

Forces in everyday life

Strand

Energy and Change

Key concept

The forces acting on objects influence their motion, shape, behaviour and energy.

Purpose

Activities in this module are designed to help students understand that everyday situations can be analysed in terms of energy transfer and the motion of objects. Students have opportunities to:

- explore the relationship between the motion and behaviour of objects and the forces acting on the objects;
- investigate situations where objects float or sink;
- discuss thinking about the effects of gravitational forces on the motion and behaviour of objects;
- investigate the influence of friction on motion.

Overview of activities

The following table shows the activities in this module and the way in which these are organised in **introductory**, **developmental** and **culminating** phases.

Introductory >	Developmental 🕨	Culminating
Investigating buoyancy	Force games	Gravity
Clay boats	Forces in water	
	Investigating friction	
	Inertia	
	Forces and simple machines	



Core learning outcomes

This module focuses on the following core learning outcomes from the Years 1 to 10 Science Syllabus:

Energy and Change 4.1 Students design and perform investigations into relationships between forces, motion and energy.

5.1 Students analyse situations where various forces (including balanced and unbalanced forces) act on objects.

6.1 Students use scientific ideas of motion (including action and reaction) to explain everyday experiences.

Core content

This module incorporates the following core content from the syllabus:

Energy and Change

Motion and forces

- floating, sinking, sliding
- pushing/pulling
- friction opposing motion, everyday applications and implications
- balanced/unbalanced forces forces acting in pairs
- Newton's laws of motion inertia, action and reaction

Manipulation of forces

- simple machines levers, pulleys, inclined planes
- mechanical advantage

Assessment strategy

Suggestions for gathering information about student learning are provided in each of the activities in this module. Once sufficient information has been collected, judgments can be made about students' demonstrations of outcomes. Typical demonstrations of this module's intended outcomes are provided here to indicate the pattern of behaviour to look for when making judgments.

Energy and Change 4.1 Students design and perform investigations into relationships between forces, motion and energy.

Students may:

- identify situations where pairs of forces are acting on falling objects, and name the forces acting, such as gravity and air resistance;
- label diagrams to show forces acting on objects;
- investigate the motion of objects in terms of friction and inertia;
- investigate the operations of some simple machines.



Energy and Change	5.1 Students analyse situations where various forces (including balanced and unbalanced forces) act on objects.
	Students may:
	• illustrate balanced pairs of forces acting on an object in simple (straight- line) motion;
	 make predictions about the effects on objects of changes to uniform motion;
	 investigate the effects of forces on objects placed in water;
	• make links between friction and the movement of objects;
	• draw conclusions about the effects on motion of forces that are balanced or unbalanced;
	• generalise that an object in constant motion has balanced forces acting on it;
	 create presentations about the forces acting when simple machines are used.
Energy and Change	6.1 Students use scientific ideas of motion (including action and reaction) to explain everyday experiences.
	Students may:
	• use the property of inertia to explain the movement of objects;
	• make conclusions about the mechanical advantage of simple machines.

Background information

Current scientific conceptions

The theory of motion traditionally presented in lower secondary school science is based on the laws of motion developed by Sir Isaac Newton in the seventeenth century. Forces cause the motion of objects to change. A moving object will continue to move with the same speed in the same direction unless it is acted on by an external force such as friction, gravity, the field of a magnet or the kick from a boot.

Forces act in pairs. For example, an object floating in a liquid is acted on by gravity (acting downwards) and by the upthrust of displaced liquid (acting upwards). If these forces are of the same magnitude, and are acting in exactly opposite directions, an object's motion will not change.

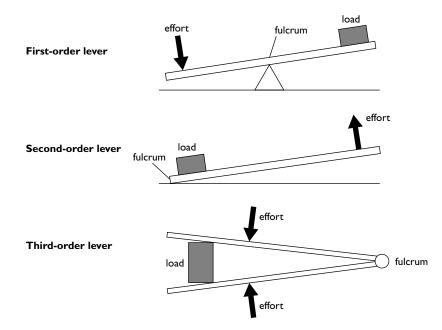
Machines are devices that allow a small force (the **effort**) to overcome a larger force (the **load**). The effort is applied to the machine and the machine transfers the effort to the load. The two forces may be of different magnitudes (sizes) or act in different places. For any machine, the **mechanical advantage** (MA) is the advantage gained by using a machine to transmit a force. It is represented by the following equation:

MA = load/effort.

Simple machines include levers, pulleys, inclined planes (screws and knives) and gears.

Levers are simple machines that consist of a rigid rod that moves around some point, called the **fulcrum**. Levers are classified as:

- first-class levers, in which the fulcrum is between the load and the effort (for example, seesaw);
- second-class levers, in which the load is between the fulcrum and the effort (for example, wheelbarrow);
- third-class levers, in which the effort is between the fulcrum and the load (for example, tongs).



Students' prior understandings

Students may have a range of conceptions about forces and their effect on the motion of an object. Younger students may not have a scientific conception of force. Students in the lower secondary years of schooling may have an awareness of the term 'force', but may retain the intuitive idea of impetus — that the force of an object resides within the object. This idea may derive from the common misunderstanding that an object that is not moving has no forces acting on it, and an object moving with constant velocity has a force acting on it in the direction of that motion. These naive understandings are not supported by the scientific idea of forces acting in pairs.

Terminology

Terms associated with the motion of objects are essential to the activities in this module — for example:

balance buoyancy density efficiency force force ratio friction fulcrum inclined plane inertia lever mechanical advantage pulley simple machines upthrust work

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Students may already be familiar with some of these terms and understand their meanings and use in scientific contexts. If so, the activities in this module will provide opportunities for them to evaluate current usage. If not, these activities will provide opportunities for students to develop their understandings.

School authority policies

Teachers need to be aware of and observe school authority policies that may be relevant to this module.

Safety policies are of particular relevance to the activities that follow. It is essential that demonstrations and student activities are conducted according to procedures developed through appropriate risk assessments at the school.

Support materials and references

Lofts, G. & Marrett, M. J. 1997, Science Quest, Jacaranda Wiley, Brisbane.

Skamp, K. (ed.) 1998, *Teaching Primary Science Constructively*, Harcourt Brace, Marrickville, NSW.

VanCleave, J. 1993, A+ Projects in Chemistry, John Wiley and Sons, Brisbane.

Introductory

Α C T I V I T Y	
Investigating buoyancy	

Focus

This activity provides opportunities for students to make observations and to reflect on their understanding of forces and buoyancy.

Materials

For each student:

- Resource Sheet 1, 'Investigating buoyancy: Bouncing raisins'
- Resource Sheet 2, 'Investigating buoyancy: Water balance'

For the class:

materials listed on Resource Sheets 1 and 2

Teaching considerations

This activity suggests two investigations into forces and buoyancy. In each investigation encourage students to identify pairs of opposing forces by considering the forces that are acting upwards and those that are acting downwards. The investigations on Resource Sheets I and 2 are suggestions only; other investigations could be used to develop these concepts.

Students with vision impairment

Students with vision impairment may need assistance for this activity. Seek advice from their support teacher.



Working scientifically

Time: 40 minutes

Making observations Predicting Discussing thinking

> Resource Sheets 1, 2

▶ Students work in groups to participate in the investigations on Resource Sheets 1 and 2. Each investigation involves objects in or on water. Students record their observations on the Resource Sheets as they engage in the investigations.

► Students discuss their thinking about what happened in each activity, either in their groups or as a whole class. Discussion questions could include:

- What forces were acting in each situation?
- Were the same forces acting all the time? Why do you think that?
- How did the size of the different forces compare?
- How did the effect of the different forces cause the events that you were able to observe?



Gathering information about student learning

Sources of information could include:

- students' completed Resource Sheets 1 and 2;
- students' contributions to discussions.

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Clay boats	Introductory
	Focus
	This activity provides opportunities for students to explore and express ideas about the forces that cause objects to float or sink in water.
	Students manipulate modelling clay to make it sink or float.
	Materials
	• buckets of water
	 modelling clay
	 samples of equal size and shape of polystyrene, aluminium, iron, plastic (the plastic should be one that floats below the surface of water) salt
	Teaching considerations A piece of clay in the shape of a ball sinks when it is placed in water. When it is shaped into a boat, it can be made to float. As students perform this activity, encourage them to consider the forces acting on the clay in each case. Remind them that using the same piece of clay means that the mass stays the same.
	Introduce the idea of density to the students: Density = mass/volume
	The density of the samples of polystyrene, aluminium, iron and plastic can be calculated. Each of these densities can be compared with the density of water (1 kg/L).
	Adding salt to water increases its density. The effect of this change on floating can be investigated.
	Working scientifically Time: 40 minutes
Collecting nformation	► Students take a small piece of modelling clay, drop it in a bucket of water and describe what happens.
Engaging with problems Exploring	► Students are challenged to devise a way to make the modelling clay float and to test their ideas.
ohenomena Looking for patterns and meanings	Students describe what they did and what happened.
Predicting Constructing meaning	 Students discuss their thinking about why the change in shape of the modelling clay is able to make it float. Discussion questions could include: What forms are acting on the ball of modelling clay when it sinks?
Formulating and elaborating ideas	 What forces are acting on the ball of modelling clay when it sinks? What forces are acting on the modelling clay best when it floats?
Making comparisons	 What forces are acting on the modelling-clay boat when it floats? In what were have these forces shareed?
Suggesting	• In what ways have these forces changed?
Describing	• What happened to the water level in the container when:
Discussing thinking	– the ball of modelling clay sank?

- the boat floated?
- In what ways was the modelling clay changed so that it floated?

Retelling and

restating

- Students record their ideas about:
- the forces acting when objects float and sink;
- the effect that a change of shape has on the mass and the volume of an object.

► Students discuss their understandings of density. They calculate the density of the samples of polystyrene, aluminium, iron, plastic and water. Using this information, they predict which of the substances will float in the water and which will sink, and record the reasoning they used to make these predictions.

▶ In groups, students test their predictions. They record the results and then compare them with their predictions. They explain any differences between the predictions and the results of their investigations.

► Students suggest how the results of their investigations would change if salt water was used instead of fresh water for the medium in which substances are floated. They record the reasons for making the predictions, test the predictions and explain any differences between the results and the predictions.

Gathering information about student learning

Sources of information could include:

- students' contributions to discussions;
- students' ideas about how to make the clay float;
- students' records of investigations.

	Development
orce games	
	Focus
	This activity provides opportunities for students to investigate balanced and unbalanced forces.
	Students play the nuclear reactor game.
	Materials
	For the class:
	• empty box (about A4 size)
	large rubber bands
	• string
	• 4 soft-drink cans or bottles
	 4 chairs
	• 12–15 metres of ribbon
	Teaching considerations
	An area about $3 \text{ m} \times 3 \text{ m}$ is cordoned off with ribbon tied at a height of $0.6-0.8 \text{ m}$ around four chairs. An open, empty box is placed in the middle of th square and four soft-drink cans or bottles are placed around it. (The bottles may be weighted with sand or pebbles to make them more stable.) Also inside the square is a large, thick rubber band that, when fully contracted, will grip an emp soft-drink can sufficiently tightly that the can may be lifted. Eight pieces of string are tied in pairs at equal intervals around the elastic band to form 'handles'. Eac piece of string must be long enough to extend from the most remote corner or the square to well past the ribbon. One of each pair of handles is passed over t ribbon; the other goes underneath it. The set-up is shown in the diagram below.
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Eight students then begin the game. Two students stand or sit outside each side of the square. One holds the handle (piece of string) above the boundary (ribbon) and the other holds the handle below it. Non-participating students watch the game and indicate when participants place some part of their bodies inside the boundary or touch the ribbon directly or with their pieces of string. Those participants are then replaced. If the game finishes before all students have participated, it should be repeated.

The scenario

We have an emergency situation. What you see is a nuclear reactor core (the box) in a meltdown situation. Four nuclear fuel rods (the cans) are outside the core and must be put back inside. Luckily, we have a device that we can use (the eight-handled rubber band). We need eight people to take one handle each, pick up the rods and return them to the core. Because the area around the core is highly radioactive, it has been cordoned off using an electric fence (the ribbon). The people may not touch the fence, or place any part of their bodies inside it. If they do, they will die and will need to be replaced.



Engaging with

problems

Analysing Applying ideas

Generalising

Summarising

Using scientific terminology

Playing

Working scientifically

Time: 60 minutes

As a whole class, students participate in the nuclear reactor game.

▶ When every student has participated in the game, the class discusses the game to highlight the forces that act when they use the device to pick up and release the soft-drink cans or bottles. Questions to guide discussion could include:

- What forces were acting on the 'fuel rod' (the soft-drink can or bottle)?
- How do the forces change to make each of these events happen:
 - wrapping the elastic band around the can?
 - lifting the can?
 - releasing the can?

► Students identify situations where some of the opposing forces were balanced and generalise about the effect on motion of forces acting in balanced and unbalanced pairs.

• Students follow up the activity by drawing or summarising each of the situations discussed above.

Students brainstorm and analyse everyday situations where balanced or unbalanced forces are involved.

Gathering information about student learning

Sources of information could include:

- students' contributions to discussions;
- students' generalisations;
- students' drawings or summaries.

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A C T I V I T Forces in wat	
	Focus
	This activity provides students with opportunities to experiment with objects immersed in water, and to develop their understandings of the factors that cause a change in the apparent weight of objects immersed in a liquid.
	Materials
	For each group:
	newton balance
	• buckets
	• water
	• 2 cm cube of modelling clay
	• measuring cylinders
	• 1000 mL beaker
	Teaching considerations
	The scientific unit for measuring force (weight is a force) is the newton (N). While there is a relationship between the mass of an object (measured in kilograms) and its weight, many students will believe from their everyday experience that mass and weight are the same thing. It can be useful for students to reflect on the difference between the two terms as they are used in science. They could experiment with the newton balances to explore the relationship between the two quantities — for example, measuring the weight of a kilogram of flour or sugar (a I kilogram mass has a weight of 9.8 newtons on the Earth's surface). This would help to reinforce the idea that the weight of an object is the force exerted downwards due to gravity.
	Encourage students to design quantitative investigations of the relationship between upthrust and displacement.
	Working scientifically Time: 80 minutes
Designing and performing investigations Predicting Drawing conclusions Making links Discussing thinking Using scientific terminology	► In groups, students take the piece of modelling clay and attach it to the hook of the newton balance. They predict what will happen when the modelling clay, still attached to the balance, is immersed in a beaker of water. Students share their predictions, and the range of predictions made by the class is recorded for later reference.
	► Students test their predictions by immersing the modelling clay in a beaker of water and recording their observations. They describe and discuss their observations, comparing them with their predictions.
	► Students discuss their thinking about what causes the weight measurement to change. They make suggestions about the action of forces on the object before and after it was immersed. Questions to consider could

- What forces are acting on the object before it is immersed?
- In what directions are these forces acting?

include:

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- What changes happen to these forces when the object is immersed?
- Does gravity change?
- What other forces are acting?

► Students mark the level of water on the side of the beaker. They immerse the cube of modelling clay in the water and once again mark the level of water on the side of the beaker. Students change the shape of the modelling clay so that it floats in water. They float it in the beaker and again mark the water level on the side of the beaker.

• Students again consider the forces on the modelling clay and discuss how these are different when the clay is floating.

► Students work in groups to investigate upthrust and displacement. They design investigations to study the relationship between the two phenomena. They consider the relationship between the change in apparent weight of an object and the volume and weight of the water displaced. Students formulate one or more researchable questions and design and perform investigations to answer these questions. Students share the answers to their questions with the rest of the class.

► Students engage in a whole-class discussion of the factors involved when objects are immersed in water. Students then compare the relationships they have identified with Archimedes' principle: *The upward force on an object totally or partly submerged in a fluid (water) is equal to the weight of fluid (water) it displaces.*

► Students record the comparisons they made and use experimental error to explain any difference between the relationship they proposed and the definition of Archimedes' principle.

• Students record their thinking about forces acting in water and the effect the forces have on objects placed in water.



Gathering information about student learning

Sources of information could include:

- students' contributions to discussions;
- students' designs for investigations;
- students' records of predictions, observations and explanations.

12

ΑСΤΙΥΙΤΥ

Investigating friction

Focus

This activity provides opportunities for students to investigate and explore friction, the force that acts when two surfaces are in contact.

Materials

For each group:

- newton balance
- small blocks of wood, or other regularly shaped objects, with hooks that can be attached to the newton balances
- access to various surfaces to test for friction (e.g. carpet, wood, concrete)
- materials for the investigation devised by students

Teaching considerations

Friction

Friction is a phenomenon that can be linked to the direct experiences of students. In this activity students analyse situations to identify the forces that are acting. Remind students that forces always act in pairs: when paired forces acting on an object are balanced, the motion of the object remains constant; when they are unbalanced, there is a change in the object's motion.

A block moving at a constant speed has two pairs of forces acting on it: vertical forces and horizontal forces. The two vertical forces acting are weight downwards and a reaction force acting upwards. These forces are balanced and there is no net resultant vertical force. The horizontal forces acting are the 'forward' force being applied by the person dragging the block, and the opposing force. The opposing force acts as a result of the contact between the object and the surface, and some will name this opposing force 'friction'. Students should be encouraged to describe friction as the force that resists the sliding motion of objects in contact with each other.

The investigation suggested here is about the effect of different surfaces on friction. This investigation involves using a block of wood (or similar object) and a newton (spring) balance to measure the friction that acts when the block is dragged along a range of surfaces.

Fair tests

Students may need assistance to ensure their investigations incorporate the elements of a fair test. To achieve a fair test:

- the question being considered must be answerable through experiment;
- the experiment must deal with the question being studied;
- all the variables in an experiment must be considered and controlled;
- only one variable may be altered at a time;
- the experiment must be able to be replicated;
- the experimenters must make objective observations;
- the results from which conclusions are drawn must be better than those from chance.

The variable that is changed (independent variable) in this investigation is the type of surface. The force used initially to move the block will be measured (the dependent variable). The object that is moved, the balance that is used to measure the force, and all other variables should be kept the same. Several trials need to be done for each surface and an average of the results calculated.





Designing and performing investigations Drawing conclusions Suggesting Explaining ideas Illustrating

Working scientifically

Time: 60 minutes

► Students work in pairs to perform the following investigation into friction. They attach a newton balance to an object (for example, a block of wood) and drag the object along a surface, such as a desk top or floor. As they drag the object along, they note the reading on the balance and suggest what this indicates (that a force is acting). Students repeat the exercise and record the measurement of the force from the newton balance when the object is moving at a steady speed.

▶ Individually, students draw a diagram of the object being dragged along by the newton balance. On the diagram they:

- indicate where forces are acting when the object is moving at a steady (constant) speed;
- label the forces;
- show the direction and relative size of the forces acting.

► Students discuss their diagrams with their partners, comparing their ideas about the size and direction of the forces. They share their ideas with another pair and again compare responses. The group of four students prepares a diagram to share with the rest of the class.

► Students discuss factors that could affect friction. In groups, students propose ways to investigate these factors and then design their investigations ensuring that it is a fair test. They perform their investigations and present their findings to the class.

► As a class, students discuss the findings of all the groups. They draw conclusions about the relationship between the surface and the frictional force it exerts.

► Students reflect on and consider ways that friction affects daily living. They could do this by:

- brainstorming ways in which friction is helpful and ways in which it is a hindrance, then creating a concept map of their ideas;
- exploring some common ways to reduce friction by devising and performing investigations and reporting on the most effective ways to reduce friction for example, which oil lubricates best;
- exploring some common ways to increase friction by devising and performing investigations and reporting on the most effective ways to increase friction for example, which tread on tyres or the soles of sports shoes provides the best grip.

Gathering information about student learning

Sources of information could include:

- students' contributions to discussions;
- students' diagrams;
- students' plans and reports from investigations.

14 •

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астіvі Inertia	Г Y Developmental
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	Focus The activity provides opportunities for students to explore the behaviour of objects in motion and to use the idea of inertia to explain motion.
	Materials
	• small trolleys or toy cars
	• ruler or other piece of material to use as a ramp
	• small object to place in trolley
	• a brick or similar heavy object for the trolley to crash into
	Teaching considerations
	Role-play The role-play in this activity provides students with an opportunity to reflect on their experiences with motion. Students should be encouraged to use these experiences to generalise about the tendency of objects to stay at rest or to keep moving in one direction unless forced to change. The idea and terminology of inertia can be introduced at this time.
	The most important part of a role-play is the debrief, which identifies and clarifies what was learnt.
	Four chairs are arranged to represent the front and back seats of a car. Students participate by taking the roles of four people sitting in a car. Students are asked to react as they normally would when they are in a car.
	The car and the scenario can be described as dramatically as is necessary.
	A possible scenario A car is parked in a driveway. The driver and passengers get into the car. The car is reversed rapidly out of the driveway and then accelerated rapidly forwards. The car moves along at a uniform speed and then brakes suddenly to stop for a red light. The car moves away from the lights as the driver accelerates rapidly and then swerves hard (to the left or right) to turn into a side street.
	Other manoeuvres relevant to the local context could be introduced. The issues of seat belts and traffic accidents could further contextualise the lesson.
	Alternative activities to investigate inertia include:
	 jerking a tablecloth from under crockery and cutlery set out on a table;
	• tossing and then catching objects while in a fast-moving vehicle.
	Working scientifically Time: 60 minutes
Clarifying and challenging Designing and performing investigations Exploring phenomena	► Four students from the class take their seats as 'driver' and 'passengers' in the 'car'. A scenario is read to the students and the passengers in the car react as they normally would when they are in a car that performs manoeuvres during a typical journey. The rest of the students observe the behaviour of the passengers in the car and reflect on how realistic it is.

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investigations Exploring phenomena

Applying ideas and concepts Generalising Reflecting and considering Improvising and performing Summarising and reporting Using scientific terminology

- Students discuss ways that the passengers move as the car:
- reverses rapidly out of a driveway;
- accelerates rapidly forward;
- moves along at uniform speed;
- brakes suddenly to stop for a red light;
- swerves hard (to the left or right);
- performs other manoeuvres relevant to the local context for example, going up (and then down) a steep incline; driving along a very rough, unsealed road.

► The rest of the class can be involved in the activity by suggesting which way they would lurch if they were in the car. They discuss the ways that the passengers moved and explain why they moved in that way.

Students discuss the term 'inertia' and use it to refine their descriptions of the movement of the passengers in the car.

▶ Students investigate the inertia of an object by placing a small object on a trolley, running the trolley down a ramp and letting it crash into a barrier (for example, a brick) so that the object falls off the front. One set-up is shown in the diagram.



► Students are shown the equipment and how it will be set up. They predict what will happen when the trolley is run down the ramp. They record their observations of the demonstration as the trolley runs down the ramp and compare these with their predictions. They should use the term 'inertia' in their explanations.

► Following the demonstration, students work in groups to devise and perform an investigation into inertia. Variables investigated could include:

- speed at impact;
- mass of object;
- material crashed into;
- rate of deceleration.

▶ Students conduct their investigations and report to the class. In their discussions and conclusions, students use the idea of inertia to explain what happened.



Gathering information about student learning

Sources of information could include:

- students' comments and responses during the role-play;
- students' predictions about the demonstration of inertia;
- students' plans and reports from investigations.

Α C T I V I T Y

Forces and simple machines

Developmental

Focus

The activity provides opportunities for students to apply ideas of forces acting in pairs to situations where simple machines are used to do work.

Materials

For each student:

- metre ruler
- weights
- Resource Sheet 3, 'Levers are simple machines'

Teaching considerations

The investigations about the variables in levers can be made clearer to students if they concentrate on investigating a balanced seesaw, or a balanced metre ruler suspended by a hook in the middle of it. Students can experiment by changing one variable and then determining what is needed to keep the system in balance. If possible they should be shown and discuss a seesaw in the playground with students seated so that they are balanced.

When discussing the seesaw, encourage students to:

- suggest that the turning effect increases with:
 - the distance between the fulcrum and the point at which the force is applied;
 - the size of the applied force;
- use appropriate terms such as lever, effort, load and fulcrum;
- consider different classes of levers, focusing on the idea that levers are classified according to the position of the fulcrum with respect to load and effort.



Working scientifically

Time: 60 minutes

► Students are shown a seesaw in a state of balance. They then work in groups in the classroom to simulate the seesaw using a metre ruler with two sets of weights arranged so that the ruler is balanced.

▶ In groups, students investigate the seesaw simulation, experimenting, and discussing their thinking about questions such as:

- What would happen if one of the masses was much heavier than the other?
- How could two very different masses (for example, an adult and a child on either side of a seesaw) be balanced?
- What happens when the distance from the fulcrum to the mass is changed?
- What forces are involved? Where are they acting?
- If one of the masses is removed, and a force is applied to lift the mass that remains, what could be done to make it easier to move? Where would the greater force be needed close to or distant from the fulcrum?

Designing and performing investigations Performing experiments Predicting Discussing thinking Illustrating

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Resource

Sheet 3

▶ Students, as a class, discuss their thinking about the seesaw as a lever — where the force is applied (the effort) and how it is transferred to the load.

Students investigate other classes of levers where the fulcrum is in a different position relative to the fulcrum and load.

► Students are given copies of Resource Sheet 3 which shows everyday applications of levers. Working individually, they cut out each illustration, paste it in their workbooks, describe the class of lever shown, and then label the diagram with the position of the fulcrum, load and effort. They state the class of lever (1, 2 or 3) and explain how the machine makes it easier to move the load.

• Students observe situations in daily life in which levers are used and describe how the lever is used to transfer applied forces.

► Students create presentations about the class of lever they have investigated.

▶ In groups, students design and perform investigations to collect quantitative data about the use of simple machines. They could investigate:

- how inclined planes of different lengths affect the effort required to raise an object to a particular height;
- how the length of the rope in a pulley, or the use of one, two or three pulley wheels, affects the effort used to raise an object;
- the relationship between length of the handle and length of the cutting blades that produces greatest mechanical advantage in a pair of scissors.
 - Students create presentations of their investigations for the class.



Sources of information could include:

- students' contributions to discussions;
- students' responses to Resource Sheet 3;
- students' presentations.



νιτγ Gravity Culminating Focus This activity provides opportunities for students to design and perform investigations about the effect of gravity and air resistance on falling objects. **Materials** patty cake papers or paper cups for muffins materials required for student-designed investigations **Teaching consideration** Planning and reporting worksheets (sourcebook guidelines, appendix 3) could be used to help students design and conduct investigations. Working scientifically Time: 40 minutes Identifying and Students are shown a demonstration of two patty cake papers held at the controlling variables same height, released and allowed to fall. The class then discusses the variables Generalising that could influence the rate of falling. Discussion questions could include: Explaining ideas What forces are acting on the patty cake papers? Where are these forces acting and in what direction? What could be done to make one of the patty cake papers fall faster? If I start with two patty cake papers that fall at different speeds, how could the reasons for the difference be investigated? Students work in groups to design an investigation into the effect of air resistance or gravity on falling objects. In their design they clearly explain what they are investigating, the variable they are going to change, the variable they are going to measure and the variables they will keep the same. Students perform their investigations and prepare a report to present to the class. In the report they explain what they were investigating and the variables they changed and measured. They respond to questions from the teacher or other students about their investigations, the forces that influence the rate at which objects fall, and how the forces acting on the objects were changed as a result of changes made to the variables. Gathering information about student learning Sources of information could include: students' contributions to discussions; students' designs for investigations; students' reports; students' explanations.

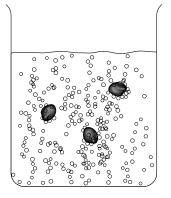


Resource Sheet

Investigating buoyancy: Bouncing raisins

You will need:

- clear beaker or drinking glass
- baking soda
- vinegar
- 2 or 3 sultanas or raisins
- I. Add vinegar to a beaker until it is about half full.
- **2.** Add about I teaspoonful of baking soda.
- 3. Quickly drop 2 or 3 sultanas or raisins into the beaker.



Record your observations of what happens to the raisins.

What forces do you think are acting on the raisins:

(a) when they are rising to the top of the beaker?

(b) when they are sinking to the bottom of the beaker?

(c) when they are stationary (at the top or on the bottom of the beaker)?



Investigating buoyancy: Water balance You will need: Second Sec

Set up the materials as shown in the diagram so that the system is balanced. The pencil should hang from the desk so that it is approximately horizontal, and each of the metal washers should hang inside a glass or beaker.

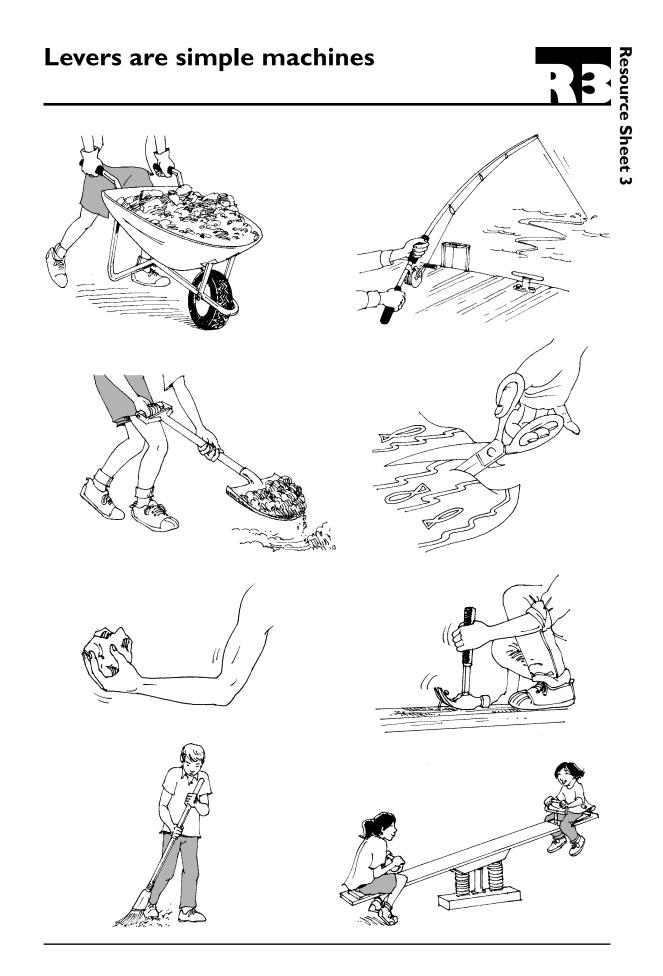
Make and record a prediction of what will happen if glass A is filled with water.

Pour water into glass A and observe what happens. Record your observations.

State whether your observations were the same as or different from your predictions. Explain any differences.

Use a coloured pencil to indicate on the diagram where the forces were acting on each of the washers before the water was poured into glass A.

Use a pencil of a different colour to show the changes to the forces acting after water was poured into glass A.



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This sourcebook module should be read in conjunction with the following Queensland School Curriculum Council materials:

Years 1 to 10 Science Syllabus Years 1 to 10 Science Sourcebook: Guidelines Science Initial In-service Materials

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Any inquiries should be addressed to: Queensland School Curriculum Council PO Box 317 Brisbane Albert Street, Q 4002 Australia

Telephone: (07) 3237 0794 Facsimile: (07) 3237 1285 Website: http://www.qscc.qld.edu.au Email: inquiries@qscc.qld.edu.au

Illustrations by Stephen Francis

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