Chapter 10: Experiments

Challenge 1.1: Sideways ping pong

Teacher notes (page 170)

Safety

• Ping pong balls could cause a slip hazard – ensure ping pong balls are removed from the floor.

• A risk assessment should be completed before undertaking this activity. A suggested risk assessment template is provided in the teacher obook resources.

Practical hints

Insist that each group make a list of their hypotheses and the results of each test. For weaker students, encourage them to follow the ‘What if …?’ method of constructing a hypothesis. Stronger students will be confident to write the ‘If … then …’ statement outright.

Draw attention to the fact that students can’t test their predictions, but that they can test their hypotheses.

Skills Lab 1.2: Drawing scientific diagrams

Teacher notes (page 171)

Station 1

Departments will expect their students to consistently represent equipment, such as a Bunsen burner being used to heat (conventionally this is an upward pointing arrow, with the word ‘heat’ underneath it), and whether students should include ‘holding’ apparatus, such as retort stand, boss heads and clamps, in their diagrams (the convention is that these should not be included in diagrams that represent a number of pieces of equipment).

Step 3 of Station 1 provides an opportunity for collaborative work between students. Possible groupings for the equipment may be measuring, pouring, mixing chemicals or heating. Venn diagrams could be used to show that some pieces of equipment have multiple uses. Considering different ways of grouping equipment is a good lead-in to Chapter 5: Classification.

Station 2

Students’ answers will vary, depending on their personal experiences and the storage locations of each piece of equipment. For question 3, which asks students to identify equipment and its uses, answers may include:

• for holding things: metal tongs, test tube holder, boss head, clamp

• for mixing chemicals: stirring rod, conical flask

• for pouring: beaker, measuring cylinder, conical flask, test tube.

Safety

A risk assessment should be completed before undertaking this activity. A suggested risk assessment template is provided in the teacher obook resources.

Skills Lab 1.8: Heating water

Teacher notes (page 173)

Safety

• Safety glasses and lab coats should be worn and long hair tied back.

• Risk of serious burns from hot equipment. Allow equipment to cool before handling or packing away.

• Glass rod should be inspected and discarded if cracked or chipped.

• A risk assessment should be completed before undertaking this activity. A suggested risk assessment template is provided in the teacher obook resources.

Teaching tip

This activity explores conductivity, but this is not made explicit, so lower ability students may need additional prompting to identify that the activity is about thermal conductivity.

Challenge 2.1: Comparing different types of mixtures

Teacher notes (page 174)

A Dirty water

Dirty water is an example of a suspension. Ask students what other mixtures are suspensions – snow dome, sandy water, oil and water, dust in the air, flour in water, algae in water, paint, and so on.

B Making a foam

Whipping egg whites is the basis for making meringues. As an alternative to this activity, students could make a meringue to explain colloids.

Safety

Egg can cause allergic and anaphylactic reactions. Wiping of benches and collection of egg waste must be thorough, so no traces are left for current and future classes.

C Mixing olive oil and water

Discuss the results as a class. Oil and water particles are more attracted to themselves than one another, which is why they don’t mix without an emulsifier. Detergent particles are attracted to both water and oil, which helps them join together. This is why detergent removes oil and grime off plates and clothes.

D Adding sugar to water

Have students add sugar to cold water, and then to hot water. Ask them to describe what happened to the sugar in both cases. Students should note that sugar dissolves quicker in hot water. Ask students whether sugar is soluble or insoluble, and to identify the solute and solvent in this solution (solute = sugar; solvent = water).

E Making perfume: another solution

The type of flower used can be modified in this activity. Whatever flower is chosen, the perfume should be relatively strong. A good alternative may be mint, chamomile flower heads or peppermint gum leaves.

Practical hints

The rubbing alcohol Isocol is an alternative to using methylated spirits. It is used in other methods of perfume making in schools. This can be bought from the supermarket.

Using a cotton bud for dipping in your ‘perfume’ to smell it is an alternative to putting it on your skin.

Experiment 2.2A: What if salt were dissolved in water?

Teacher notes (page 175)

Discuss the process of designing an experiment including creating, testing and modifying. Students should be given a significant amount of time to complete this task; however, it can be broken up so students know what is expected of them in a certain period of time. For example, one lesson could be designated to questioning and predicting, and the next to planning and conducting. To ensure students are working through the task, they could be required to get permission from the teacher to continue to the next stage. Their results could be presented in a number of ways including a traditional prac report, a presentation to the class, a movie showing the entire process, and so on.

An extension to these experiments is to use alcohol as a solvent instead of water and compare the two sets of results.

Suggestions for classes with no access to a science laboratory

Leave copper carbonate off the list if you are unable to get it. Perhaps replace with sand.

If you do not have test tubes, try using small jars, glasses or cups for mixing samples. You should already have thermometers as a standard purchase for science. Use hot tap water for heating water or boil a jug. Plastic teaspoons for stirring and sample measurement are also needed.

Practical hints

Students need to consider the size of the sample. Suggest a spatula with a sample that will fit inside the test tube or a funnel. The sample must sit in the bottom of the test tube.

Another consideration is the volume of water – 10 mL to 20 mL in a test tube is enough.

Safety

Use safety glasses and lab coats. If the samples require heating then lighting a Bunsen burner safely needs to be considered.

Rather than heating the samples and water in the test tube directly in a flame, suggest setting up a 500 mL beaker half-filled with hot water on the gauze mat above the Bunsen burner and using it as a water bath. This is much safer than directly holding the sample over a flame and it also allows control over the temperature of the sample, which should be a variable the students come up with in this prac.

Class clean-up

Copper carbonate should not be put down the sink. Set up a large funnel with fast flowing filter paper and a large 1- to 2-litre flask, and filter the copper carbonate solution. Allow the filter paper containing the copper carbonate to sit on the bench overnight to dry out. Store the saved copper carbonate in a labelled jar and recycle for next year.

All other samples named can go down the sink, followed by water.

Lab tech notes

The class will need a variety of equipment: safety glasses and lab coats, matches, 500 mL beakers, samples, spatulas, thermometers, stirring rods, timers, funnels, perhaps ice, balances and a waste container for copper carbonate (large flask with filter paper).

Copper carbonate is classified as a hazardous substance and non-dangerous substance. It is a solid, does not mix with water, sinks in water and is combustible. Write a risk assessment and check the Material Safety Data Sheet (MSDS).

Experiment 2.3: What if a flocculent were added to muddy water?

Teacher notes (page 178)

Discuss the effect and usefulness of flocculants with students. Ask students to find out where flocculation is commonly used – to remove algae and microscopic particles from water.

Practical hints

Use 250 mL beakers instead of jars.

Use 20 mL of 0.5 M sodium carbonate and 20 mL of 0.5 M potassium aluminium sulfate (alum) to approximately 100 mL of muddy water. Muddy water is 3 g dirt to 50 mL water.

Class clean-up

Empty the liquid down the sink followed by water and bury the dirt mix in the bin.

Lab tech notes

Do a risk assessment for the making up of 0.5 M potassium aluminium sulfate (alum). Refer to the MSDS.

Expected results

The jar containing the muddy water, 0.5 M alum and 0.5 M sodium carbonate will have a clear layer at the top of the jar. The middle will contain the flocculant layer and the bottom layer, settled dirt.

Skills Lab 2.4: Filtering a mixture of sand and water

Teacher notes (page 179)

Practical hints

Use 1 tablespoon of sand per 200 mL of water per student or pair.

Class clean-up

Collect sand in one container and pour the water down the sink.

Dry out the sand by evaporation and recycle for next year.

Experiment 2.4: What if you centrifuge tomato sauce?

Teacher notes (page 180)

Practical hint

The centrifuge must be balanced; that is, samples need to be of equal weight opposite each other and placed into the centrifuge in a symmetrical pattern.

Safety

• Wear safety glasses in case of shattered glass if you are using glass inserts in the centrifuge. Plastic can be used, although glass allows for better observation of results.

• If there is a lid to the centrifuge, make sure it is closed properly.

• Do not open the centrifuge until it has completely stopped spinning.

• A risk assessment should be completed before undertaking this activity. A suggested risk assessment template is provided in the teacher obook resources.

Experiment 2.5: Crystallisation of salt water

Teacher notes (page 180)

Many students won’t have experience using a clay triangle, so it’s important to show them and discuss whether a gauze mat is needed or not. Ask the students whether a gauze mat is listed in the materials.

Safety

• Follow the procedure for lighting a Bunsen burner.

• Wear safety glasses and lab coats.

• Be careful as the evaporation nears completion because the hot salt may spit and splatter.

• All equipment used on the Bunsen burner will be hot. Leave for at least 15 minutes to cool before touching.

Class clean-up

Wash and dry evaporating dishes.

Lab tech notes

Make up a 10-per cent salt solution (approximately 2 teaspoons of salt to 1 litre of water).

Expected result

A layer of salt should be caked in the bottom of the evaporating dish.

Experiment 2.6: Who wrote the nasty note?

Teacher notes (page 182)

Preparation

Whiteboard markers and felt-tip pens can be used for this experiment.

A chromatogram will need to be prepared for students so they can compare their results to the ‘original note’ (teacher’s chromatogram) and work out who the culprit is.

Extension

Students could test different colours of water-soluble pens, or different brands of the same colour. They should investigate which colour is found in most of the different coloured pens tried, or which colour pens had similar chromatographs. If testing different brands of a colour, students could determine whether other colours are similar to the black and different colours in it or not.

Practical hints

This works well with just water. It is not necessary to use a 1-per cent salt solution.

Make sure that only the tip of the filter paper touches the liquid. Try not to dunk the felt-tip pen mark under water – allow the water to be drawn up the filter paper.

Challenge 2.6: Separation challenge

Teacher notes (page 183)

Discuss the process of designing an experiment, including creating, testing and modifying. Students should be given a significant amount of time to complete this task; however, it can be broken up so students know what is expected of them in a certain period of time. For example, one lesson could be designated to questioning and predicting, and the next to planning and conducting. To ensure students are working through the task, they could be required to get permission from the teacher to continue to the next stage. Their results could be presented in a number of ways, including a traditional prac report, a presentation to the class, a movie showing the entire process, and so on.

As an extension, students could design an experiment to separate different substances and undertake that experiment.

Safety

• Wear safety glasses and lab coats.

• Follow the procedure for lighting a Bunsen burner.

• Be aware of splattering of salt solution.

• Know where to find your fire blanket and fire extinguisher.

Practical notes

• Equipment that may be required: mixture of sand, sawdust, salt and iron filings; matches; Bunsen burner; heatproof mat; evaporating dishes; stirring rods; beakers; pipe clay triangle; magnets.

• Use 2 tablespoons of mixture per student or pair.

• Students collect separated items into small ziplock bags and name them, for the teacher to see.

Class clean-up

• Collect the solids.

• Wash glassware, evaporating dishes, stirring rods, and so on, and rinse them in clean water.

Lab tech notes

Make up the mixture of salt, sand, iron filings and sawdust. Mix well.

Challenge 3.1B: Ice cube necklace

Teacher notes (page 184)

Safety

• Avoid splashes of salt to the eyes and wash hands after handling.

• Skin may stick to very cold ice, causing injury.

• A risk assessment should be completed before undertaking this activity. A suggested risk assessment template is provided in the teacher obook resources.

Teaching tip

This activity works because the melting of ice is an endothermic reaction that takes energy from the surroundings (air and liquid water) to give the particles in the solid lattice enough kinetic energy to change state into a liquid. Adding salt (or many other dissolvable substances) disrupts the lattice structure of ice and lowers the freezing/melting temperature to below 0°C. Adding salt to the ice cubes causes them to melt a little faster because they need to be colder than 0°C to remain frozen.

However, as they melt, the water they produce washes away the salt, reducing the salt concentration and causing the freezing temperature to rise back to around 0°C. This means the liquid water can return to its frozen, solid state, but it traps the cotton thread that has been laid across the surface.

This activity works best when more absorbent cotton string is used.

Experiment 3.2: What if the temperature were increased in the water cycle?

Teacher notes (page 185)

Discussion

**1** As the water collects on the plastic wrap, the water will move across the plastic before evaporating.

**2** Water can escape from this water cycle model, as it is part of a much greater environment. Water cannot leave the actual water cycle as it constantly changes states and cycles.

**3** The model is an accurate representation of the real water cycle, as it demonstrates the basic principles and processes that occur.

**4** Modifications will vary; however, suggestions are:

• Ensure the plastic wrap is adequately fixed to the bowl.

• Add things such as grass, mountains and so on to simulate an environment.

• Introduce a pollutant into the system to observe how pollutants affect the system.

Conclusion

There is a limited amount of water and the water cycle is a system in which water is recycled. The water goes through changes of state to move through the system.

Challenge 4.2: Can you increase the output of a power station?

Teacher notes (page 186–187)

Discussion

**1** The pinwheel spins when placed in the steam flow.

**2** In order to generate electricity, a generator would need to be added.

**3** The fuel in this ‘power station’ is steam.

**4** Yes, the ‘power station’ will run out of fuel once all water has been converted to steam.

Conclusion

Power stations burn coal, which produces heat that is used to boil water and create steam. This steam causes a turbine to spin. The movement of the turbine is converted into electrical energy by a generator.

Practical hints

• Paper works for the pinwheel, but A4 card works better. Because it is above steam, it is inclined to get moist, so card tends to be a little more robust.

• Plastic pinwheels can be bought if necessary.

Safety

• Wear safety glasses and a lab coat. Have a heatproof glove handy. Tie hair back.

• Follow the procedure for lighting a Bunsen burner.

• You are working with boiling water and steam. Be careful not to burn yourself. If burnt, run the area under cold water for 15 minutes immediately and seek medical advice from the school nurse or a doctor.

Lab tech notes

• Cut the aluminium foil and squares of paper or card to size before class.

• Have a plastic pinwheel available for a demonstration or as back-up. Know it works well.

• Use a rubber band to secure the aluminium foil to the top of the beaker.

Class clean-up

Leave Bunsen burner and boiling water to cool for at least 15 minutes before handling and putting away.

Challenge 4.3: Can you increase the power of solar cells?

Teacher notes (page 188)

Practical hint

Use flour or talcum powder as a dust for the solar cells.

Discussion

**1** The best conditions for generating electricity from a solar cell are outside, in sunny conditions and using multiple cells.

**2** A house with solar energy would have six or more cells to produce a suitable amount of photovoltaic energy.

**3** Solar panels should be cleaned regularly to ensure they can collect the sunlight effectively.

Conclusion

The amount of electricity produced by solar cells is higher when they are located outside and consist of multiple cells. More energy can be collected when it is sunny.

Experiment 4.4A: What if a muffin were mined in different ways?

Teacher notes (page 189)

Discussion

**1** The method that recovered the most ore will depend on where the chocolate chips are located. It is likely that the open-cut mining will actually recover more.

**2** Open-cut mining will be the fastest method.

**3** Open-cut mining will be the easiest method.

**4** Underground mining would allow the environment to be rehabilitated more easily as it doesn’t disturb as much of the environment.

Practical hints

Use trays or paper to do your muffin mining, to avoid mess spreading.

Safety

Do not eat in the lab.

Class clean-up

Wrap or bag the mined muffins and put out in the rubbish.

Lab tech notes

Make muffins before the day. Ensure they are cool so the chocolate is hard again. Count 20 chocolate chips into each muffin. Use two muffins per student or group.

Experiment 4.4B: What if a metal were obtained from a mineral?

Teacher notes (page 190)

Obtaining a metal from a mineral.

Discussion

**1** The coating should look similar to that of a two-cent piece.

**2** The copper coating came from the electrolysis of copper sulfate.

**3** The electricity caused the copper ions to ‘jump’ onto the electrical leads. Copper sulfate reacts with more reactive metals than copper, and the copper component is deposited on the surface of the other metal.

Safety

• Wear safety glasses and a lab coat.

• You are using a power supply plugged into mains electricity, therefore keep this supply dry.

• Don’t touch rods together with power supply on.

Class clean-up

• Collect 0.5 M copper sulfate. Do not put it down the sink as it is harmful to the environment, particularly aquatic life.

• Wash the carbon rods and beakers.

Lab tech notes

• 500 mL of 0.5 M copper sulfate is made up by dissolving 62.4 g into 500 mL of water.

• Store the used copper sulfate in a bottle for next year.

Alternative method

• Use a 12 V battery as a power supply.

• Get some copper sulfate from a garden store and place approximately five teaspoons of copper sulfate in 500 mL of water. The carbon rods work beautifully, but a nail will work as well.

Experiment 4.5: What if different soils were exposed to water?

Teacher notes (page 191)

A Looking at dry soil

All particles won’t have the same colour, nor will they be the same size. There are likely to be animal and plant remains in the garden soil, more so than in any other soil.

Safety

Read the safety warnings on the potting mix bags. Generally, they have a warning about avoiding breathing bacteria.

Class clean-up

Collect the soil and take it back to the garden. Do not put it down the sink.

B What’s in soil?

1 The soil will separate into layers – sand at the bottom, silt, then clay at the top. There should be water on top of the soil layers.

2 The components likely to float are plant or animal material (humus).

Safety

Read the safety warnings on the potting mix bags. Generally, they have a warning about avoiding breathing bacteria.

Class clean-up

Collect the soil and take it back to the garden. Do not put it down the sink.

C Testing

Discussion

**1** Sandy soil will drain the quickest.

**2** Clay soil will stop the most water from flowing.

**3** Clay soil will also hold the water the best.

**4** The difference in water-holding ability has to do with particle size. The smaller the particle (clay), the less room water has to move. The larger the particle (sand) the more movement water can have.

**5** Student response.

**6** For plants to grow well, soil needs to both drain and hold the water. Particle size should be medium to allow this to occur. Soil must also have a good organic component. Some gardeners add fertiliser or animal manure to change the soil structure.

Conclusion

Clay holds water the best, with sand being unable to hold water. Garden soil and potting mix have the ability to hold water, while also letting water drain. (It will depend on the garden soil and potting mix tested as to the exact results.)

Challenge 5.1: Department store classification

Teacher notes (page 192)

Responses will vary significantly for this activity. Students should identify the benefits of grouping objects according to function more than appearance. For example, nail polish and a Hacky Sack might both be red, but grouping them according to colour makes little sense. Grouping nail polish with perfume would be a more logical combination, as would grouping a Hacky Sack with a cricket ball.

Discussions could centre on department stores and supermarkets familiar to the students. They would most likely be aware of grouping electrical goods, clothing, laundry products and fresh produce. Students could suggest aspects of this organisation that are beneficial and aspects that they would modify.

Similarities could be drawn with the organisation of files on computers, in particular the organisation of students’ iTunes libraries or similar.

Challenge 5.3: Dichotomous key

Teacher notes (page 193)

This activity could be modelled to the students by first constructing a dichotomous key as a class. Model the design of a dichotomous key using the eight characteristics of living things. The key will have three possible outcomes: living, dead and non-living. Test the key out on a range of living, non-living and dead things such as in the bushfire example.

Before starting this activity, get students to come up with their own peer assessment criteria. They can then use this to assess each other’s dichotomous keys. The ‘best’ key, as per class consensus, should be put up on display with annotations describing its strengths.

If food is used for this activity, remind students that food should not be eaten in the science laboratory.

Challenge 5.5: Classifying living things

Teacher notes (page 195)

Seaweed – Plantae

Shark – Animalia

Sea monkey – Animalia

Sea jelly – Animalia

Robots and ice crystals are non-living.

Students could add other living things into their columns and could be set a number to complete.

Experiment 5.6: Dissecting skeletons

Teacher notes (page 196)

Discussion

**1 a** The skeleton of the fish is inside its body.

**b** This type of skeleton is called an endoskeleton.

**2 a** The skeleton of the prawn is outside its body.

**b** This type of skeleton is called an exoskeleton.

**3** A squid does not have a skeleton; however, it has an internal gladius to support the mantle.

**4** Fish – vertebrate; prawn – vertebrate; squid – invertebrate.

**5** Humans are vertebrates and have an endoskeleton.

Conclusion

Two types of skeleton are possible – internal (endo) and external (exo). Squids, however, have no skeleton.

Lab tech notes

Fish shops and markets, if given time, will supply whole squid, whole or filleted fish, and prawns.

Class clean-up

• Dirty scalpels to be collected and kept separate from other dissection equipment to avoid cuts. Ask the lab tech to clean.

• All other equipment should be washed in hot soapy water. Ensure sinks are free from specimen parts, as they will smell.

• Wrap all specimens and dirty gloves in newspaper, place in and sealed bag, and bin.

Safety

The use of vinyl gloves is recommended, as latex has been known to cause allergic and anaphylactic reactions.

Challenge 5.6: Identifying invertebrates

Teacher notes (page 197)

Students may find the tabular key on page 90 inadequate for identifying the organisms they discover in their local environment. They should be encouraged to suggest whether it is possible to provide an adequate key for invertebrates given the enormous number that are involved. Obviously, such keys do exist, but the level of detail they include would not be appropriate for Year 7 students.

The invertebrates on page 197 can be identified as follows (left to right):

• top: earthworm – annelid; leech – annelid; starfish (sea star) – echinoderm

• middle: sponge – poriferan; centipede – arthropod

• bottom: spider – arthropod; mosquito – arthropod; fly – arthropod.

Challenge 5.7: Who are the vertebrates?

Teacher notes (page 197)

Vertebrate alphabet graffiti

Students may need to conduct some research to complete all letters of the alphabet. They may also like to research some of the more interesting species.

Jellyfish organiser for vertebrates

This could be done as a whole-class activity or students could rotate around the classroom to different vertebrate groups.

Challenge 5.8: Identifying plants

Teacher notes (page 198)

Safety

• Plants may have thorns or stinging hairs, cause allergic reactions or be toxic if ingested.

• Wash hands after handling plant material.

• A risk assessment should be completed before undertaking this activity. A suggested risk assessment template is provided in the teacher obook resources.

Practical hints

Organise an excursion to a local park or reserve, or even within the school grounds, to observe and collect plants. Plant descriptions are often based on their growth habit (grasses and herbs, shrubs, trees, mallees) or growth cycles (annuals or perennials).

Class clean-up

Plant material may be disposed of into a garbage or compost bin.

Challenge 6.1: Studying food webs

Teacher notes (page 198)

When students are picking their areas to study, they need to ensure some life form exists in this area even if it’s only in a very small amount. The surrounding habitats will produce energy to sustain the life in areas of low productivity.

Challenge 6.2: Exploring leaf litter

Teacher notes (page 199)

Students may also like to look at their leaf litter under a microscope to identify whether any microscopic organisms exist there. A stereo microscope is likely to be sufficient in most cases.

Ask students whether they think the same kinds of organisms would be found in all leaf litter. Why or why not? They should be able to hypothesise that the kinds of organisms will change depending on the location and the type of area. For instance, a desert environment is not going to be the same as a forest environment.

Challenge 6.4: Calculating your ecological footprint

Teacher notes (page 201)

As a class, discuss the impact students are having on the environment and how many worlds we would need to sustain our current lifestyle.

Challenge 6.6: Making a biosphere

Teacher notes (page 201)

Students should understand that respiration is the opposite of photosynthesis, even though they do have similarities.

Challenge 6.7: Looking at eucalypt adaptations

Teacher notes (page 202)

An extension to this activity is to compare the seeds of a eucalypt to those of wheat (or similar). Students should observe that the wheat seed is much softer and therefore doesn’t need heat to trigger the release of a seed. Students could also compare the environments in which both types of plants are commonly found and why the plants have these types of seeds.

Experiment 7.1: Measuring forces

Teacher notes (page 202)

Discussion

Answers will vary; however, students should discuss how the force required to perform different actions varied depending on things such as the weight of the object to be moved and whether it was on hinges or castors.

Conclusion

Students should say something about how the forces required will vary depending on the situation and object.

Practical hint

The best size rubber bands to use are approximately 10 cm long and 5 mm wide.

Safety

Wear safety glasses if working close to the rubber band. Be aware that if the rubber band breaks, whatever you are pulling may fall.

Challenge 7.2: Design a ball whacker

Teacher notes (page 203)

Discuss the process in designing an experiment including creating, testing and modifying. Students should be given a significant amount of time to complete this task; however, it can be broken up so that students know what they are expected to achieve in a certain period of time. For example, one lesson could be designated to questioning and predicting, and the next to planning and constructing. To ensure that students are working through the task, they could be required to get permission from the teacher to continue to the next stage. Their results could be presented in a number of ways, including a traditional prac report, a presentation to the class, or a movie showing the entire process.

Safety

• Use tennis balls or other soft balls for this activity to avoid risk of injury.

• A risk assessment should be completed before undertaking this student design task. A suggested risk assessment template is provided in the teacher obook resources.

Processing, analysing and evaluating answers

**1** Hitting the ball with a greater force will make it travel further.

**2** Various reflective answers. Less able students may wish to compare their ball whacker to others.

**3** The heavier block is better than the lighter block at hitting the ball only if the heavy block hits the ball with a greater force. If the two blocks are travelling at about the same speed when they hit the ball, the ball will travel further from the heavier block because it hits with a greater force than the lighter block.

**4** Pile drivers that drive in foundations for bridges are effectively ‘whackers’ like this. There are many other examples.

**5** Student responses will vary. Encourage students to clearly state which aspects of their experiment they wish to change, why they want to change it, and a prediction of how each change will improve their experiment.

Experiment 7.6: What if the amount of friction were changed?

Teacher notes (page 205)

Safety

A risk assessment should be completed before undertaking this experiment. A suggested risk assessment template is provided in the teacher obook resources.

Lab tech notes

Pieces of dowel and a piece of wood of good weight, with a nail in the top, would be ideal for this prac; however, improvising with what is available (e.g. heavy textbooks and round pencils) is also fine.

Class clean-up

Sand should be disposed of into a receptacle or directly into the garbage. Students should not put the sand down a sink.

Discussion

**1** Compare results with others in the class.

**2** The best way to reduce friction is to use rollers.

**3** Yes, five rollers would be better than two for reducing friction.

**4** Theoretically, ten rollers would be better than five for reducing friction; however, if there are too many rollers, they won’t have room to move and therefore may not actually reduce friction.

**5** The size of the roller that is most suitable will depend on the size of the textbook used. If it is a large, heavy textbook, a larger roller would be more suitable.

**6** Problems with using rollers could be getting them to roll the way you need them to unless they are on castors or on tracks. Additionally, as each roller comes out the back, it needs to be moved to the front where the book can then roll onto it.

**7** Practical examples of rollers being used to reduce friction: conveyer belts, castors on a drawer.

**8** Square rollers wouldn’t be any good because they don’t roll and therefore don’t reduce friction.

**9** Coarse sand is likely to increase friction better than fine sand as it has a greater particle size and a higher frictional force.

**10** Practical examples of sand being used to increase friction: before snow, sand or salt is spread out on roads; it is used to override grease and contaminants and increase friction for locomotives; it is also used in sandpaper.

**11** Problems with using sand for this purpose: it can get into the mechanics of the automobile; it may scratch the object or automobile.

Conclusion

Student answers will vary; however, they should include the fact that, to reduce friction, lubricants need to be used.

Experiment 7.7A: Using a first-class lever to lift weights

Teacher notes (page 206)

Safety

A risk assessment should be completed before undertaking this experiment. A suggested risk assessment template is provided in the teacher obook resources.

Lab tech notes

The weights can be brittle and break. A foam pad can be given to students to put under the weights to ensure that if they do fall, they do not break.

Class clean-up

Investigating levers requires little clean-up. String loops can be disposed of.

Discussion

• Experiment 7.7A: First-class levers act as a force magnifier when the effort arm is longer than the load arm. They act as a distance magnifier when the load arm is longer than the effort arm.

Conclusion

A first-class lever can act as either a force magnifier or a distance magnifier. A second-class lever can only act as a force magnifier, and a third-class lever can only act as a distance magnifier.

Experiment 7.7B: Using a second-class lever to lift weights

Teacher notes (page 207)

Safety

A risk assessment should be completed before undertaking this experiment. A suggested risk assessment template is provided in the teacher obook resources.

Lab tech notes

The weights can be brittle and break. A foam pad can be given to students to put under the weights to ensure that if they do fall, they do not break.

Class clean-up

Investigating levers requires little clean-up. String loops can be disposed of.

Discussion

• Experiment 7.7B: Second-class levers always act as a force magnifier.

Conclusion

A first-class lever can act as either a force magnifier or a distance magnifier. A second-class lever can only act as a force magnifier, and a third-class lever can only act as a distance magnifier.

Experiment 7.8: Calculating mechanical advantage

Teacher notes (page 208)

Allow students to experiment with more than four or less than four pulleys.

Discussion

**1** The effort needed decreases as more pulleys are used.

**2** The distance the effort moves decreases as the distance the load moves increases.

**3** The spring balance would read 83 g if six pulleys were used to lift 500 g.

**4** Double the length of string will be required to lift the load twice as high.

Conclusion

The more pulleys that are used, the less effort required to lift the load, but over a longer distance.

Experiment 7.9: Comparing different machines

Teacher notes (pages 208–209)

A Inclined plane

Conclusion

An inclined plane can provide a mechanical advantage by reducing the effort required to move a load.

B Wedges / C Screws

Conclusion

The function of wedges and screws is to offer a mechanical advantage.

D Wheels and axles

This activity could be used as an assessment or for getting students to design their own practical. A class discussion could help students frame their investigation.

Skills Lab 8.1: Calculate weights in the solar system

Teacher notes (page 210)

This could be used as an assessment task. Students could spend one lesson collecting data, and the next doing the calculations and writing up the lab prac as a written prac. Students are likely to need help to understand the calculations. It may be useful to get them to add the calculation bases to their method.

• Earth weight × gravity factor = weight on other planet

• Earth distance × gravity factor = distance on other planet

• Earth height × gravity factor = height on other planet

Challenge 9.1: Modelling how the Earth moves in space

Teacher notes (page 211)

How does the Earth move in space?

• Night and day: the Earth should spin anticlockwise, or from east to west.

• A year: the Earth should spin 365.25 times in one orbit as the Earth spins on its axis once every 24-hour period, and an orbit is one year.

Challenge 9.2: Modelling the phases of the Moon

Teacher notes (page 212)

When people are referring to the dark side of the Moon, they are always referring to the same side. This is because the Moon’s orbit is so slow.

Challenge 9.3: Modelling the seasons

Teacher notes (page 212)

The Earth is tilted on its axis, so sometimes the Sun is in the same direction as the tilt of the Earth is pointing and sometimes the tilt is away from the Sun. This varying amount of sunlight hitting the Earth creates the seasons. The part of the Earth facing the Sun will be different from where you started. The part facing the Sun is the part of the world experiencing summer.