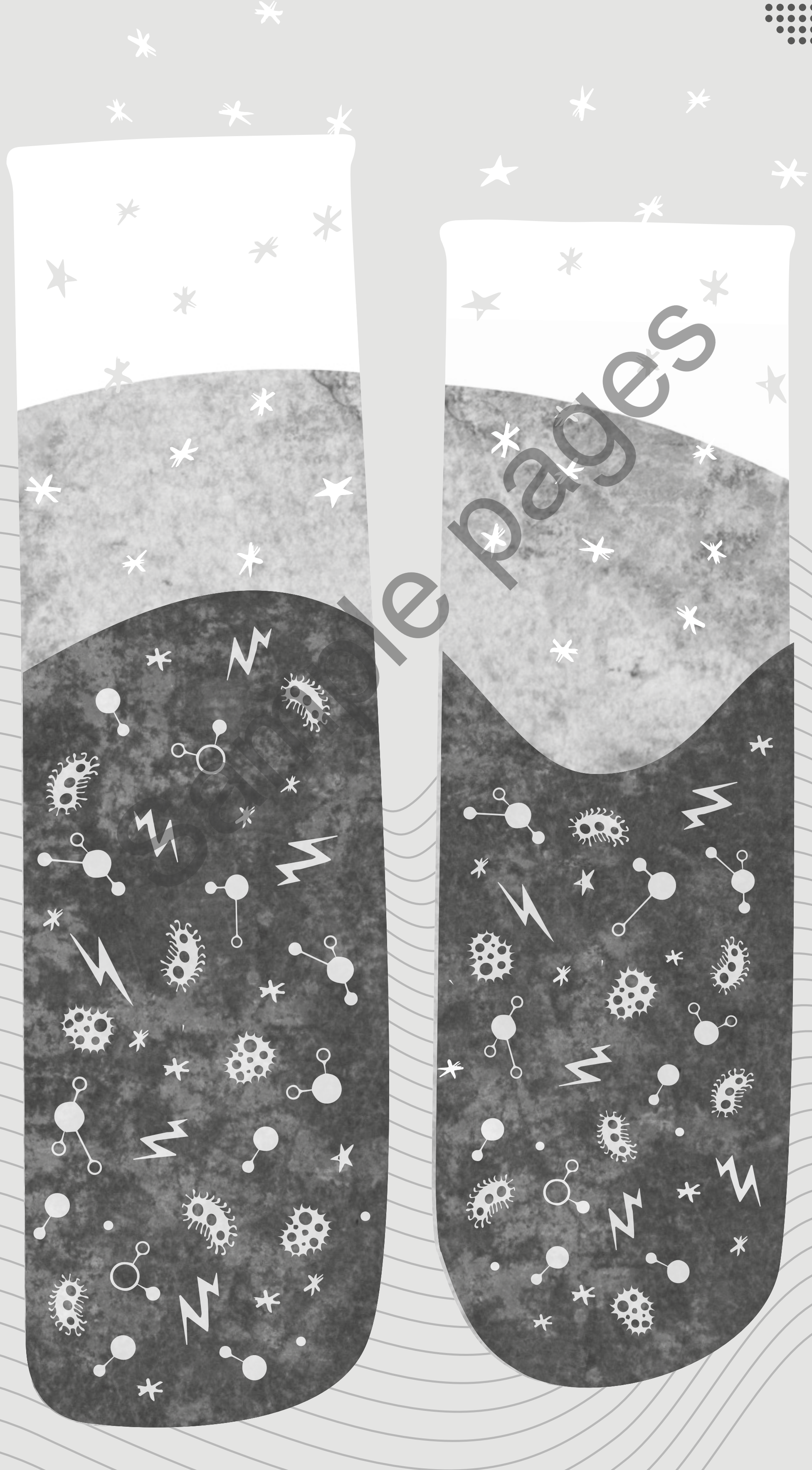
PEARSON

SCIENCE

SKILLS AND ASSESSMENT

STAGE 5



NSW STAGE 5

Contents

Physical world

■ Motion

■ Energy

■ Waves

■ Electricity

Earth and space

■ The universe

■ Plate tectonics

■ Global systems

Living world

■ Systems in multicellular organisms

 ISBN 978 1 4886 2615 9

How to use this book

PEARSON SCIENCE STAGE 5 NEW SOUTH WALES SKILLS AND ASSESSMENT

The *Pearson Science Stage 5 New South Wales Skills and Assessment* book provides an opportunity for you to practise, apply and extend your learning through a range of supportive and challenging activities. There are also regular opportunities for reflection and self-evaluation at the end of individual activities throughout the book.

This resource is split into the four strands of the syllabus: Physical world, Earth and space, Living world and Chemical world. Each strand consists of four main sections:

- worksheets
- practical activities
- inquiry activities
- a depth study.

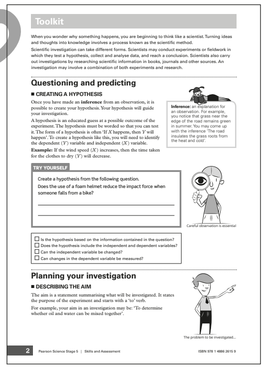
Explore how to use this book below.

Working scientifically toolkit

The **Working scientifically toolkit** supports development of the skills and techniques you need to complete the worksheets, practical activities, inquiry activities and depth studies. You can refer back to the toolkit at any time, to remind yourself of a specific skill.

Try yourself boxes can be found throughout the toolkit. They are to check your understanding, and to provide you with the chance to practise what you have just learnt.

Revision boxes can be found through the Stage 5 Skills and Assessment book toolkit, highlighting content that was covered within Stage 4.

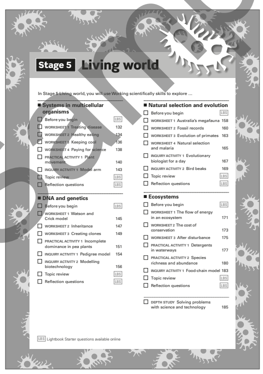

Toolkit

Questioning and predicting

Planning your investigation

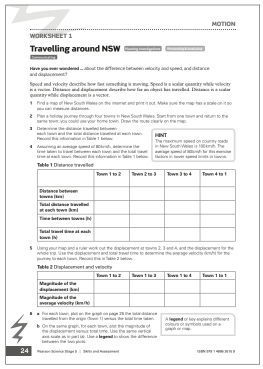
Strand opener

Each book is split into the four strands of the syllabus, with the strand opener acting as a checklist of all the activities available, both within the book and online on *Lightbook Starter*. Tick each activity off once you've completed it!


Stage 5 Living world

Worksheets

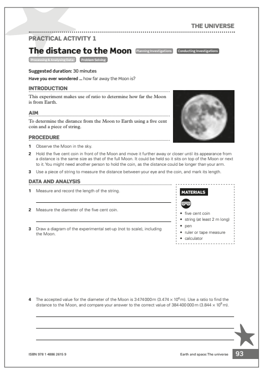
The worksheets feature questions that allow you to practise and apply the Working scientifically skills; for example, interpreting data from a table, plotting data on a graph or communicating your understanding of scientific concepts.


WORKSHEET 1

Travelling around NSW

Practical activities

Practical activities offer you the chance to complete practical work related to the various topics in your Skills and Assessment book. You will have to the chance to design and conduct experiments, record results, analyse data and prepare evidence-based conclusions. You will also need to create risk assessments for your activities, to ensure you understand how to conduct experiments safely. An icon indicates where a SPARKlab alternative practical is available.


PRACTICAL ACTIVITY 1

The distance to the Moon

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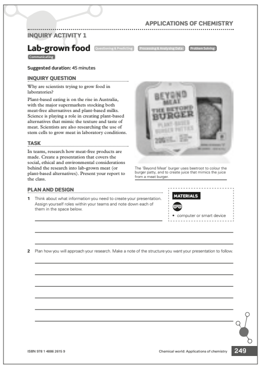
Inquiry activities

The inquiry activities are a bit different to the practical activities. In practical activities you are usually provided with a procedure and specific steps to follow. Instead, inquiry activities are open-ended questions that encourage you to plan, design and create your own solution to a problem. They also provide you with a chance to improve and reflect on your idea or investigation. These problems require you to use prior knowledge along with the skills you will have learnt from the toolkit.

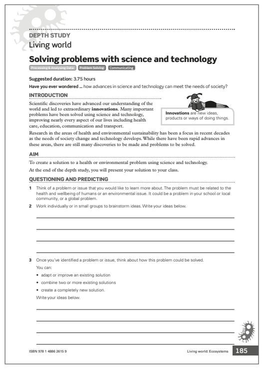

APPLICATIONS OF CHEMISTRY

INQUIRY ACTIVITY 1

Lab-grown food

Depth study

This is where your skills and knowledge come together. Each strand contains one depth study. These take a mixture of the content and skills you have learnt and apply it to a larger, real-world investigation that you need to solve.


DEPTH STUDY

Living world

Solving problems with science and technology

In each depth study, you will demonstrate your understanding of a range of different Working scientifically skills, showing how important each type of skill is in thinking like a scientist.

Icons and features

The **skills icons** show you which of the Working scientifically skills you are using to complete that activity.

Questioning & Predicting | Planning Investigations | Conducting Investigations | Processing & Analysing Data | Problem Solving | Communicating

The **safety icon** highlights hazards that may cause harm. Be sure to prepare a risk assessment for these activities and show it to your teacher.

Highlight boxes identify important information such as formulae or prompts.

Vocab boxes provide you with definitions for key words.

Hint boxes provide hints and tips.

SPARKlab icons direct you to where an alternative, online practical activity is available.

Check-in boxes allow you to check your risk assessment or procedure with a teacher before starting. Make sure you tick these boxes!

Materials boxes show you all the materials you need to complete an activity. Sometimes they might include a safety icon which highlights any substances or materials that require you to take care when preparing or using them.

LIGHTBOOK STARTER

LS **Lightbook**Starter

Lightbook Starter LBS, our digital formative assessment tool, works alongside the Skills and Assessment book. Test your knowledge before starting the activities in the Skills and Assessment book with the 'before you begin' questions on Lightbook Starter. Then, after you've completed a topic, do the topic review and reflection questions on Lightbook Starter to review what you've learnt. The progress tracker records your results and helps you monitor your learning.

Rate my learning

At the end of each activity you can rate your learning for that activity. Colour in the circle that represents how you think you did at each activity. This way, you will be able to see what areas you need to work on to improve.

RATE MY LEARNING ○ Not confident ○ Somewhat confident ○ Mostly confident ○ Very confident

Teacher support material

Comprehensive answers and fully worked solutions for the toolkit plus all worksheets, practical activities, inquiry activities and depth studies are provided on the **Pearson Places website**.

Stage 5 Physical world

In Stage 5 Physical world you will use Working scientifically skills to explore ...

LBS Lightbook Starter questions available online

WORKSHEET 1

Travelling around NSW

Planning Investigations | Processing & Analysing | Communicating

Have you ever wondered ... about the difference between velocity and speed, and distance and displacement?

Speed and velocity describe how fast something is moving. Speed is a scalar quantity while velocity is a vector. Distance and displacement describe how far an object has travelled. Distance is a scalar quantity while displacement is a vector.

1. Find a map of New South Wales on the internet and print it out. Make sure the map has a scale on it so you can measure distances.
2. Plan a holiday journey through four towns in New South Wales. Start from one town and return to the same town; you could use your home town. Draw the route clearly on the map.
3. Determine the distance travelled between each town and the total distance travelled at each town. Record this information in Table 1 below.
4. Assuming an average speed of 80 km/h, determine the time taken to travel between each town and the total travel time at each town. Record this information in Table 1 below.

HINT
The maximum speed on country roads in New South Wales is 100 km/h. The average speed of 80 km/h for this exercise factors in lower speed limits in towns.

Table 1 Distance travelled

	Town 1 to 2	**Town 2 to 3**	**Town 3 to 4**	**Town 4 to 1**
Distance between towns (km)				
Total distance travelled at each town (km)				
Time between towns (h)				
Total travel time at each town (h)				

5. Using your map and a ruler work out the displacement at towns 2, 3 and 4, and the displacement for the whole trip. Use the displacement and total travel time to determine the average velocity (km/h) for the journey to each town. Record this in Table 2 below.

Table 2 Displacement and velocity

	Town 1 to 2	**Town 1 to 3**	**Town 1 to 4**	**Town 1 to 1**
Magnitude of the displacement (km)				
Magnitude of the average velocity (km/h)				

6. **a** For each town, plot on the graph on page 25 the total distance travelled from the origin (Town 1) versus the total time taken.
   b On the same graph, for each town, plot the magnitude of the displacement versus total time. Use the same vertical axis scale as in part (a). Use a **legend** to show the difference between the two plots.

A **legend** or key explains different colours or symbols used on a graph or map.

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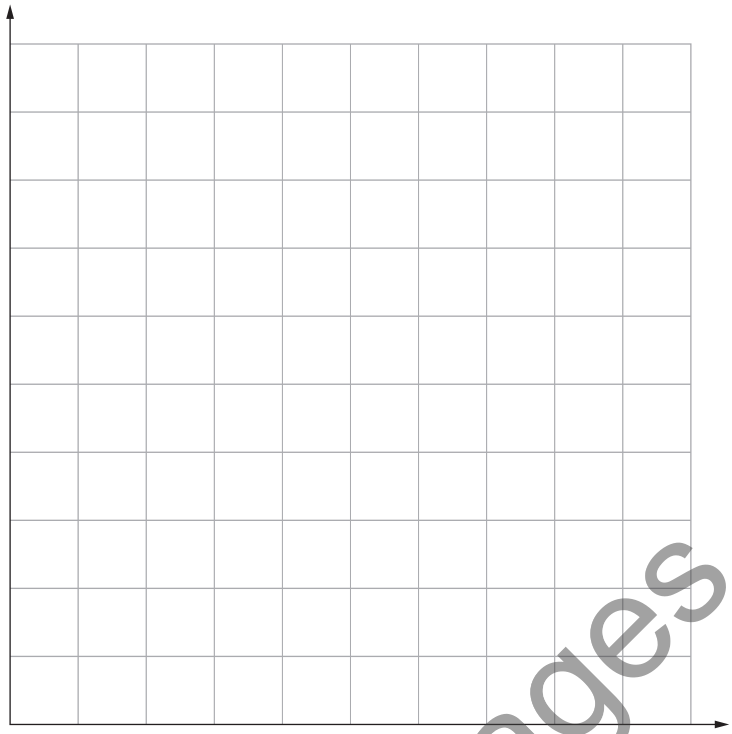
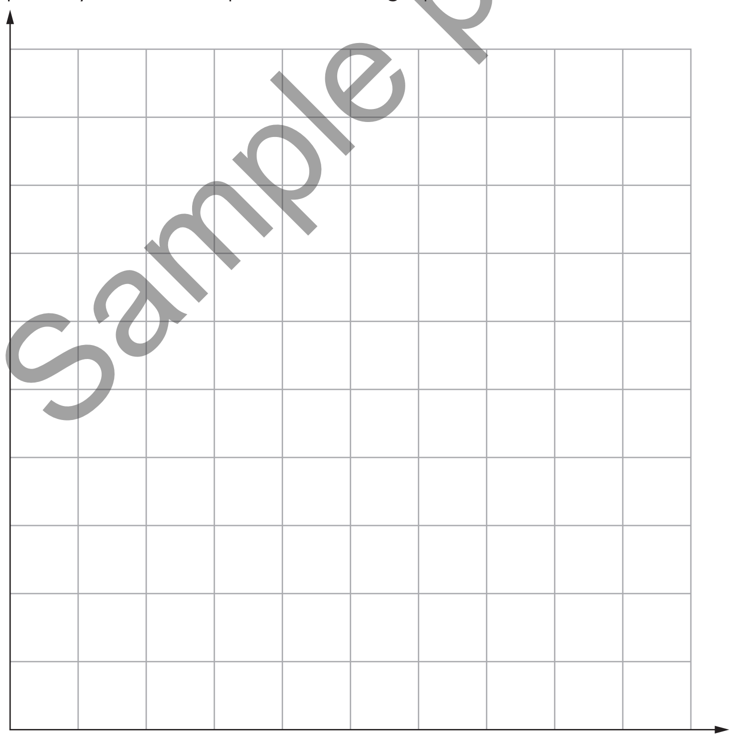


7 Plot the magnitude of the average velocity versus time on a second graph, below. Use the same time scale as the first graph so you can compare the two graphs.



TAKE THIS FURTHER

Look at the distance from your house to your school. Calculate the total travel time, magnitude of the displacement, and magnitude of the average velocity. In your calculations, use an average speed of 60 km/h.

RATE MY LEARNING

- ◯ Not confident
- ◯ Somewhat confident
- ◯ Mostly confident
- ◯ Very confident

WORKSHEET 2

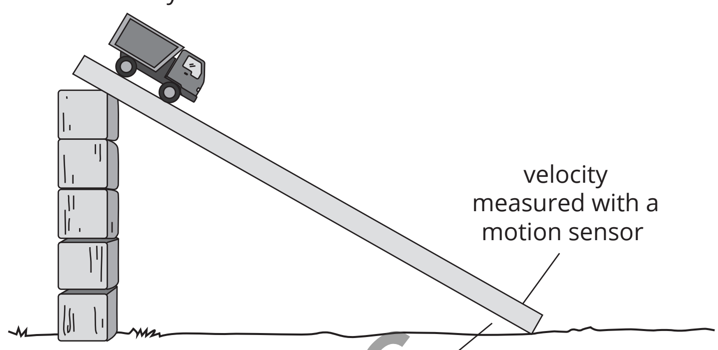
Acceleration, velocity and force

Questioning & Predicting

Planning Investigations | Processing & Analysing Data

Have you ever wondered ... how the velocity and acceleration of an object changes when it travels down a hill?

A high-school student notices young children playing with a range of toy vehicles and running them down a ramp. The student decides to do a scientific analysis of the motion of the vehicles as they travel down the ramp.



The car has zero velocity at the top of the ramp. A motion sensor is used to measure the speed at the bottom just before the car comes off the ramp.

1 The student places the car at the top of the ramp, with an initial speed of zero, and measures its final speed at the end of the ramp using a motion sensor. Predict what would happen to the final speed if the student increased the angle of the ramp, and explain why.

2 Design an experiment to look at the effect of ramp angle on the speed and acceleration of the car. Assume you have a motion sensor available for your experiment.

Independent variable:

Dependent variable(s):

Controlled variables:

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3 Draw a suitable table with headings for your experiment. Assume you can take measurements for two different angles.

4 a Describe the data analysis you would have to do.

b State what force causes the vehicle to accelerate down the ramp.

5 a The student collects the following data and scribbles it down in their book without putting it directly into a table. Place the data in your table and calculate the acceleration at the two angles.

Angle 30°, initial velocity = 0 m/s

Measurement 1: Final velocity = 2.64 m/s
time taken = 0.58 s

Measurement 2: Final velocity = 2.68 m/s
time taken = 0.61 s

Measurement 3: Final velocity = 2.62 m/s
time taken = 0.62 s

Angle 55°, initial velocity = 0 m/s

Measurement 1: Final velocity = 3.46 m/s
time taken = 0.44 s

Measurement 2: Final velocity = 3.58 m/s
time taken = 0.47 s

Measurement 3: Final velocity = 3.52 m/s
time taken = 0.46 s

b Discuss whether the trend of the data matches your prediction.

c Describe what the student needs to do to improve the experiment.

TAKE THIS FURTHER

Would the initial velocity change if the truck was at the bottom of the ramp about to be pushed up the ramp?

RATE MY LEARNING ◯ Not confident ◯ Somewhat confident ◯ Mostly confident ◯ Very confident

WORKSHEET 3

Newton's three laws

Processing & Analysing Data

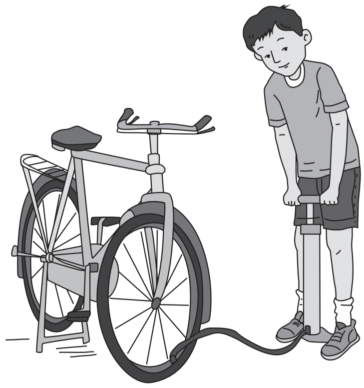
Have you ever wondered ... how forces affect motion?

1 A bike pump works in the following way. When the handle is pulled up, air is drawn into the main cylinder. Pushing down on the handle compresses the air in the main cylinder and forces it into the bike tyre.

Use a bike pump and consider the forces acting on the handle as you push down.

a Using a black pen or pencil, draw and label all of the forces acting on the pump handle in the figure to the right.

b In a different colour, draw the reaction force of the pump handle acting on the hand. Which of Newton's laws is relevant here?



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2 a Arrange to travel as a passenger in a car and place a light box, with low friction, on your legs. You should sit with your thighs horizontal. Place the box on the middle of your thighs and observe what happens in the following situations. Draw on each diagram the net force acting for each situation and explain what is happening.

		
Car accelerates	Car travels at constant speed	Car slows down or decelerates
Observation:	Observation:	Observation:
Explanation:	Explanation:	Explanation:

b State which of Newton's laws is relevant here. ______________________

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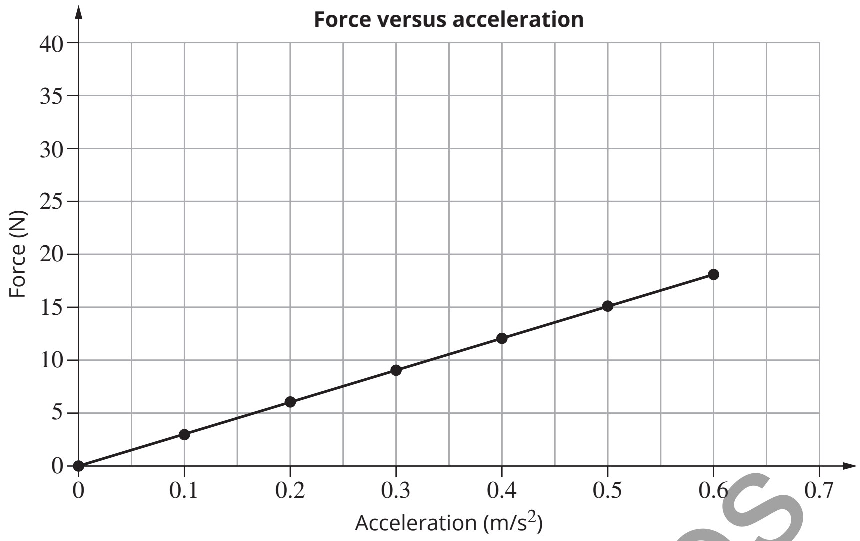
3 A person is pushing a shopping trolley filled with shopping. The following graph shows how the acceleration of the trolley varies with the force used to push it.



a State which of Newton's laws is relevant here. ______

b Use the graph to determine the force required to accelerate the trolley at 0.45 m/s^2. Draw lines on the graph to show your working.

c From this information determine the total mass of the trolley and the shopping.

______

______

d Check your value for the mass using another point on the graph.

______

______

______

e On the same axes, draw the expected shape of the graph if the total mass were doubled.

TAKE THIS FURTHER

In the Marvel comics there is a supervillain, Juggernaut, who is physically unstoppable once he is in motion. Using your knowledge of Newton's laws, discuss with your classmates why this is or isn't possible.

RATE MY LEARNING ○ Not confident ○ Somewhat confident ○ Mostly confident ○ Very confident

PRACTICAL ACTIVITY 1

Exploring velocity: Crash test

Questioning & Predicting

Conducting Investigations

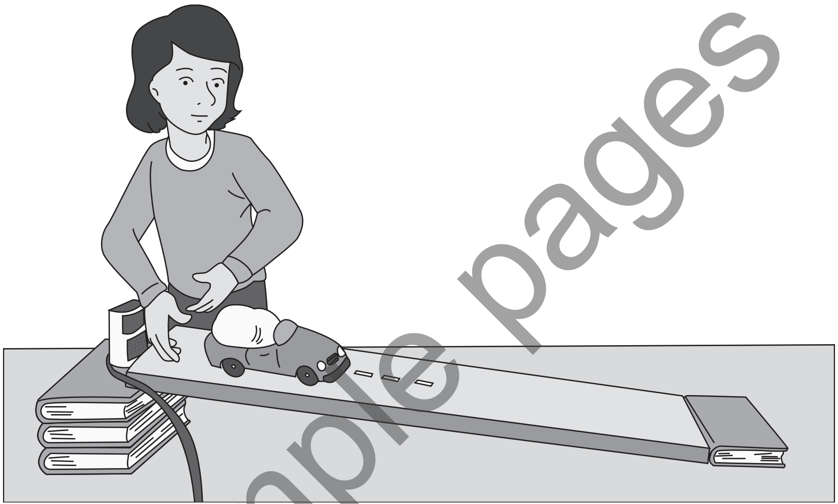
Processing & Analysing Data

Suggested duration: 50 minutes

Have you ever wondered ... why an object keeps moving after a collision?

INTRODUCTION

Newton's first law of motion states that an object in motion will continue that motion with constant speed in a straight line unless a force acts on it. This resistance to a change in motion is referred to as inertia. A person riding in a car is traveling at the same rate as the car. If the car suddenly stops due to an outside force acting on it, such as from a tree, the person would continue moving forward due to their inertia, until a force is applied to him or her. Inertia is why someone who is not wearing a seatbelt could get ejected from the car, since there is no force acting to prevent their forward motion.



AIM

To investigate the relationship between velocity and the distance an object is thrown after a collision.

HYPOTHESIS

1 Write a prediction of how velocity will affect the distance a bean bag is thrown after a collision.

____

____

2 Based on your prediction, write a hypothesis for this investigation.

____

____

MATERIALS

- data-collection system
- motion sensor
- dynamics track
- dynamics cart or toy car
- marble
- small bean bag
- tape
- metre ruler

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PROCEDURE

1 Set up the motion track on the floor, ensuring there is enough clear area for the bean bag to be thrown from the cart without hitting anything.

2 Incline the motion track using books or the adjustable feet at one end of the track.

3 Using the metre ruler, determine the height of the track at the raised end. Record this as the height 1 measurement in Table 1 in the Data and analysis section.

4 Place a textbook at the lower end of the motion track so the cart will collide with its bound side.

5 Attach the motion sensor to the track, making sure the gold disk is perpendicular to the track.

6 Place the bean bag at the front of the cart, sitting as if it were driving.

7 Mark the spot where the cart will hit the book with a small strip of tape on the floor.

8 Start a new experiment on the data-collection system.

9 Connect the motion sensor to the data-collection system. Create a graph with velocity on the *y*-axis and time on the *x*-axis.

10 Hold the cart in position at the top of the track, begin data recording and release the cart. When the cart stops moving, stop data recording.

11 Measure the distance from the collision spot (marked with tape) to the middle of the bean bag, to the nearest 0.1 cm. Record this distance in Table 1 in the Data and analysis section.

12 From your velocity graph, determine the maximum velocity of the cart. Record this in Table 2.

13 Repeat this test for a total of three trials for this height of the track. Record all results in Table 1.

14 After completing three trials for the first height of the motion track, change the height of the track. Measure the new height of the track at the inclined end. Carry out three collisions for this height of the track. Record all results (distance travelled and maximum velocity) in Table 1.

15 After completing three trials for height 2 of the motion track, change the height of the track. Measure the new height of the track at the inclined end. Carry out three collisions for this height of the track. Record all results (distance travelled and maximum velocity) in Table 1.

DATA AND ANALYSIS

Table 1 Collected data

	Height 1: ____ cm	**Height 2: ____ cm**	**Height 3: ____ cm**
	Distance bean bag travelled (cm)	**Distance bean bag travelled (cm)**	**Distance bean bag travelled (cm)**
Trial 1			
Trial 2			
Trial 3			
	Maximum velocity of cart (m/s)	**Maximum velocity of cart (m/s)**	**Maximum velocity of cart (m/s)**
Trial 1			
Trial 2			
Trial 3			

HINT

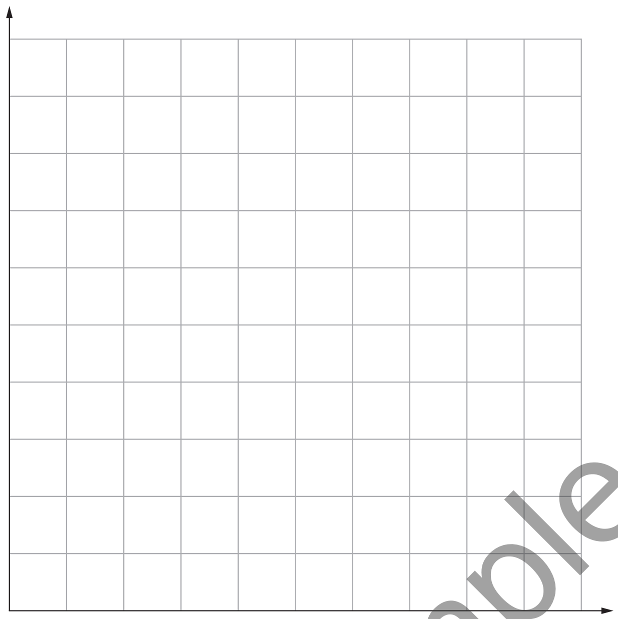
Be careful converting between centimetres and metres when calculating the velocity.

1 Average your results for each trial. Record the results of these calculations in Table 2 below.

Table 2 Average distance and velocity

	Average maximum velocity for all trials (m/s)	**Average maximum distance for all trials (cm)**
Height 1		
Height 2		
Height 3		

2 On the graph below, plot the average distance against the average maximum velocity.



HINT

Be careful to label units correctly on your graph axes. Height and distance have been measured in cm, but the velocity from the motion sensor will be given in m/s.

CONCLUSION

3 Look over your experimental results in Table 1. Do your results agree with your hypothesis? Why or why not? Explain your thinking.

4 What property of matter causes the bean bag to carry on travelling for a distance after the cart has stopped?

RATE MY LEARNING

○ Not confident ○ Somewhat confident ○ Mostly confident ○ Very confident

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PRACTICAL ACTIVITY 2

Newton's first law

Questioning & Predicting | Conducting Investigations | Processing & Analysing Data

Suggested duration: 50 minutes

Have you ever wondered ... how force affects an object's motion?

INTRODUCTION

In physics, a force is a push or a pull on an object. Discuss with your lab group some examples of forces you commonly encounter and write them in the space below.

____

____

____

____

Isaac Newton is known for his work on forces; in fact, the SI unit of force is called the newton (N). Newton derived three laws of motion that describe the effects of forces acting on objects. Newton's first law of motion states that an object at rest stays at rest, or that an object in motion stays in motion, unless an external force is exerted upon that object. Newton's first law is commonly called the law of **inertia**.

Inertia means resistance to change. The amount of inertia an object has depends on its mass.

AIM

To investigate how applied forces change an object's motion.

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HYPOTHESIS

If an object in motion is not acted on by an external force, then the object will stay in motion.

⚠ Do not apply a pushing or pulling force greater than 50 N to the force sensors. Doing so will result in damage to the sensors.

MATERIALS

- data-collection system
- force sensor with hook and rubber bumper
- motion sensor
- PAScar, other cart or toy car
- duct tape or packing tape (several strips)
- metric ruler

PROCEDURE

1 Start a new experiment on the data-collection system.

2 Connect the motion sensor and the force sensor to the data-collection system.

3 Create a graph with position on the *y*-axis and time on the *x*-axis.

4 Position the cart approximately 50 cm from the metal screen of the motion sensor.

5 Start data recording. Slowly and steadily push and pull the cart so it travels as follows.

- **a** Push the cart towards the motion sensor, stopping about 15 cm in front of the metal screen.
- **b** Pause for 5 s.
- **c** Pull the cart back to the beginning position.
- **d** Pause for 5 s.
- **e** Push the cart towards the motion sensor, stopping again about 15 cm in front of the metal screen.

6 Stop data recording.

7 Observe the graph of position versus time. Describe or print and paste your graph in the Data and analysis section.

8 Attach the force sensor to your cart.

9 Zero the force sensor. Create a graph with force on the *y*-axis and time on the *x*-axis.

10 Position the cart approximately 50 cm from the metal screen of the motion sensor. Begin data recording.

11 Firmly grasp the hook of the force sensor, and steadily push and pull the car as you did in the first trial—towards the motion sensor, stop for 5 s, away from the motion sensor, stop for 5 s, and then towards the motion sensor, stopping about 15 cm in front of the metal screen.

12 Stop data recording. Observe the graph of force versus time. Describe or print and paste your graph in the Data and analysis section.

DATA AND ANALYSIS

1 Describe or paste your position versus time graph below.

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Practical activity 2

2 Describe or paste your force versus time graph below.

CONCLUSION

3 Newton's first law can be stated as: 'Every object that is standing still stays standing still, and every object that is moving keeps on moving, unless some outside force acts upon that object'. Suppose Newton was referring to the cart you just used in this investigation. What outside forces acted on the cart?

4 What evidence do you see in your graphs of position and force versus time that supports Newton's idea?

RATE MY LEARNING ◯ Not confident ◯ Somewhat confident ◯ Mostly confident ◯ Very confident

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INQUIRY ACTIVITY 1

Acceleration and speed in a car

Planning Investigations

Conducting Investigations | Processing & Analysing Data | Problem Solving | Communicating

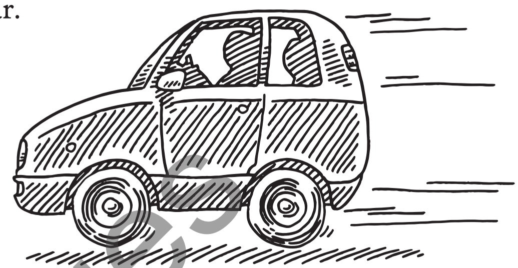
Suggested duration: 120 minutes

INQUIRY QUESTION

How does a car's acceleration vary during a journey?

TASK

In this inquiry you are going to take a simple journey in a car. You will need a friend or parent to drive you while you take your observations. Using the in-built accelerometer in your phone or any Apple or Android device, you can measure the acceleration as function of time. Your task is to compare the acceleration you record using your device with the acceleration determined from your observations of the changes in speed of the car over time taken from the car's speedometer. This inquiry activity should be written up as a full laboratory report using a logbook.



PLAN AND DESIGN

1 Plan the route you are going to take and where you are going to accelerate, travel at a constant speed and decelerate.

2 Determine a plan for taking the following measurements.

  a Measure the acceleration as a function of time using a phone or tablet.

  b Measure the speed from the car's speedometer as a function of time.

  Note: it is important to be able to match the times for the two measurements.

3 In your logbook, write up your procedure and draw up a suitable table for recording your results. Keep in mind that you will need to produce the following graphs in your analysis of your results:

- speed versus time
- calculated acceleration (found from measuring the speed) versus time
- measured acceleration versus time.

MATERIALS

- a vehicle
- device containing an accelerometer such as a smartphone or tablet, with SPARKvue 4.0 software (or similar software) installed
- second device to measure time intervals (i.e. the stopwatch on a phone)

⚠ Ensure you use a reliable and safe driver and that your seatbelt is on. Use quiet streets with no pedestrians, or a big car park after closing time. Have a third person watch the streets to look out for traffic and pedestrians.

HINT

Remember, acceleration is equal to the change in speed over time.

☐ Have you checked your procedure with your teacher?

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CREATE

4 Conduct your experiment.

IMPROVE

5 Discuss any issues you faced when designing and carrying out your experiment.

6 How could the experiment be improved?

REFLECT

7 Compare the acceleration calculated from the speed versus time data and the acceleration directly measured from your device. How well did they agree?

8 Compare the shape of the velocity versus time graph with that of the acceleration versus time graph. Did your car accelerate at a constant rate or did it change? How did this affect your measurements?

RATE MY LEARNING ○ Not confident ○ Somewhat confident ○ Mostly confident ○ Very confident

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