4 August 2020
Stages 4 & 5 Science
Professional Development Workshop

Scaffolding skills for HSC Science success

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Welcome to today's workshop

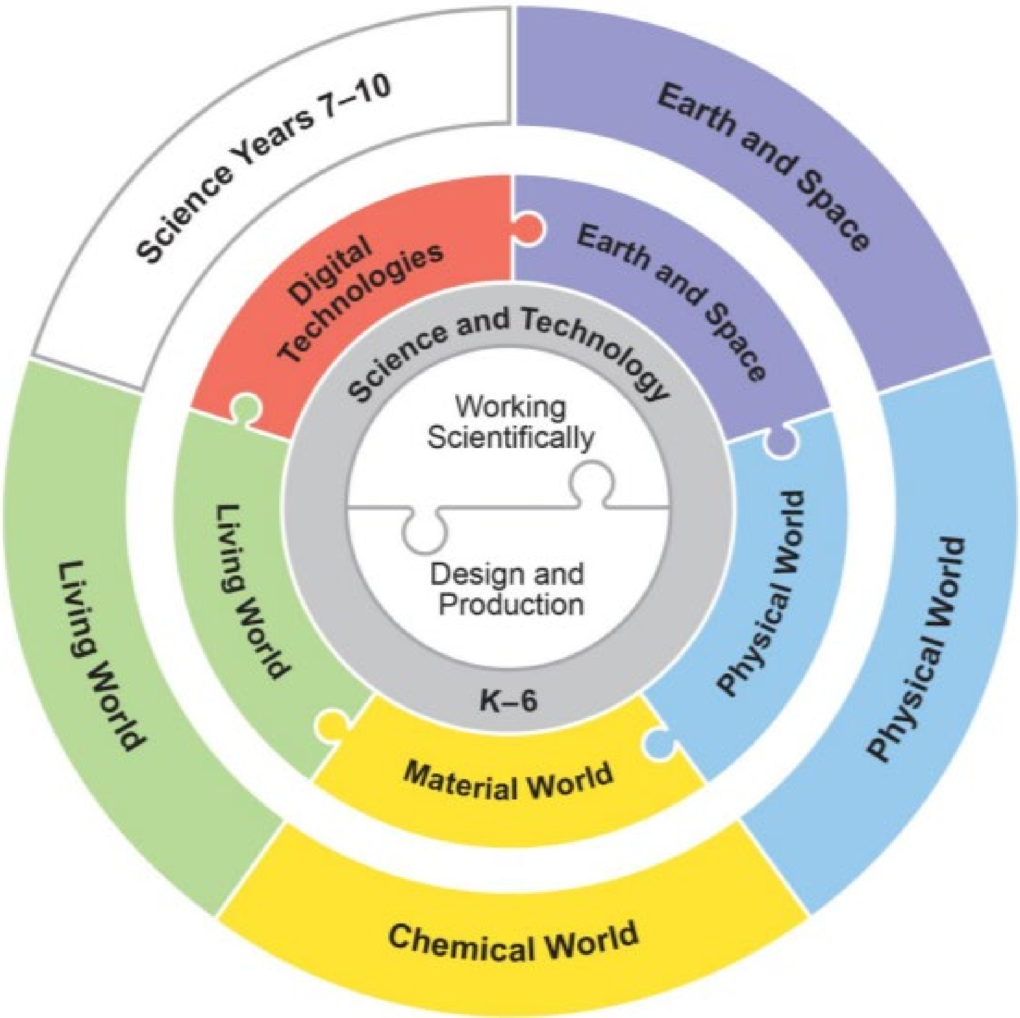
PART A HSC Science Examiner report feedback

PART B How *Oxford Insight Science* supports students for Stage 6 success

PART C Overview of the *Oxford Insight Science* series

PART D Questions and comments

Organisation of content in Stages 4 and 5 Science



Mapping Working Scientifically skills

	Stage 4	Stage 5	Stage 6
Questioning and predicting	Identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge	Develops questions or hypotheses to be investigated scientifically	develops and evaluates questions and hypotheses for scientific investigation
Planning investigations	Collaboratively and individually produces a plan to investigate questions and problems	Produces a plan to investigate identified questions, hypotheses or problems, individually and collaboratively	designs and evaluates investigations in order to obtain primary and secondary data and information
Conducting investigations	Follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually	Undertakes first-hand investigations to collect valid and reliable data and information, individually and collaboratively	conducts investigations to collect valid and reliable primary and secondary data and information
Processing and analysing data and information	Processes and analyses data from a first-hand investigation and secondary sources to identify trends, patterns and relationships and draw conclusions	Processes, analyses and evaluates data from first-hand investigations and secondary sources to develop evidence-based arguments and conclusions	selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media
			analyses and evaluates primary and secondary data and information
Problem solving	Selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems	Applies scientific understanding and critical thinking skills to suggest possible solutions to identified problems	solves scientific problems using primary and secondary data, critical thinking skills and scientific processes
Communicating	Presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations	Presents science ideas and evidence for a particular purpose and to a specific audience, using appropriate scientific language, conventions and representations	communicates scientific understanding using suitable language and terminology for a specific audience or purpose

Stage 6 Examiner reports: What do students need to improve?

Questioning and predicting:

- Explicitly outlining how the dependent variable will be measured

Planning and conducting investigations:

- “Distinguishing between the aim of an experiment and a hypothesis”
- “Explaining the relationship between two variables tested in an experimental method rather than just describing it”
- “Providing examples of variables to be kept constant to increase the validity of the experiment”
- “Understanding that repetition is a necessary requirement to ensure experiments are reliable”
- “Describing why variables need to be kept constant in a fair test”
- Students continue to struggle with distinguishing between reliability, validity and accuracy.

Processing and analysing data and information:

- “Constructing graphs with a ruler and noting the scale for accuracy”
- “Identifying the line of best fit”
- “Correctly placing the independent variable on the x-axis and the dependent variable on the y-axis”
- “Ensuring all numbers in a table are correctly rounded to the same number of decimal places”
- “Ensuring numbers in a table are correctly rounded off to the same number of decimal places”
- “Using correct units relating to a question, for example, car speed is usually measured in kilometres per hour rather than metres per second”
- Performing mathematical equations and correctly applying formulas

Communicating:

- “Correctly writing a procedure with enough material “
- “Avoiding using generalised information, for example, self-reproduction or non-sexual reproduction”
- “Communicate succinctly and logically using correct terminology”

How *can we scaffold these skills better in Stages 4 & 5?*

Oxford Insight Science focuses on developing key science skills from day one.

1 Complete syllabus coverage

- All subject matter in the syllabus has been included and ordered **sequentially** to help scaffold learning.
- Every chapter opener clearly indicates which syllabus points are covered.
- If it's covered in the syllabus, it's covered in our book!

2 A pathway to HSC Success

- HSC key words are used from Stage 4 so students are prepared to answer when they reach Stage 6
- Science skills are targeted through ‘Skill builders’ in each section
- Questions focus on application as well as consolidation

3
Easier to use and more accessible

To make our resources simple and easy to use, we have:

- a **section-based approach** to ensure our Student books are easier to navigate – one section, one concept, one lesson.
- Concepts delivered in **plain English**, with, concise, instructional language
- added more **graphic organisers** and **images** to support learning
- built in differentiation opportunities

4

Support for experiments and the Student Research Project

- Editable worksheets for all investigations in the obook assess
- Risk assessments and lab tech notes for all practical activities
- A dedicated chapter in each Student book to assist students plan and finish their Student Research Project

5
Full support for teachers

- Teachers are provided with a range of **additional support materials** (i.e. differentiated worksheets, teaching notes, assessment tasks and answers to all questions).
- Spread-based learning
- obook content is assignable to students at the discretion of the teachers

Working scientifically

Chapter 1, Working Scientifically, is a **stand-alone reference chapter** that appears at the front of each Student book. It includes:

- An introduction and step by step instructions on how to master science skills:
  Questioning and predicting
  Planning investigations
  Conducting investigations
  Processing and analysing data
  Problem solving
  Communicating
- A guide to carrying out scientific research safely and ethically

A quick tour of the new Student Books

- Check your learning questions aligned to Bloom's taxonomy
- Skill builder questions in every section to scaffold skill development
- Investigations, Challenges and Skills lab provide practical opportunities
- Margin glossary definitions for literacy support
- Worked examples for better application
- **Working Scientifically** chapter targets skill acquisition and development
- **Student Research Project** chapter supports students to complete this assessment

The topic of each section is introduced with a **concept statement**.

2.1 A force is a push or a pull

Key ideas

In this topic, you will learn that:

> unbalanced forces act on everything, causing objects to move or stop moving, or change speed, shape or direction.
> the unit used to measure a force is a newton (N).

force
push or pull that, if unbalanced, can cause a change in an object's motion

calibrate
to check the accuracy of a metre against known measurements

newton
unit used to measure force; symbol N

Margin glossary terms support student understanding at the point of learning

A **force** is a push or pull that happens when two objects interact. Sometimes forces are easy to identify and describe, such as a foot kicking a ball. Other forces are harder to identify and describe; for example, the force that keeps you on the ground.

Forces in action

Forces act on everything around us. Usually, more than one force is acting on any object at one time, but often we do not notice them. You have many forces acting on you at the moment. For example, when you sit on a chair, gravity is pushing you down. The chair is pushing back against you. Because these forces acting on you are in balance (the same strength but opposite directions), you do not move.

... ball, you need to ... causes the ball to ... you are still giving ... force causes the

... round us all the

> remain still.

Examples of these forces are shown in Figures 2–7.

Measuring forces

One way to 'see' a force at work is to measure it. Push forces can be measured with a set of scales like the ones you might find in a kitchen or bathroom. Pull forces can be measured using a **spring balance**. As shown in Figure 1, a stiff spring in the balance stretches when an object pulls on it.

spring balance
device consisting of a spring and a scale, used to measure forces in the laboratory

The distance the spring stretches represents the amount of force applied. This distance is measured by a marker on the spring balance. A rubber band can measure the size of forces in a similar way to a spring balance. Before we can use a rubber band to measure a force, it must be **calibrated**. This means we need to match the stretch of the rubber band to the force pulling on it.

The unit used to measure forces is called a **newton** after English physicist Isaac Newton (1642–1727), who first described the force used to pull an apple from a tree. Spring balances are also known as newton meters. Scientists around the world have agreed to this standard measurement so that they can communicate with one another. In every country, the force of 100 grams being pulled to the centre of the Earth is about 1 newton (N). This is about the same as one large chocolate bar sitting on your hand.

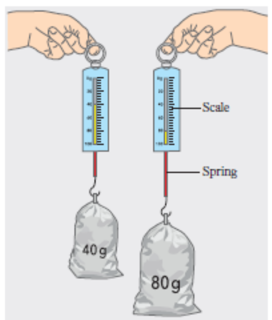


Figure 1 Spring balances are used to measure force.

SKILLS LAB 2.1: Measuring forces Go to page 17.

Figure 2 Begin to move. The golf club pushes the ball. The club exerts a force on the ball, causing it to begin to move. If the club misses the ball, there is no additional force on the ball from the club and the ball stays still.

Figure 3 Speed up. When the skateboarder wants to move faster, they use their foot to exert a force on the ground.

Figure 4 Slow down. The brakes on this bicycle wheel push down on the tyre, causing the tyre to slow down. This in turn brings the bicycle to a stop.

Figure 5 Change direction. The tennis racquet pushes the ball in a different direction.

Figure 6 Change sh... push the plasticine i... shape. When the fin... the plasticine no lon...

Check your learning questions are structured to Bloom's taxonomy. **Skill Builder** questions scaffold syllabus science skills.

Check your learning 2.1

Recall and explain

1. **Define** the term 'force'.
2. **Recall** six things that forces do.
3. **Recall** the unit used to measure force.

Apply and analyse

4. **Order** these forces from biggest to smallest.
   a. A truck hitting a pole
   b. A rocket being launched
   c. Typing one letter on a computer keyboard
   d. Kicking a soccer ball

Skills builder: Planning investigations

7. A student was using the force measurer from Skills Lab 2.1 (see page 15) when the rubber band broke.
   a. **Identify** the aim of Skills Lab 2.1. (THINK: Why was the student using the force measurer?)
   b. **Suggest** why the original force measurer might have broken. (THINK: What needs to change to make it work?)
   c. **Propose** a new way to conduct Skills Lab 2.1. (THINK: Could a different rubber band be used with the same scale?)

We're leading the way

Investigations are signposted at the point of learning.

CHALLENGE
2.2: Design a ball whacker
Go to page 18.

2.2 An unbalanced force causes change

Key ideas

In this topic, you will learn that:

- when forces acting on an object are balanced, the object's motion does not change
- forces acting on an object are unbalanced when there is a change to the speed, direction of motion, or shape of an object.

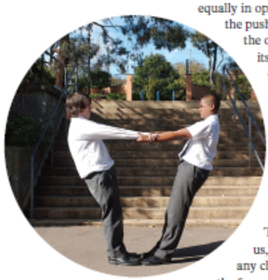


Figure 1 Forces can balance each other.

Forces always come in pairs. Forces are balanced when they are pushing or pulling equally in opposite directions. If one of the push or pull forces is larger than the other, the object will change its speed, direction of motion or shape. When this happens, the forces are said to be **unbalanced**.

Balanced forces

Pushing on a brick wall does not usually cause the brick wall to move. This does not mean your force did not exist. There are many forces around us, but most of them do not cause any change in motion. This is because the forces are balanced. It means they are equal in size but opposite in direction. If the forces of the two people in Figure 1 balance each other, the people stay still. This is because they are pushing or pulling with equal and opposite forces. **Balanced forces** are very important. Two tug-of-war teams will be balanced if they pull with the same amount of force but in opposite directions.

balanced forces
two forces equal in size and opposite in direction

Unbalanced forces

Unbalanced forces are also very important. Consider the forces acting on the barbell in Figure 2. The barbell stays in the air at a particular height because the forces on it are in balance. The weightlifter is pushing the barbell up with exactly the same amount of force as the Earth is pulling down. To move the barbell up, the weightlifter must use a stronger force than the Earth's pull. This will make the forces on the barbell unbalanced.

unbalanced forces
two or more forces that are unequal in size and direction and therefore change an object's speed, direction or shape

Evidence of an unbalanced force

There are three ways you can tell if a force is unbalanced. Forces are unbalanced if there is a change in an object's:

- speed
- direction
- shape.

Figure 2 A weightlifter applies a force to lift the barbell.

If a ball is resting on the ground, then all the forces acting on it are balanced. If two people are pushing equally on a stationary object in opposite directions, then the forces are balanced and the object does not move. If one person starts pushing harder, then the object will start to move. There is a change in motion because the forces are unbalanced.

Consider a soccer ball rolling towards the goal. If the goalkeeper kicks it away, then the ball will change direction because the goalkeeper's kick unbalanced the forces.

Playdough sitting on the bench will not change unless you add a push force with your finger. The evidence for this unbalanced force is a change in shape.

Figure 3 This door is opened by applying either a direct push or pull force (contact).

Worksheet
Predicting the effect of forces

Icons highlight digital resources to support learning

Contact forces

Contact forces involve two objects touching each other. Some forces make objects move because of a direct push or pull. It is much easier to move a pencil if you push it with your finger. Your finger has to touch the pencil or be in contact before the pencil will move. This is called a contact force. Friction is also an example of a contact force, which you will learn more about later in this chapter.

If an object is able to push or pull another without touching, it is called a **non-contact force**. Magnetism and **gravity** are examples of non-contact forces.

contact forces
forces that occur whe[n] objects are touching e[ach] other

non-contact force
force that operates be[tween] two objects when they [are] not touching each oth[er] e.g. gravitational force

gravity
force of attraction tha[t] objects have on one another due to their m[ass]

Check your learning 2.2

Recall and explain

1. **Identify** an example of balanced forces acting on an object.
2. **Describe** how the forces acting on the objects in the following situations are unbalanced.
   a. Pushing down the lever on the toaster
   b. Jumping on a trampoline
   c. A car starting to move

Apply and analyse

3. **Examine** Figure 2. What are the forces acting on the barbell?
4. **Explain** why weightlifters get tired when they hold heavy masses in the air.
5. **Explain** why a brick wall does not fall over when you push it. Why can a bulldozer push it over?
6. Jack pushes a trolley quickly down a supermarket aisle. He builds up speed and then stops, letting go of the trolley.
   a. **Predict** what would happen to the trolley.
   b. **Explain** your answer in terms of the forces acting on the trolley.

Skills builder: Questioning and predicting

7. Sam wants to investigate if having more people on one side of a tug-of-war will affect the result of the game. He has created this scientific question for his investigation: 'Is it good to have lots of people for tug-of-war?'
   a. **Identify** what is wrong with Sam's question. (THINK: Is this question specific enough and easy to test?)
   b. **Propose** your own scientific question for Sam's investigation. (THINK: How does your question improve on Sam's question?)

We're leading the way

2.3 Forces can be added together

Key ideas summarise key concepts addressed in the section

Key ideas

In this topic, you will learn that:

- forces can be added together to calculate the net force working on an object
- force diagrams use arrows to represent the direction and strength of a force.

f all the
n an object

If you tried to lift a heavy object such as a piano, you would not succeed because the upward force you exerted on the piano would be too weak. But if a few of your friends helped you by adding their force to yours, the combined upward forces would be stronger than the downward pull of the Earth. The **net force** is the combination of all the forces acting on the piano. If the piano is lifted up, the forces are unbalanced and the net force on the piano is upward.

If an object is stationary (not moving) or moving at a steady speed in the same direction, then the net force acting on that object is zero. All the forces are balanced. If an object changes its speed (by speeding up or slowing down), shape or direction, then a net force must be acting on it.

In tug-of-war (see Figure 1), if one team pulls with more force, the rope will move towards them. If the rope stays in the same place while both teams pull, the net force acting on the rope must be zero.

Drawing force diagrams

Force diagrams show all the forces acting on an object. There is one arrow to represent each force. The arrows on a force diagram can tell you information about the forces being exerted:

- The length of the arrow shows the size of the force. For example, a short arrow shows a weak force and a long arrow shows a strong force.
- The direction of the arrow shows the direction of the force.

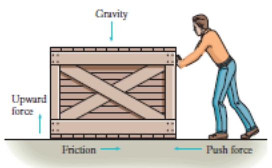
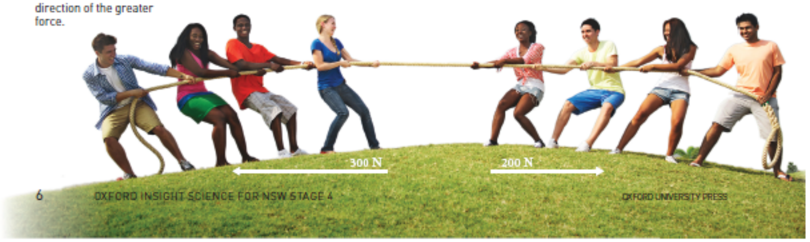


Figure 2 The arrows in this diagram show the forces acting on the box as it is moved.

More than one force is usually acting on an object at a time. Figure 1 shows a tug-of-war between two teams. The arrows show the pull force they are exerting on the rope. The arrow for the 200 N force is twice as long as the arrow for the 100 N force, but they are showing opposite directions. One team is much stronger than the other team. Which team will win? What evidence will you see in real life that this team is stronger?

Figure 1 When forces are unbalanced, a change in motion will occur, with the greatest force 'winning'. In a game of tug-of-war, if one team pulls with a force of 200 N to the right and the other team pulls with a force of 300 N to the left, the net force is 100 N to the left. The team on the left will win the game because both teams will move that way. Unbalanced forces lead to a movement in the direction of the greater force.



Worked example: Drawing force diagrams

Question

Construct a force diagram to represent the car being pushed in Figure 3.

Figure 3 When one of these people tries to push the car, they are not strong enough. But their combined net force is enough to move the car.

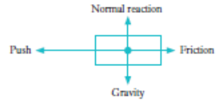
Solution

Step 1 Draw a box or dot to represent the car.

Step 2 Identify all the forces acting on the car, and in which direction they are acting. In this example, the forces are the people pushing on the car, the friction acting in the opposite direction to the movement, gravity acting down on the car and the force of the ground pushing upward (called normal reaction).

Step 3 Draw an arrow for each of these forces. Use a ruler to draw straight lines. The push causes the car to move so it must be an unbalanced force. Therefore, the arrow for the push force should be longer.

Step 4 Label the arrows.



Worksheet
Drawing force diagrams

Worked examples assist students to apply processes and formulas

Check your learning 2.3

Recall and explain

1. **Define** the term 'net force'?
2. **Identify** two examples where forces cancel each other out (net force = 0) and where two forces add together.
3. **Explain** what the arrows represent on a force diagram.

Apply and analyse

4. If Sally can push with 150 N and Marilla with 200 N in the same direction, **calculate** the force they push with together. **Calculate** the net force if they push in opposite directions.
5. **Construct** a diagram of two people having a tug-of-war. Give them names and draw arrows to show the force they are exerting on the rope. Identify the winner.
6. **Construct** a force diagram for the following examples.
   a. A broken-down car being pushed
   b. A ball being thrown
   c. Laying still on the grass

Evaluate and create

7. **Identify** if the forces acting on a car are balanced or unbalanced in each step. **Justify** each of your answers.
   a. A car is stationary.
   b. It then starts moving and keeps travelling at a constant speed on a straight road for 5 minutes.
   c. It next turns right.
   d. Then it continues to travel at straight road.
   e. The driver sees a dog crossing the road, so he brakes and the car stops after 1 minute.

Skills builder: Communicating

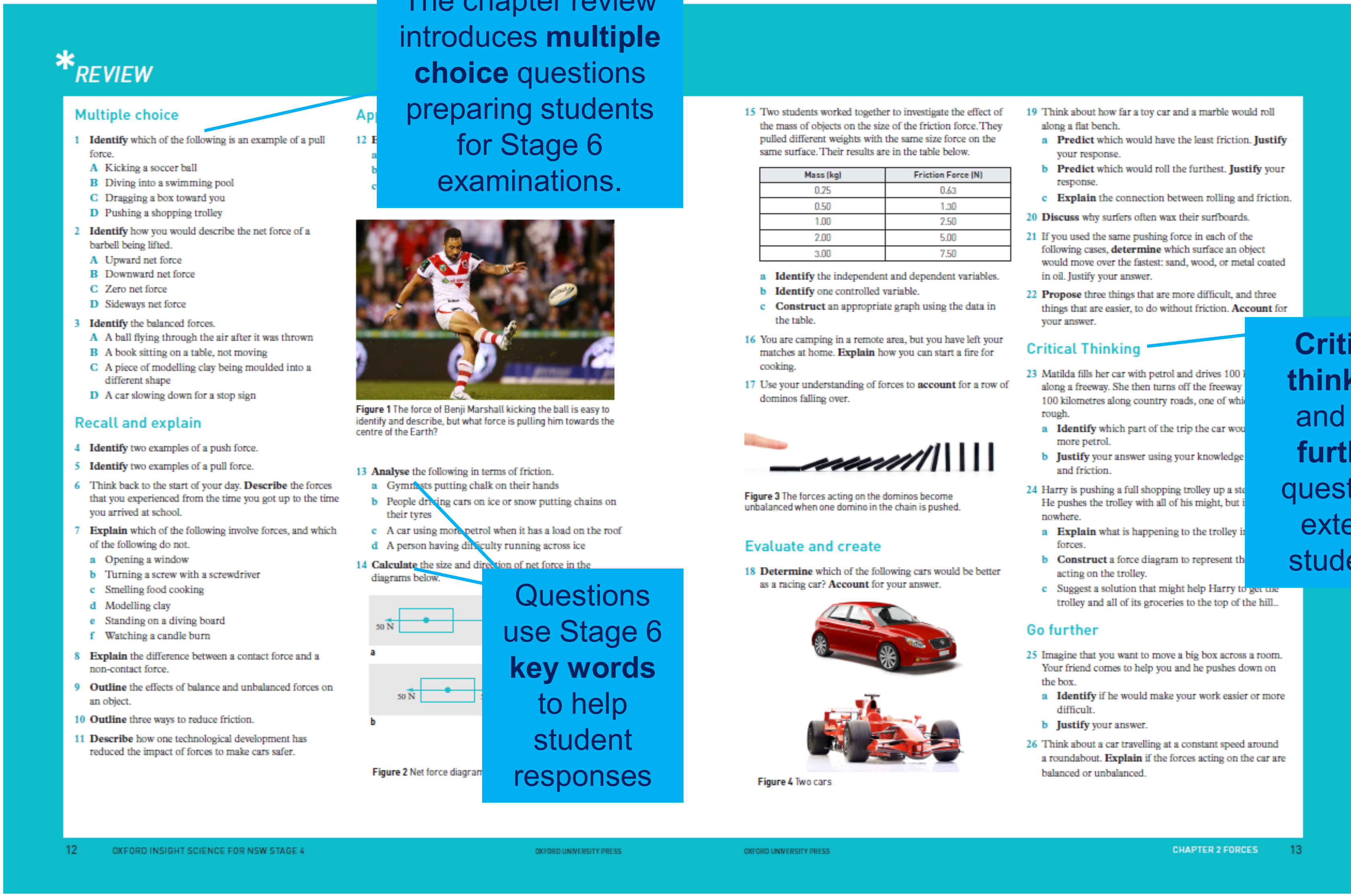
8. Your classmate does not understand why his team lost a tug-of-war, even though he had more people on his side.
   a. **Construct** a force diagram to demonstrate the forces in the tug-of-war. (THINK: What kind of representation is normally used to demonstrate forces?)
   b. Label your force diagram. (THINK: What does your classmate need to know about what heat?)

We're leading the way

The chapter review introduces **multiple choice** questions preparing students for Stage 6 examinations.

Critical thinking and **Go further** questions extend students

Questions use Stage 6 **key words** to help student responses



*REVIEW

Multiple choice

1 **Identify** which of the following is an example of a pull force.
A Kicking a soccer ball
B Diving into a swimming pool
C Dragging a box toward you
D Pushing a shopping trolley

2 **Identify** how you would describe the net force of a barbell being lifted.
A Upward net force
B Downward net force
C Zero net force
D Sideways net force

3 **Identify** the balanced forces.
A A ball flying through the air after it was thrown
B A book sitting on a table, not moving
C A piece of modelling clay being moulded into a different shape
D A car slowing down for a stop sign

Recall and explain

4 **Identify** two examples of a push force.
5 **Identify** two examples of a pull force.
6 Think back to the start of your day. **Describe** the forces that you experienced from the time you got up to the time you arrived at school.
7 **Explain** which of the following involve forces, and which of the following do not.
a Opening a window
b Turning a screw with a screwdriver
c Smelling food cooking
d Modelling clay
e Standing on a diving board
f Watching a candle burn
8 **Explain** the difference between a contact force and a non-contact force.
9 **Outline** the effects of balance and unbalanced forces on an object.
10 **Outline** three ways to reduce friction.
11 **Describe** how one technological development has reduced the impact of forces to make cars safer.

Ap...

12 ...

Figure 1 The force of Benji Marshall kicking the ball is easy to identify and describe, but what force is pulling him towards the centre of the Earth?

13 **Analyse** the following in terms of friction.
a Gymnasts putting chalk on their hands
b People driving cars on ice or snow putting chains on their tyres
c A car using more petrol when it has a load on the roof
d A person having difficulty running across ice

14 **Calculate** the size and direction of net force in the diagrams below.

Figure 2 Net force diagram...

15 Two students worked together to investigate the effect of the mass of objects on the size of the friction force. They pulled different weights with the same size force on the same surface. Their results are in the table below.

Mass (kg)	Friction Force (N)
0.25	0.63
0.50	1.30
1.00	2.50
2.00	5.00
3.00	7.50

a **Identify** the independent and dependent variables.
b **Identify** one controlled variable.
c **Construct** an appropriate graph using the data in the table.

16 You are camping in a remote area, but you have left your matches at home. **Explain** how you can start a fire for cooking.

17 Use your understanding of forces to **account** for a row of dominos falling over.

Figure 3 The forces acting on the dominos become unbalanced when one domino in the chain is pushed.

Evaluate and create

18 **Determine** which of the following cars would be better as a racing car? **Account** for your answer.

Figure 4 Two cars

19 Think about how far a toy car and a marble would roll along a flat bench.
a **Predict** which would have the least friction. **Justify** your response.
b **Predict** which would roll the furthest. **Justify** your response.
c **Explain** the connection between rolling and friction.

20 **Discuss** why surfers often wax their surfboards.

21 If you used the same pushing force in each of the following cases, **determine** which surface an object would move over the fastest: sand, wood, or metal coated in oil. Justify your answer.

22 **Propose** three things that are more difficult, and three things that are easier, to do without friction. **Account** for your answer.

Critical Thinking

23 Matilda fills her car with petrol and drives 100 ... along a freeway. She then turns off the freeway ... 100 kilometres along country roads, one of whi... rough.
a **Identify** which part of the trip the car wou... more petrol.
b **Justify** your answer using your knowledge ... and friction.

24 Harry is pushing a full shopping trolley up a ste... He pushes the trolley with all of his might, but i... nowhere.
a **Explain** what is happening to the trolley i... forces.
b **Construct** a force diagram to represent th... acting on the trolley.
c Suggest a solution that might help Harry to get the trolley and all of its groceries to the top of the hill.

Go further

25 Imagine that you want to move a big box across a room. Your friend comes to help you and he pushes down on the box.
a **Identify** if he would make your work easier or more difficult.
b **Justify** your answer.

26 Think about a car travelling at a constant speed around a roundabout. **Explain** if the forces acting on the car are balanced or unbalanced.

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OXFORD UNIVERSITY PRESS CHAPTER 2 FORCES 13

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Research offers preparation and prompts for the Student Research Project

Research

27 Choose one of the following topics to research further. Present your findings in a format that best fits both the information you have found and the understandings you have formed.

»Seatbelts

The wearing of seatbelts in cars became compulsory in Australia in 1970. Research the materials that are used to make seatbelts. Use your knowledge of forces to explain how seatbelts prevent injury in a car accident.

»Aeroplanes

There are always forces acting on objects. What are the push and pull forces acting on an aeroplane? How do these push and pull forces change as an aeroplane takes off, flies and lands? Research the forces acting on an aeroplane and draw a labelled diagram to show the forces.

»Footwear for friction

Investigate how different types of footwear have been designed to reduce friction. What type of footwear do you think is the best for reducing or increasing friction? What features have designers included to manage friction? Draw a diagram of one shoe and label how it has been designed to improve the impact of friction.

Reflect

Now that you have completed this chapter, reflect on your ability to do the following:

	I can do this.	I cannot do this yet.
Identify changes that take place when particular forces are acting.	☐	☐ Go to pages xxx - xxx
Predict the effect of unbalanced forces acting in everyday situations.	☐	☐ Go to pages xxx - xxx
Describe some examples of technological developments that have contributed to finding solutions to reduce the impact of forces in everyday life, e.g. car safety equipment and footwear design.	☐	☐ Go to pages xxx - xxx
Analyse some everyday common situations where friction operates to oppose motion and produce heat.	☐	☐ Go to pages xxx - xxx
Investigate factors that influence the size and effect of frictional forces.	☐	☐ Go to pages xxx - xxx

Reflect encourages students to take charge of their own learning and conduct self-assessment on learning outcomes.

Challenges introduce STEM concepts and ask students to apply critical thinking or problem solving skills.

2.1 Measuring forces

SKILL

Aim

To measure a variety of forces in common situations.

Risk assessment 2.1 Measuring forces

Lab tech notes 2.1 Measuring forces

Materials

- Rubber band
- Thin strip of timber (or a ruler)
- Mass carrier and masses
- Pen

Method

A rubber band can measure the size of forces in a similar way to a spring balance. But before it can, the rubber band must be calibrated. This means matching the stretch of the rubber band to the number of newtons pulling on it.

1 Calibrate the rubber band on the strip of timber, as shown in Figure 1.

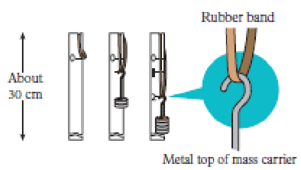


Figure 1 Calibrating the force measurer

2 Mark the distance that the rubber band is stretched on the timber when the mass carrier holds a 100 gram mass. Remember: The weight force of 100 grams equals 1 newton of force.

3 Repeat for masses of 200 grams, 300 grams, 400 grams and so on, marking the timber each time.

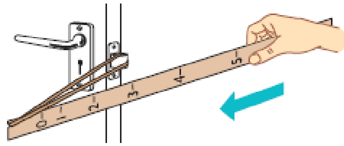


Figure 2 Measuring the force needed to open a door

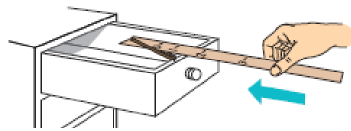


Figure 3 Measuring the force needed to close a drawer

4 Use your measuring device to measure the force needed to:

a open the door to a room
b drag a chair across the floor
c close a drawer in the laboratory
d move your pencil case
e pull up your sock
f carry out three movements of your choice.

Results

Draw a column graph showing the amount of force needed to move each object.

Conclusion

What do you know about the force required to move different objects?

Skills lab practicals introduce laboratory work and key science skills

2.2 Design a ball whacker

CHALLENGE

Design brief

Design equipment that uses a block of wood to hit a tennis ball. A block of wood from home or the woodwork room is ideal.

Risk assessment 2.2 Design a ball whacker

Lab tech notes 2.2 Design a ball whacker

Questioning and predicting

- How will you create a contact force between the wooden block and the ball?
- How will you make the wooden block swing?
- How far do you want your ball to move?

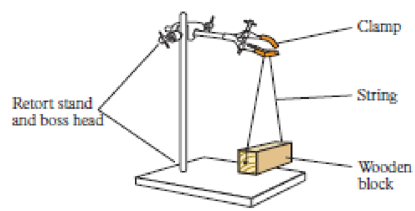


Figure 1 A possible design for the experiment

Planning and conducting

Figure 1 shows one way to set this experiment up. You must use only the force of gravity – you cannot push the wooden block.

Processing, analysing and evaluating

1 What changes did you have to make to move the ball further?
2 What was the most successful feature of your ball whacker? What was the least successful?
3 Is a heavy block better than a light one?
4 Is there any practical use for a 'whacker' like this?
5 If you were doing this experiment again, how would you modify your device? Explain.

Communicating

Present the various stages of your investigation in a formal experimental report.

Investigations provide students with experiment style activities

2.4 What if the amount of friction was changed?

INVESTIGATION

Aim

To investigate how friction may be reduced.

Investigation
2.2 What if the amount of friction changed?

Risk assessment
2.4 What if the amount of friction changed?

Lab tech notes
2.4 What if the amount of friction changed?

Materials

- Force measurer (see Skill Lab 2.1) or spring balance
- Thick textbook
- Wooden rollers (round pencils)
- Book
- Sand

Method

1 Use your force measurer to measure the friction of your textbook being dragged along the table. (Hint: Drag it at constant speed.)

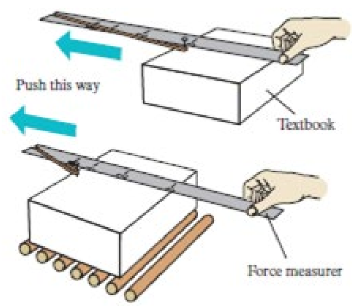


Figure 1 Measuring the friction of a textbook

2 Place two books on top of each other and measure the friction.

Inquiry: Choose one question to investigate

1 What if rollers were placed under the textbook?
2 What if sand was placed under the textbook?

- Write a hypothesis for your inquiry.
- What (independent) variable will you change from the first method?
- What (dependent) variable will you measure/observe?
- What variables will you need to control to ensure a fair test? How will you control them?

Results

1 Record your results in a table like the one below.

Object	Force needed to make it move (N)			
	Trial 1	Trial 2	Trial 3	Average
Textbook				
Textbook with a second book on it				
Textbook with rollers under it				
Textbook with sand under it				

2 Draw a column graph showing the effect of sand/rollers on the object's friction.

Discussion

Compare your results with those of others in the class.

1 What was the best way to reduce friction?
2 Would 5 rollers be better than 2 for reducing friction?
3 Would 10 rollers be better than 5 for reducing friction?
4 Would bigger or smaller rollers be better for reducing friction?
5 What are some problems with using rollers?
6 Write down a practical example of rollers being used to reduce friction.
7 Why would square rollers not be any good?
8 Would fine sand or coarse (large-grained) sand be better for increasing friction?
9 Write down a practical example of sand being used to increase friction.
10 What are some problems with using sand for this purpose?

Conclusion

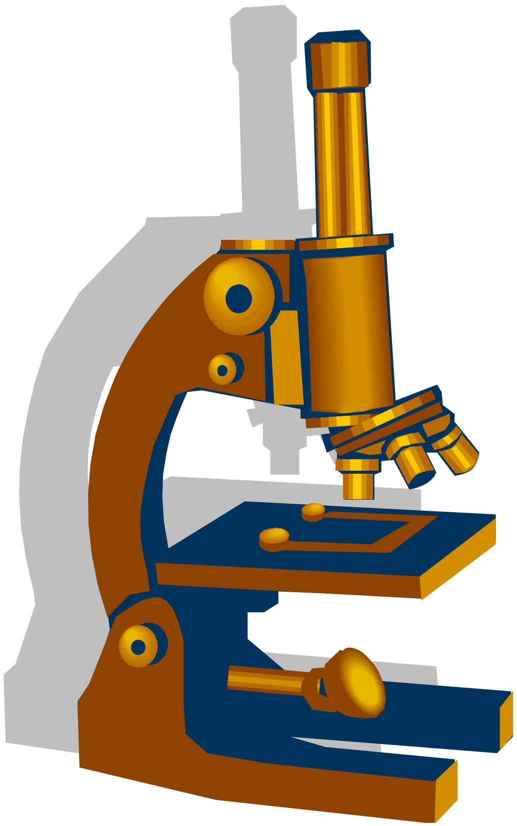
What do you know about how to reduce friction?

For each Skills Lab, Challenge or Investigation there is a worksheet, risk assessment and lab tech notes available digitally.

Student Research Project

The Student Research Project chapter is a **stand-alone** reference chapter.
It acts as a guide for the Student Research Project including:

- choosing a topic
- conducting research safely and accurately
- managing time
- working in groups
- communicating findings



A quick tour of the new Student Skills books

- **Working Scientifically** chapter introduces each of the six skills and provides opportunities for practice (one activity per skill, per chapter)
- **Literacy builders** open each chapter (practice speaking, vocab, writing, comprehension etc.)
- **Skills labs** conclude the chapters with a practical activity that requires students to engage with aim, method, materials etc.
- Consolidation of science understanding and knowledge in each activity.

8A Questioning and predicting

Making predictions

Wind energy can be captured by wind turbines. They use the wind to spin an electric generator that creates useable energy in the form electricity. Wind power is a renewable energy. Wind turbines are often placed in windy areas, such as along a coast line (Figure 1) or on the top of hills. These long lines of wind turbines are called a wind farm.

1 Predict what would happen to energy production from the wind turbines in the following scenarios:

IF		THEN	
	the wind speed increases		
	the wind speed decreases		
	two of the wind turbines are removed		
	the sun disappears behind a cloud		

2 Explain what you know about wind energy that helped you to make your predictions in Question 1.

Figure 1 A wind farm in Albany, Western Australia

Each activity targets one **science skill** through application questions. These questions progress throughout Stage 4 and 5 to prepare students for Stage 6.

8B Planning investigations

Identifying the purpose of an investigation

The *aim* of an investigation is a short statement that identifies its purpose. In other words, what is the reason for doing the investigation? What question or problem is the investigation trying to answer? This is answered in the aim.

1 Consider the two investigations outlined below. Can you identify an aim for each of these? Draw a line between each investigation and its correct aim.

- Electron microscope
- Light microscope
- Compound microscope

- To investigate how wind can affect a solar panel
- To investigate what type of household waste decomposes the quickest
- To investigate how different waste materials can be thrown out
- To investigate what type of solar panel generates the most energy
- To investigate how much energy is produced by the sun
- To investigate whether the sun's heat affects the rate at which waste decomposes

...s in Question 1. Why did you choose these two aims and not the others?

CHAPTER 8

We're leading the way

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Each chapter concludes with a **skills lab** which brings multiple working scientifically skills together.

8G Skills lab

CAUTION: Risks should be managed by use of personal protective equipment and/or specified control measures. Always consult your teacher before conducting an experiment.

Sustainable fishing

Read through the following practical activity. Use the skills you've practised in this chapter to help you fill in the blanks.

Context

Fish are a resource, which we can farm or take from the ocean for food. But many species of fish are threatened with extinction from overfishing. Humans are catching fish from populations faster than the fish can reproduce. This could one day leave us with no fish at all.

Sustainable fishing means that we only take the fish we need, and leave enough so that the populations of fish can continue to survive.

Aim

1 Read through this activity to identify the aim:

___

Materials

- M&Ms and jelly beans
- Straws
- Trays
- Stopwatch
- Spoons

1 You are not allowed to use M&Ms and jelly beans, because you cannot have food in the lab. What would you replace these items with so that you can still conduct this activity?

___

2 Explain why you chose these replacement materials.

___

___

Update the method to include your replacement materials.

1 Place plates of 20 M&Ms and 10 jelly beans (representing fish) around the room.

___

2 Each student should use a straw (without using their hands) to collect as many 'fish' as they can for 1 minute.

3 After 1 minute, the remaining fish are available for breeding. Add one new M&M 'fish' for every M&M left on a plate and one jelly bean 'fish' for every jelly bean left on a plate.

___

4 Repeat steps 2 and 3 several times.

5 How long can you keep fishing? Is the fishing sustainable?

6 Repeat steps 2–5, but this time using your hands to help move your straws. (This represents using technology to help find fish.)

7 Repeat steps 2–5 using a spoon instead of a straw. (This represents fishing with a net.)

Prediction

1 Before you begin, predict what would will happen in this experiment.

IF a straw is used to fish, THEN

IF a spoon is used to fish, THEN

IF hands are used with a straw to fish, THEN

Results

Conduct the investigation using your updated method. Record what happens at each round.

CHAPTER 8

We're leading the way

Digital resources and purchasing options

obook

obook is a fully interactive digital version of every student book with note-taking, highlighting and dictionary support included. Every obook contains links to additional resources, such as videos, interactive modules and worksheets.

assess

assess is an online assessment platform that provides access to tens of thousands of additional auto-correcting questions designed to support student understanding and progression across all subjects.

Teacher support

Additional teacher notes, answers, tests, and assessments and differentiated learning advice is all included for teachers. Teacher obook assess also allows teachers to assign work electronically, track progress, and manage results and assessment.

Oxford Insight Science for NSW is supported by a range of additional digital resources, including:

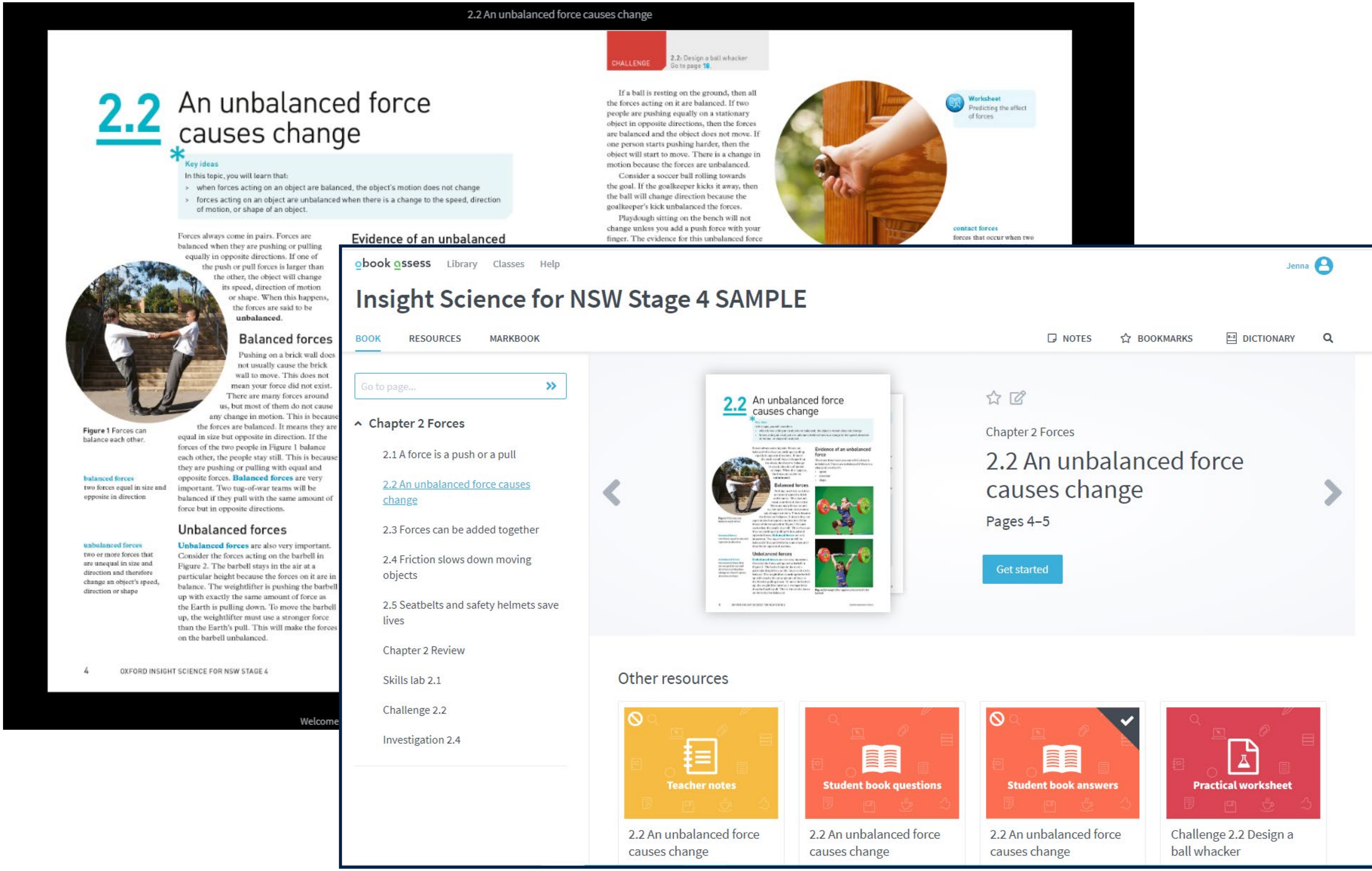
- **obook**
- **assess**
- **Teacher support**.

Digital resources and purchasing options

obook is visually integrated with the printed Student book, enabling students to move seamlessly between print and digital products. It provides a range of additional teacher and student resources including:

- Teacher notes
- Answers
- Practical worksheets (for each Investigation, Challenge or Skills lab)
- Lab tech notes and risk assessments
- Mock data and answers for each practical activity
- Video tutorials
- Revision notes for students
- Quizlet qiuzzes
- Markbook Differentiated worksheets to ensure every student is supported.

These are all designed to help you feel confident that your students will be prepared for their internal and external assessment.



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Q & A

What’s next?

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