting its results. (See Primary**Connections** 5Es Video, *Elaborate*).

Science question starters

Question type	Question starter
Asking for evidence	I have a question about ______________ . What is your evidence to support your claim?
Agreeing	I agree with ________ because __________ .
Disagreeing	I disagree with ________ because __________ . One difference between my idea and yours is ________ .
Questioning further	I wonder what would happen if ____________? I have a question about ______________ . I wonder why ______________? What caused ______________? How would it be different if ____________?
Clarifying	I'm not sure what you meant there. Could you explain your thinking to me again?

DISCUSSION SKILLS

- Listen when others speak
- Ask questions of each other
- Criticise ideas, not people
- Listen to and discuss all ideas before selecting one

Appendix 6
Magnetic moves equipment list

EQUIPMENT ITEM	QUANTITIES	LESSON	1	2	3	3	4	5	6	7	7	8
		SESSION			1	2				1	2	
Equipment and materials												
adhesive tape	1 per team							●				
bar magnet	1 per class			●								
bar magnet with poles marked	1 per class						●					
bar magnet with poles marked	2 per team						●					
cloth to cover table	1 per class		●									
clothes peg	1 per team						●					
collection of different sized and shaped magnets	1 per class			●							●	
completed game (see Lesson 7)	1 per team											●
cotton thread, 30 cm	1 piece per class						●					
cotton thread, 30 cm	1 piece per team							●				
equipment to make a game (see 'Preparation')	per class										●	
magnet, ring, colour-coded	4 per team						●					
magnet, bar, ring or horseshoe	1 per team			●	●			●				
magnet, for home task	1 per student			●								
magnet, large	1 per class		●									
magnet, large	1 per pair		●									
magnet for home task, eg, magnetic whiteboard buttons				●								
magnetic compass *optional*							●					
paperclip	1 per team				●			●				
paperclip, large (or magnetic object)	1 per class		●	●								
paperclip, large (or magnetic object)	1 per pair		●									
ruler	1 per team			●			●					
sheets of different materials (see 'Preparation')	per team				●							
straw	1 per team						●					
table, small	1 per class		●									
objects made from magnetic and non-magnetic materials	1 set per class			●								

EQUIPMENT ITEM	QUANTITIES	LESSON	1	2	3	3	4	5	6	7	7	8
		SESSION			1	2				1	2	
Resource sheets												
‘A strong attraction’ (RS1)	1 per student			●								
‘A strong attraction’ (RS1), enlarged	1 per class			●								
‘Information note for families’ (RS2)	1 per student			●								
‘Information note for families’ (RS2), enlarged	1 per class			●								
‘Passing through’ (RS3)	3 per team				●							
‘Passing through’ (RS3), enlarged	1 per class				●							
‘All lined up’ (RS4)	3 per team						●					
‘All lined up’ (RS4), enlarged	1 per class						●					
‘A floating paperclip’ (RS5)	3 per team							●				
‘A floating paperclip’ (RS5), enlarged	1 per class							●				
‘Forces all around’ (RS6)	1 per student								●			
‘Forces all around’ (RS6), enlarged	1 per class								●			
‘Making plans’ (RS7)	1 per student									●		
‘Making plans’ (RS7), enlarged	1 per class									●		
‘Game check’ (RS8)	1 per student											●
‘Game check’ (RS8), enlarged	1 per class											●
Teaching tools												
class science journal	1 per class		●	●	●	●	●	●	●	●	●	●
student science journal	1 per student		●	●	●	●	●	●	●	●	●	●
TWLH chart	1 per class		●	●	●	●	●	●	●	●	●	●
word wall	1 per class		●	●	●	●	●	●	●	●	●	●
team roles chart	1 per class			●	●	●	●	●		●	●	●
team skills chart	1 per class			●	●	●	●	●		●	●	●
role wristbands or badges	1 set per team			●	●	●	●	●		●	●	●

Appendix 7
Magnetic moves unit overview

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to represent their current understanding as they:	Students will be able to:	Students:	
ENGAGE	**Lesson 1** Mystery moves	• discuss ideas about why objects move • suggest how an object can move without direct contact • list ideas about magnets and magnetic force.	• understand the purpose and features of a science journal • understand the purpose and features of a TWLH chart • understand the purpose and features of a word wall • contribute to discussions about magnets and magnetic force.	• observe an object moving without an obvious push or pull • list ideas about magnets and magnetic force.	**Diagnostic assessment** • Science journal entries • Class discussions • List of ideas about magnets and magnetic force.

*For information on how the lessons align with the relevant descriptions of the Australian Curriculum, see page xi for Science and xiii for English and Mathematics.

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
EXPLORE	**Lesson 2** A magnetic attraction	• predict which materials will be attracted to a magnet and give reasons for their predictions • observe and explain which objects a magnet attracts • observe the distance of attraction between different objects and a magnet • identify how people use magnets in their work.	• understand the purpose and features of a table • make a list of objects attracted to a magnet • discuss and compare results to form common understandings.	• explore whether objects made of different materials are attracted to a magnet • measure how close an object is before it is attracted to a magnet • find objects around the house which are attracted to a magnet.	**Formative assessment** • Science journal entries • Class discussions • 'A strong attraction' (Resource sheet 1) • 'Information note for families' (Resource sheet 2)
	Lesson 3 Feeling the force	• identify how a magnetic force attracts objects through sheets made of different materials • discuss how the thickness of the sheet affects whether the magnetic force affects the paperclip • describe how friction affects the movement of objects across different surfaces.	• represent forces, including the force of friction, using a force-arrow diagram • record their observations in a table • discuss and compare ideas about friction.	***Session 1*** Bumping along • explore moving a paperclip across sheets made of different materials • relate their observations to the force of friction. ***Session 2*** Very gripping • identify a living and non-living specimen at home • write a journal entry, including a labelled diagram.	**Formative assessment** • Science journal entries • Class discussions • 'Passing through' (Resource sheet 3)

*For information on how the lessons align with the relevant descriptions of the Australian Curriculum, see page xi for Science and xiii for English and Mathematics.

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
EXPLORE	**Lesson 4** Pushed and pulled	• identify the sides (poles) of each ring magnet and how they react to each other • discuss attraction and repulsion of magnets depending on the orientation of their poles • measure the distance between repelling magnets to observe strength of magnets.	• understand the purpose and features of a procedural text • follow a procedural text • create a labelled diagram • participate in class discussions.	• follow a procedural text to explore attraction and repulsion of magnets • discuss the North and South poles of magnets.	**Formative assessment** • Science journal entries • Class discussions • 'All lined up' (Resource sheet 4)
	Lesson 5 From a distance	• describe the different forces acting on a paperclip • identify that the paperclip's movement changes (it falls) when the magnetic force is removed • identify that gravity pulls objects to the Earth.	• understand the purpose and features of an annotated drawing • record their thinking in an annotated drawing • discuss and compare ideas to form common understandings.	• create a floating paperclip model • represent their understanding through force-arrow diagrams.	**Formative assessment** • Science journal entries • Class discussions • Annotated drawings • 'A floating paperclip?' (Resource sheet 5)

*For information on how the lessons align with the relevant descriptions of the Australian Curriculum, see page xi for Science and xiii for English and Mathematics.

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
EXPLAIN	**Lesson 6** Do you agree?	• support with evidence claims about forces • explain their ideas about friction, gravity and magnetic forces.	• represent their ideas through movement and discussion • understand the purpose and features of a factual text • read and discuss a factual text.	• discuss their thoughts on different claims about forces • read a factual text on contact and non-contact forces.	**Formative assessment** • Science journal entries • Class discussions • Annotated drawings • 'Forces all around' (Resource sheet 6)
ELABORATE	**Lesson 7** Forces at work	• generate and develop ideas to make a game • produce a game that uses magnetic force to work • make changes to the game based on shared ideas and feedback.	• record ideas as an ideas map • create an annotated drawing of their ideas • develop a procedure and labelled diagram of how to make their game • engage in discussions to compare ideas.	***Session 1*** Game plan • plan and develop a procedure to make a game that uses magnetic force to work. ***Session 2*** Game production • follow their procedure to construct a game that meets agreed criteria.	**Summative assessment** of Science Inquiry Skills • Science journal entries • Class discussions • Ideas map • Annotated drawing • 'Making plans' (Resource sheet 7) • Completed game

*For information on how the lessons align with the relevant descriptions of the Australian Curriculum, see page xi for Science and xiii for English and Mathematics.

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
EVALUATE	**Lesson 8** All together	• describe how gravity and magnetic force are exerted on an object from a distance • describe how friction exerts a force on another object when in contact • evaluate a game using established criteria • reflect on their learning and understanding about the designing and production process of building a game.	• create an annotated drawing of their game • share and discuss their ideas • reflect on their learning journey.	• review their understanding of contact and non-contact forces through creating an annotated force-arrow diagram of their game • evaluate the games and their design process • reflect on their learning during this unit.	**Summative assessment** Science Understanding • Science journal entries • Class discussions • Annotated drawing • Completed game • 'Game check' (Resource sheet 8)

*For information on how the lessons align with the relevant descriptions of the Australian Curriculum, see page xi for Science and xiii for English and Mathematics.

Primary**Connections**
Linking science with literacy

Primary**Connections Units**

Year	Biological sciences	Chemical sciences	Earth and space sciences	Physical sciences
F	*Staying alive* *Growing well*	*That's my hat!* *What's it made of?*	*Weather in my world*	*On the move*
1	*Schoolyard safari* *Dinosaurs and more*	*Spot the difference* *Bend it! Stretch it!*	*Changes all around* *Up, down and all around*	*Look! Listen!*
2	*Watch it grow!*	*All mixed up*	*Water works*	*Machine makers* *Push-pull*
3	*Feathers, fur or leaves?*	*Melting moments*	*Night and day*	*Heating up*
4	*Plants in action* *Friends or foes?* *Among the gum trees*	*Material world* *Package it better*	*Beneath our feet*	*Magnetic moves* *Smooth moves*
5	*Desert survivors*	*What's the matter?*	*Earth's place in space*	*Light shows*
6	*Marvellous micro-organisms* *Rising salt*	*Change detectives*	*Creators and destroyers* *Earthquake explorers*	*Circuits and switches* *Essential energy*