Moving air

Teacher guidelines

6

Science

Queensland Comparable
Assessment Tasks
(QCATs) 2011

Queensland Government
Queensland Studies Authority

Queensland Studies Authority

Contact information

Direct questions about receipt of QCAT materials or QCAT implementation to the Senior Operations Officer.
Phone: (07) 3120 6187 email: qcats.administrator@qsa.qld.edu.au

Queensland Studies Authority PO Box 307 Spring Hill Qld 4004
Phone: (07) 3864 0299 Fax: (07) 3221 2553 Email: office@qsa.qld.edu.au Website: www.qsa.qld.edu.au

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Contents

The 2011 QCATs

What are QCATs?

Queensland Comparable Assessment Tasks (QCATs) are designed to provide evidence of what students know, understand and can do in relation to a selection of Essential Learnings for English, mathematics and science in Years 4, 6 and 9, and to the Standards.

QCATs are authentic, performance-based assessments that:

- engage students in solving meaningful problems
- emphasise critical thinking and reasoning
- provide teachers, students and parents/carers with information about student progress and a focus for future teaching and learning.

Consistency of teacher judgments

QCATs support teachers in making consistent judgments about the quality of student work. Improved consistency of teacher judgments is achieved when teachers:

- engage in professional conversations about the quality of evidence in student responses
- reach consensus about the quality of student work
- adopt a consistent approach when using the Guide to making judgments (back page).

Information gathered may be used by teachers to promote, assist and improve key learning area programs, and to help students achieve the highest standards they can.

Additional resources

2011 QCATs Information statement
www.qsa.qld.edu.au/3163.html

Essential Learnings and Standards
www.qsa.qld.edu.au/574.html

Important dates

Friday 24 June	QCATs packages have arrived in schools
Monday 11 July ↓ Friday 16 September	Schools: • administer QCATs at any time during the school weeks of this period • grade QCATs • select five student samples that are representative of grades awarded
Monday 10 October	Schools are notified if selected to submit student samples for QSA's random sampling process
Monday 21 November	Final day for schools to submit student data to QSA
Friday 9 December*	Schools must retain all Student booklets until the end of the school year

* this date may vary from school to school

Getting ready

Student preparation

Students should have the opportunity to do their best work. For this to occur, student preparation should include:

- opportunities to engage with the Selected Essential Learnings (page 25) well in advance of participating in QCATs — if students have not engaged with the Selected Essential Learnings recently, review and consolidation may be necessary
- experience with the types of questions used within the QCAT.

Suggested learning experiences and resources are outlined in the document 2011 QCATs – Preparation.

The quality of information provided by the QCATs is enhanced by the level of interaction teachers have with their students before, during and after implementation.

Additional resources Queensland Comparable Assessment Tasks (QCATs)
www.qsa.qld.edu.au/3163.html

Catering for diversity — Special provisions

All students should have the opportunity to participate in school-based assessment. Schools are responsible for determining which students require special provisions.

The QCATs are designed to be part of a classroom assessment program, and principles of participation and equity apply. The Queensland Studies Authority (QSA) offers this general advice:

- Students who have been identified as having specific educational requirements may be assisted using those adjustments and supports usually available in the classroom. To make participation possible in all or part of the assessment task, such help may be in the form of inclusive learning technologies, reading support or the use of support personnel.
- Students for whom English is not their first language, and who are assessed as not achieving a reading level appropriate to complete the task, may be assisted by an interpreter or educational devices (e.g. pictures, electronic whiteboards, interactive devices) to allow participation in all or part of the task.
- In exceptional circumstances, where a student's learning difficulties have precluded them from engaging with the Selected Essential Learnings, the principal (in consultation with specialist and support staff and parents/carers) may make a decision about the participation of that student in the task. Some students may be given an opportunity to complete some aspects of the assessment.

Additional resources Inclusive strategies for implementing QCATs
www.qsa.qld.edu.au/3163.html

Equity
www.qsa.qld.edu.au/10188.html

Teacher preparation

Check the contents of QCAT packages as soon as they arrive at your school

- Check that you have the appropriate number of Student booklets (one per student) and Teacher guidelines (one per implementing teacher).
- Check for any defective Student booklets.
- Contact the QSA if any additional copies are required.

Familiarise yourself with the assessment

- Read all the documents provided.
- Review the Selected Essential Learnings (page 25).
- Complete a Student booklet yourself, and then refer to the Model response (page 27) so that you understand what students are required to do.
- Download and view Sample responses from the QSA Assessment Bank (see Additional resources below).

Plan implementation

- Discuss the assessment with your colleagues, and plan any teaching or revision that may be required.
- Set the times and dates for implementation, considering these points:
  - teachers have flexibility to implement the QCATs at any time during the designated period
  - QCATs may be completed in one, two or more sessions over one or more days
  - implementation times may differ for verified students, students with specific educational requirements or students who have English as a second language
  - QCATs will ideally replace an existing piece of assessment in the student portfolio of work for Semester 2.
- Plan:
  - any support required to enable students to do their best work (e.g. teacher aides or other support personnel)
  - any materials or equipment needed to implement the assessment.
- Decide:
  - how you will implement this task for all classes at this year level
  - the processes you will use to achieve consistency of teacher judgment
  - how you will select student samples for the QSA's random sampling process
  - when, how and who will submit your school's data.

Additional resources

Queensland Comparable Assessment Tasks (QCATs)
www.qsa.qld.edu.au/3163.html

Sample responses, QSA Assessment Bank
https://qcar.qsa.qld.edu.au/assessmentbank (registration required)

8 – Using Queensland Comparable Assessment Tasks (QCATs) to support learning
www.qsa.qld.edu.au/3166.html

Implementation

Setting up

Materials for student investigations

Prepare materials for the student investigations.

For each student:

- sticky note — about 12 cm x 8 cm
- drinking straw
- 4 paper clips

Shared access:

- scissors
- tape measure or metre rule
- open floor spaces — if possible with different surfaces, e.g. carpet, vinyl, concrete.

Working with the Student booklet

Use advice given in the Annotated Student booklet (page 8) to set the conditions that ensure all students have the opportunity to do their best work.

Encourage students to interact with teachers to seek clarification when required, and with other students if appropriate to the task.

Suggested implementation timeline

Preparation

Setting the scene: Group discussion Make an air buggy Air buggy competition Discussion	20 minutes

The assessment task

Variables	10 minutes
Testing variables	15 minutes
Explaining forces	10 minutes
Investigating	20 minutes
Applying your learning	10 minutes
Designing an investigation	20 minutes
Reflecting	5 minutes

Annotated Student booklet

Suggested time: 20 minutes

Engage students in a discussion about the pictures.

Support them to classify the images into two groups:

- things that move air
- things that are moved by air.

Explain that this section is not assessed.

Setting the scene: Group discussion

Talk about the role of **moving air** in each of the pictures below.

Is moving air pushing the object, or is the object pushing the air?

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Phone: (07) 3864 0299 Fax: (07) 3221 2553 Email: office@qsa.qld.edu.au Website: www.qsa.qld.edu.au

Images Creative Commons Attribution 2.0 Generic licensed photos <http://creativecommons.org/licenses/by/2.0> accessed 25 Jan 2011. **Cover**, Kite: dchousegrooves' photostream, "Kite flying", <www.flickr.com/photos/dchousegrooves/468394218/>; p. 2 Fan: blmurch's photostream, "Hiding behind her fan", <www.flickr.com/photos/blmurch/1866279983>; Tall ship: Port of San Diego's photostream, "Pilgrim", <www.flickr.com/photos/portofsandiego/4952655816>; Kite surfer: mrpbps' photostream, "Kite Surfer Testing Kite", <www.flickr.com/photos/mrpbps/4165387081>; RAF plane: wwarby's photostream, "Unidentified RAF Plane", <www.flickr.com/photos/wwarby/4782254981>; Windsurfer: Jason Riedy's photostream, "windsurfer heading for our wake", <www.flickr.com/photos/jason-riedy/2306065091>; Toy windmill: Thaneworks' photostream, "42/365", <www.flickr.com/photos/mtsart/4519445604>. All other images © QSA.

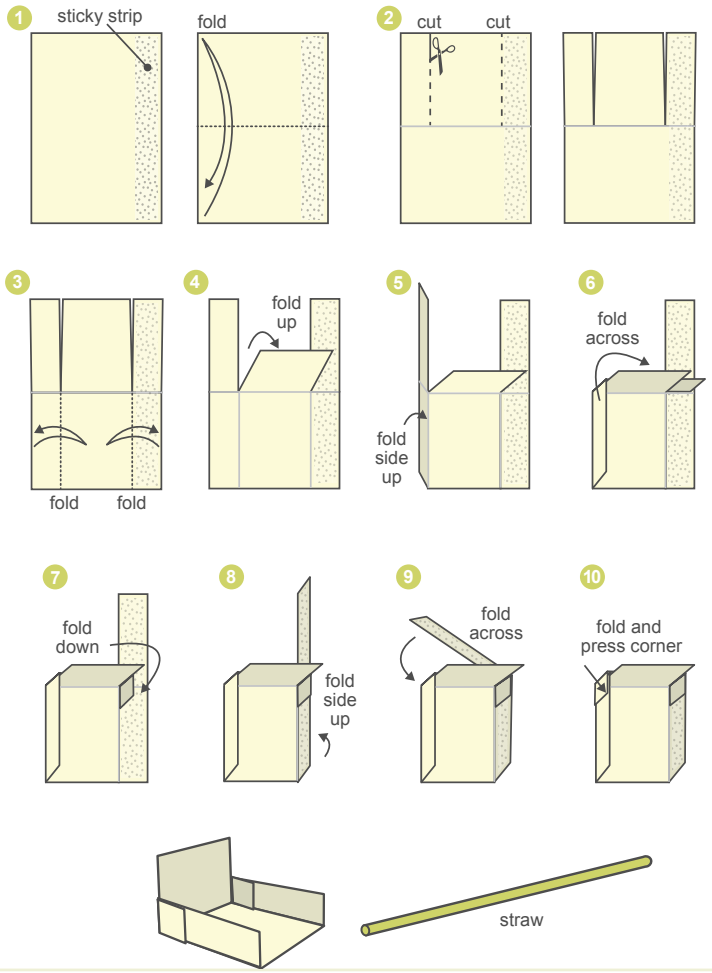
Make an air buggy

Instructions

Materials

- Sticky note — about 12 cm x 8 cm
- Scissors
- Drinking straw

Method



Hand out the sticky notes and scissors. Work through the construction of the air buggy step by step.

Do not labour over precise construction. Inconsistent size or shape is not a problem; in fact, it may promote useful discussion of the effect of variables.

When students finish their air buggy, give them a straw to begin testing. Demonstrate blowing through the straw to make the air buggy move. Keep the straw behind the starting line.

Allow a couple of minutes for students to play, exploring the way their air buggy moves.

The air buggies will probably move too far for this to be done on desks, so access to open floor space is needed.

If possible, provide access to different surfaces, e.g. carpet, vinyl, concrete.

Set up groups of two or three and allocate areas for competitions.

Explain Challenge 1: *Making the air buggy go the furthest possible distance.*

Encourage students to test different techniques and surfaces to maximise the distance. Note that accurate measuring or recording are not required at this stage.

Explain Challenge 2: *Making the air buggy go exactly 30 centimetres.*

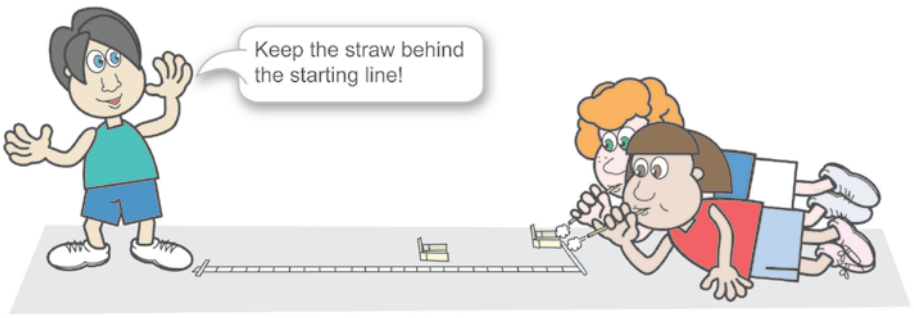
Allow time for students to play and refine their technique.

Note that guided play and exploration at this stage will provide students with the ideas they will use and refine in the assessment.

Air buggy competition

In groups of two or three, carry out these two challenges.

- **Challenge 1:** Who can make it go furthest?
- **Challenge 2:** Can you make it go exactly 30 centimetres?



Discussion

Talk about the way the air buggies moved, and answer this question:

How can forces affect the motion of your air buggy?

Discuss the questions below and add some of your own.

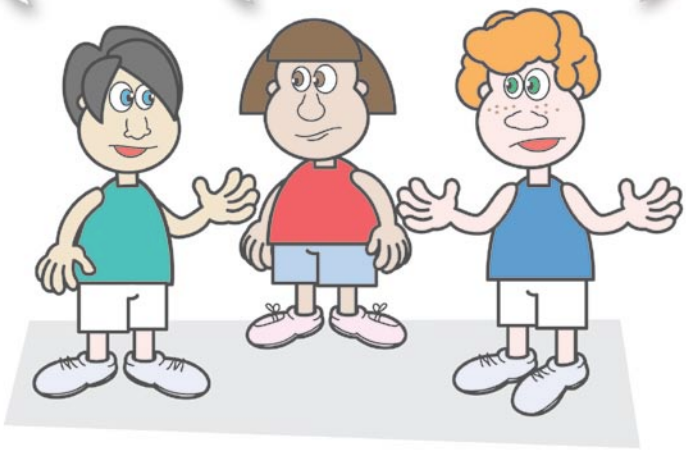
Forces and motion

- What are some different types of force?
- Can there be more than one force acting on an object at the same time?

Your questions

Science investigations

- When we tested our air buggies, why did the distance vary?
- Was it a fair test?
- What variables did we keep the same?



Elicit student responses to the discussion question.

Accept all responses without critique.

Discuss the questions being raised by the characters, and encourage students to verbalise any other questions they may have about how forces and motion relate to their air buggies.

Work through the Guide to making judgments on the last page of the Student booklet with students to highlight the assessable elements for this QCAT.

Explain, in student-friendly terms, the task-specific descriptors. These identify what is being valued in the student responses.

Suggested time: 10 minutes

As you work through the QCAT with students, check for understanding of the task and provide clarification as needed.

Where students ask individual questions, answers should be shared with all students wherever possible.

Explain that the assessment starts here.

Point out that students' play with their air buggies will have given them ideas about why the distance travelled changes so much.

Variables

The distance your air buggy travels is a bit different each time you test it.

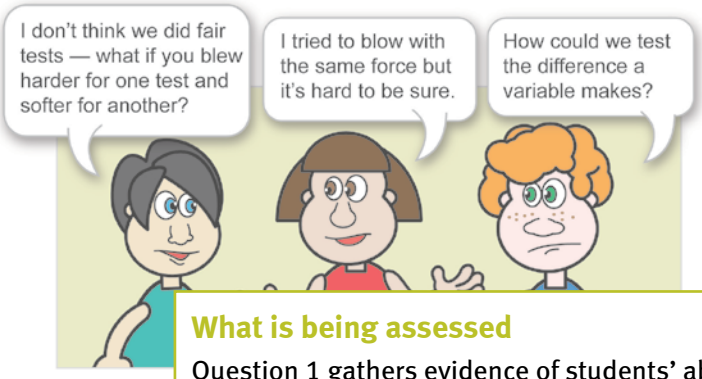
1. a) **Tick the variables that would change the distance travelled.**

   b) **Add some variables that you predict would affect the distance.**

Read the characters' conversation.

If appropriate for your class, select three students to do this in roleplay each time these characters appear through the assessment.

Discuss the scenario they present as a lead-in to the next section.



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What is being assessed

Question 1 gathers evidence of students' ability to identify variables that would affect the motion of an object. Possible responses for 1b include:

- forces on the buggy (duration of blow, direction of blow, angle of straw)
- buggy design (size, mass, material, symmetry)
- local conditions (texture of surface, prevailing wind).

Suggested time: 15 minutes

Testing variables

2. Select two variables that you predict will have a big effect on the distance travelled.

Write them in the Predict column of the table below.
Find out how these variables affect the distance your air buggy travels.

Method
Step 1. Blow through the straw to move the air buggy. **Step 2.** Check the distance it travels (you don't have to write down results). **Step 3.** Change Variable 1 and then blow again. **Step 4.** Compare the distance travelled, then complete the Observe and Explain column **Step 5.** Repeat Steps 1 to 4 with Variable 2.

Predict Name two variables that will affect the distance travelled.	Observe Describe the effect of the change on distance travelled.	Explain Use science ideas to explain your observation.
Example *How hard I blow through the straw.*	*The distance increased when I blew harder.*	*A larger force causes the object to move further.*
Variable 1		
Variable 2		

3. How did you control other variables in your investigations?

List some variables and explain your control methods.

Variable	Control method — how was it kept the same for each tes
•	•

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Ask students to complete the Predict column by selecting two relevant variables. Read the example together to clarify the kind of responses required.

Explain to students that they will do two simple fair tests. Read the method together and discuss. You may need to set guidelines on using the available space.

Literacy is not being assessed, so provide appropriate support throughout the assessment for students to understand procedures and questions and to record responses.

What is being assessed

Question 2 provides opportunities for students to identify relevant variables, test their effects, record observations, and link these to science concepts.

In Question 3, students demonstrate their ability to identify and control variables in a fair test.

Suggested time: 10 minutes

Explaining forces

4. a) **In the diagrams below, name the forces at work on the air buggy.**

Use force arrows to show their strength and direction.

e.g. small force 

large force 

Before **the air is blown**

While **the air is blowing**

Encourage students to include all the relevant forces that they can think of. They may vary the length and/or thickness of arrows to show relative strength of forces.

What is being assessed

Question 4 gathers evidence of students' understanding of:

- the forces that affect moving objects
- opposing and supporting forces.

In 4a, they also demonstrate their ability to communicate using annotated diagrams, force arrows and scientific terminology.

b) Explain how forces made your air buggy move.

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c) How do forces make a moving buggy slow down and stop?

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Encourage students to use conjunctions (e.g.“if”, “because”, “unless”) to develop reasoned explanations.

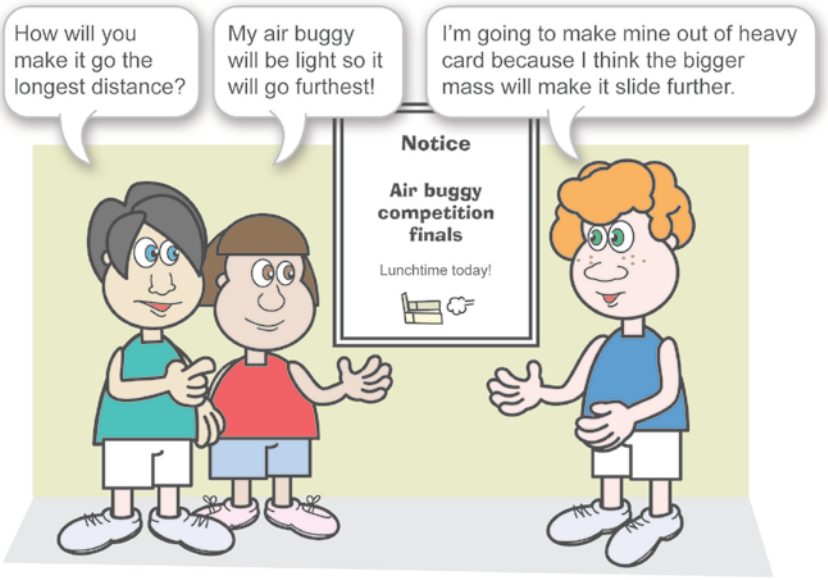
What is being assessed

In 4b and c, students explain their understanding of opposing and supporting forces in two related contexts.

Suggested time: 20 minutes

Read the characters' conversation and discuss the competition scenario that has been described.

Investigating



Read through and demonstrate the procedure.

Provide materials.

Note that you could save time by taping a set of tape measures to the floor prior to the assessment.

5. **Carry out the investigation below and record your results in the table on page 11.**

How does the mass of the air buggy affect the distance it travels?

Materials

- air buggy
- 4 paperclips
- straw
- ruler or tape measure

Method

Step 1. Place the buggy on a flat surface. Mark the starting position.
Step 2. Blow through the straw to move the air buggy (don't move the straw).
Step 3. Measure the distance the buggy travelled and record your results. Do this 3 times.
Step 4. Increase the mass of your air buggy by adding two paperclips. Repeat steps 1 to 3.
Step 5. Add two more paperclips. Repeat steps 1 to 3.
Step 6. Calculate the total and average for each data set.

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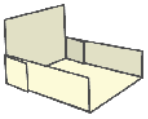
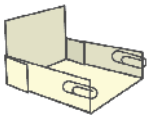
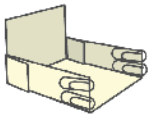
Investigation results				
Variable changed: mass of air buggy		Paperclips: 0 	Paperclips: 2 	Paperclips: 4 
Distance travelled (cm)	Trial 1			
	Trial 2			
	Trial 3			
Total (add three results)				
Average (total ÷ 3)				

Students collect data and record it in the table. They may use calculators to work out the totals and averages.

Note that mathematical accuracy is not being assessed.

6. **The question for investigation was:**

"How does the mass of the air buggy affect the distance it travels?"

a) Use your data to explain what you observed.

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b) Use your knowledge of forces to explain *why* that happened.

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c) How could you improve the investigation?

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What is being assessed

In Question 5, students demonstrate that they can collect data with appropriate accuracy and record it in a table.

In Question 6, students demonstrate how they can:

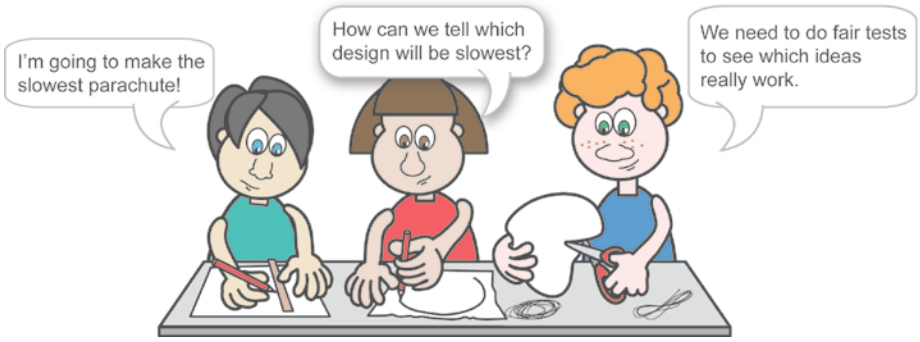
- use their data to make a concise observation
- link their observation to science concepts to draw a justified conclusion
- reflect on their practice to identify possible refinements in procedure.

Suggested time: 10 minutes

Read and discuss the scenario that is described on this page, especially the rules for the competition.

Applying your learning

These students are designing their model parachutes.



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7. Use your knowledge of forces and motion to describe how to design the slowest parachute.

How to make a parachute that falls slowly
a) Explanation
b) Diagram showing forces

Encourage students to reflect on their learning from the air buggy activities as they respond to these questions.

What is being assessed

Question 7 gathers evidence of students' ability to reflect on their learning and apply it to a new context.

They also document their knowledge and understanding of how different forces affect the motion of an object, and their ability to communicate using scientific terminology and an annotated diagram.

Suggested time: 20 minutes

Designing an investigation

- Think about the variables that would affect the speed of a parachute.
- Select one variable that you could test to see how much difference it made.

8. Design an investigation to test the effect of your selected variable.

Investigation plan
a) Complete the question for investigation: **How will changing the .....** **change the speed of my parachute?**
b) Hypothesis:
c) What will you change in your investigation?
d) What will you measure or observe?
e) What things will you keep the same to make it a fair test?
f) List the materials and equipment you will need.

Read through each step of Question 8 and clarify the task.

Note: If a student cannot think of a variable to include in 8a, write one (e.g. length of strings), making a note that this was a teacher suggestion, so that they are able to complete the rest of the question.

What is being assessed

In Question 8, students have an opportunity to demonstrate that they can design a scientific investigation, including a hypothesis, identification of relevant variables and the elements of a fair test.

g) List the steps for carrying out the investigation and collecting data.

Step 1.

Note that in Question 8, students plan an investigation but do not implement it in this assessment.

You may choose to give students a chance to try their investigations as a follow-up activity.

Reflecting

In this assessment, you have:

- carried out fair tests with your air buggy
- planned a fair test to investigate parachute design.

Suggested time: 5 minutes

9. a) What is a fair test?

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b) When investigating the effect of changing a variable, why would a scientist use a fair test?

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What is being assessed

In Question 9a, students document further evidence of their understanding of a fair test.

In Question 9b they have an opportunity to reflect on the relevance of this aspect of the nature of science, and to explain why it is important.

Making judgments

Use the Guide to making judgments (GTMJ) on the back page to grade student responses.

The Model response (page 27) and Sample responses are provided for reference purposes only. They each demonstrate possible responses and should be used to support the GTMJ.

Making judgments is not about determining whether one student's work is better than that of another. Rather, you should make standards-based judgments by matching evidence in student responses to descriptors in the GTMJ.

Read and consider all of the evidence in the student's responses before making and recording a judgment about the quality of the performance for each assessable element.

Additional resources Sample responses, QSA Assessment Bank
https://qcar.qsa.qld.edu.au/assessmentbank (registration required)

Using the GTMJ

This QCAT uses a continua-style GTMJ, where descriptors are placed along a continuum within each column.

Record a nil award of "N" only when there is insufficient evidence to make a judgment for an overall grade.

In the following diagrams:

- Diagram 1: Understanding the GTMJ points out the different parts of the GTMJ continua model
- Diagram 2: Using the GTMJ — the judgment process gives steps to follow when grading student responses.

Diagram 1: Understanding the GTMJ

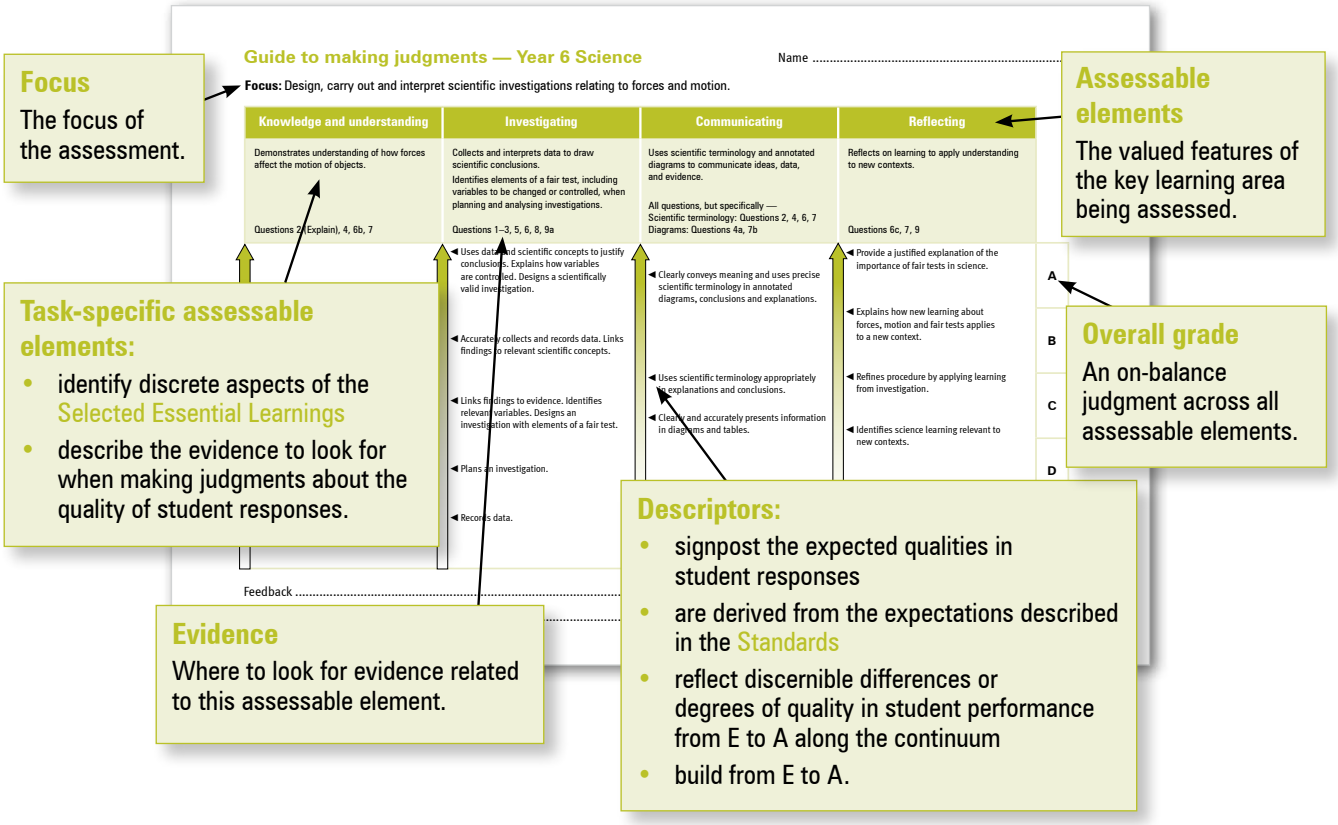
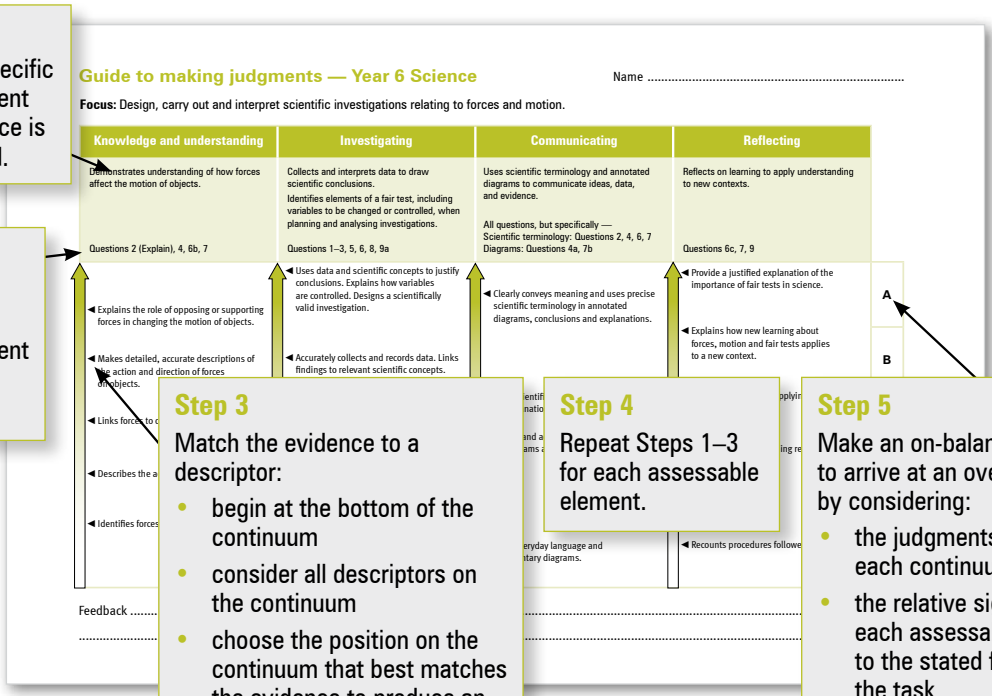


Diagram 2: Using the GTMJ — the judgment process

Step 1
Read the task-specific assessable element for which evidence is being considered.

Step 2
Locate all the evidence for an assessable element in the completed Student booklet.



Step 3
Match the evidence to a descriptor:

- begin at the bottom of the continuum
- consider all descriptors on the continuum
- choose the position on the continuum that best matches the evidence to produce an on-balance judgment for the assessable element
- look at Model and Sample responses for clarification if necessary.

Step 4
Repeat Steps 1–3 for each assessable element.

Step 5
Make an on-balance judgment to arrive at an overall grade by considering:

- the judgments recorded on each continuum
- the relative significance of each assessable element to the stated focus of the task.

Using feedback

Assessment alone will not contribute significantly to improved learning — it is what teachers and students do with the information gathered that makes the difference. Providing quality and useful feedback is a crucial step in using assessment information to support future learning.

Assessment feedback goes beyond a simple mark or grade. Comments on the strengths of students' achievements, and on areas for improvement, provide quality feedback that can be used to inform future teaching and learning. Assessment feedback is most helpful if the specific elements of the knowledge and skills are identified and specific suggestions are provided.

The information gathered from the implementation, marking and moderation of QCATs should feed back into future planning of teaching and learning.

Feedback to help students learn

Quality feedback to a student:

- focuses on their achievement in relation to either the assessable elements with their task-specific descriptors or the Selected Essential Learnings (page 25) and their associated questions
- includes strengths of achievements
- identifies areas for improvement and strategies for future learning
- is communicated in student-friendly language
- is appropriate (e.g. in quantity and detail) to the student's age and their capacity to respond
- includes the use of Sample responses to provide examples of the quality of work corresponding to each standard.

Feedback to help teacher planning

Individual and collective student performance on QCATs, along with other school-based assessment, can be used to inform teaching and learning.

Additional resources

Using feedback to inform teaching and learning
www.qsa.qld.edu.au/3163.html

Sample responses, QSA Assessment Bank
https://qcar.qsa.qld.edu.au/assessmentbank (registration required)

Resources

Selected Essential Learnings

This QCAT will assess what students know, understand and can do in relation to the following selection of Essential Learnings.

Science Essential Learnings by the end of Year 7	
Assessable elements The valued features of the key learning area about which evidence of learning is collected and assessed.	**Ways of working** The processes students use to develop and demonstrate their knowledge and understanding. Students are able to:
Investigating	• plan investigations, including identifying conditions for a fair comparison, variables to be changed and variables to be measured • collect and analyse first- and second-hand data, information and evidence • select and use scientific tools and technologies suited to the investigation • draw conclusions that summarise and explain patterns in data and are supported by experimental evidence and scientific concepts
Communicating	• communicate scientific ideas, data and evidence, using scientific terminology suited to the context and purpose
Reflecting	• reflect on learning, apply new understandings and identify future applications.
	Knowledge and understanding The essential concepts, facts and procedures.
Knowledge and understanding	***Energy and change*** **Forces and energy can be identified and analysed to provide explanations that benefit community lifestyles and decision making.** • The motion of an object changes as a result of the application of opposing or supporting forces.
Source: www.qsa.qld.edu.au/7297.html	

Connection to the Australian Curriculum

This QCAT connects to the following content descriptions of the Australian Curriculum.

The Australian Curriculum: Science		Version 1.2
Strands		**Content descriptions**
Science Understanding	Year 7	***Physical sciences*** • Change to an object's motion is caused by unbalanced forces acting on the object.
Science Inquiry Skills	Year 6	***Planning and conducting*** • With guidance, select appropriate investigation methods to answer questions or solve problems. • Decide which variable should be changed and measured in fair tests and accurately observe, measure and record data, using digital technologies as appropriate. ***Processing and analysing data and information*** • Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate. • Compare data with predictions and use as evidence in developing explanations. ***Evaluating*** • Suggest improvements to the methods used to investigate a question or solve a problem. ***Communicating*** • Communicate ideas, explanations and processes in a variety of ways, including multi-modal texts.
	Year 7	***Planning and conducting*** • Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed. • In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task. ***Processing and analysing data and information*** • Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate. • Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions. ***Evaluating*** • Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method. ***Communicating*** • Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate.

Source: Australian Curriculum, Assessment and Reporting Authority (ACARA) 2011, www.australiancurriculum.edu.au/Science
Resources: QSA 2011, www.qsa.qld.edu.au/13658.html

Model response

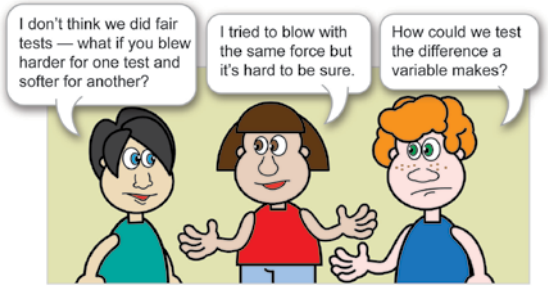
This Model response gives one example of a very high quality response for each question. The Sample responses, available for download from the QSA Assessment Bank, demonstrate the quality of student responses for each standard, A to E.

Variables

The distance your air buggy travels is a bit different each time you test it.

1. a) **Tick the variables that would change the distance travelled.**

   b) **Add some variables that you predict would affect the distance.**



Testing variables

2. **Select two variables that you predict will have a big effect on the distance travelled.**

   Write them in the Predict column of the table below.
   Find out how these variables affect the distance your air buggy travels.

Method

Step 1. Blow through the straw to move the air buggy.
Step 2. Check the distance it travels (you don't have to write down results).
Step 3. Change Variable 1 and then blow again.
Step 4. Compare the distance travelled, then complete the Observe and Explain column
Step 5. Repeat Steps 1 to 4 with Variable 2.

Predict Name two variables that will affect the distance travelled.	Observe Describe the effect of the change on distance travelled.	Explain Use science ideas to explain your observation.
Example *How hard I blow through the straw.*	*The distance increased when I blew harder.*	*A larger force causes the object to move further.*
Variable 1 surface of floor: rough or smooth	The buggy slid further on vinyl than on concrete.	Vinyl was smoother, so there was less friction forcing it to stop.
Variable 2 base of buggy: flat or creased	The crumpled one went further than the flat one.	The flat one had more contact with the floor so extra friction slowed it down.

3. **How did you control other variables in your investigations?**

   List some variables and explain your control methods.

Variable	Control method — how was it kept the same for each test?
• measuring • wind • mass of buggy • force of blow	• used same tape measure taped to floor • windows closed and fans off when measuring • used identical sticky notes • same person blows as hard as they can; straw is same distance from start line

Model response

Explaining forces

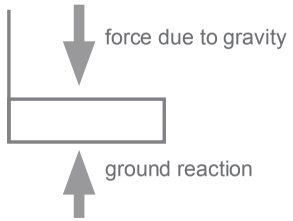
4. a) In the diagrams below, name the forces at work on the air buggy.

Use force arrows to show their strength and direction.

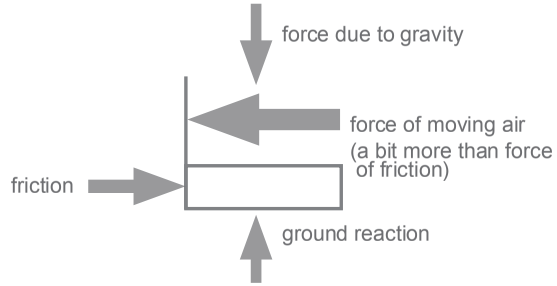
e.g. small force →

large force ➡

***Before* the air is blown**



***While* the air is blowing**



b) Explain how forces made your air buggy move.

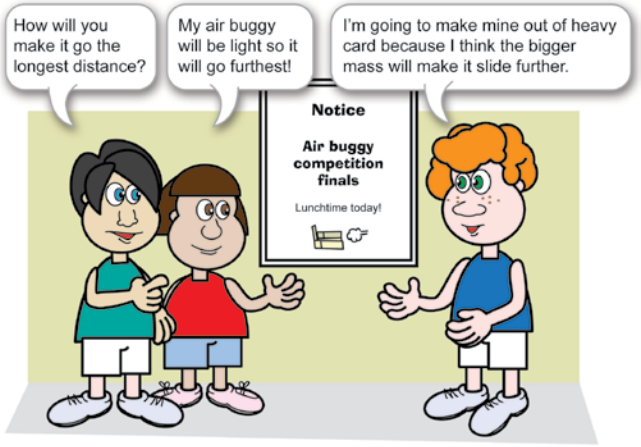
The force of the moving air pushed on the sail of the buggy and friction pushed in the opposite direction. When the force from the air was stronger, the buggy started to move.

c) How do forces make a moving buggy slow down and stop?

As the buggy moves away from the straw, there is less force of air pushing on the sail. Friction forces the buggy to slow and stop.

Model response

Investigating



5. **Carry out the investigation below and record your results in the table on page 11.**

How does the mass of the air buggy affect the distance it travels?

Materials

- air buggy
- 4 paperclips
- straw
- ruler or tape measure

Method

Step 1. Place the buggy on a flat surface. Mark the starting position.
Step 2. Blow through the straw to move the air buggy (don't move the straw).
Step 3. Measure the **distance** the buggy travelled and record your results. Do this 3 times.
Step 4. Increase the mass of your air buggy by adding two paperclips. Repeat steps 1 to 3.
Step 5. Add two more paperclips. Repeat steps 1 to 3.
Step 6. Calculate the **total** and **average** for each data set.

Note to teachers: There is no "correct" result. Buggies with 0, 2 or 4 paperclips may go furthest, depending on other variables.

An "A" response to this question is a clear explanation of the data.

Investigation results

Variable changed: mass of air buggy		Paperclips: 0	Paperclips: 2	Paperclips: 4
Distance travelled (cm)	Trial 1	11 cm	45 cm	9 cm
	Trial 2	37 cm	50 cm	11 cm
	Trial 3	42 cm	53 cm	28 cm
Total (add three results)		90 cm	148 cm	48 cm
Average (total ÷ 3)		30 cm	49.3 cm	16 cm

6. **The question for investigation was:**

"How does the mass of the air buggy affect the distance it travels?"

a) Use your data to explain what you observed.

With no clips, the buggy was very light and results were inconsistent. With 2 clips, the air buggy glides further. 4 clips was the shortest average distance.

b) Use your knowledge of forces to explain *why* that happened.

With no clips, the buggy started very fast but that made lots of wind resistance that slowed it quickly. When it had 2 clips it didn't start as fast but once it got moving the mass made it keep sliding. With 4 clips, there was not enough force from the air to make it move as fast or as far.

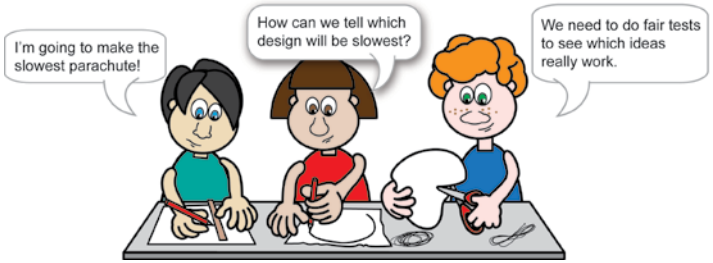
c) How could you improve the investigation?

Use a bike pump to blow the buggy so that the force is the same each time.

Model response

Applying your learning

These students are designing their model parachutes.



7. Use your knowledge of forces and motion to describe how to design the slowest parachute.

How to make a parachute that falls slowly

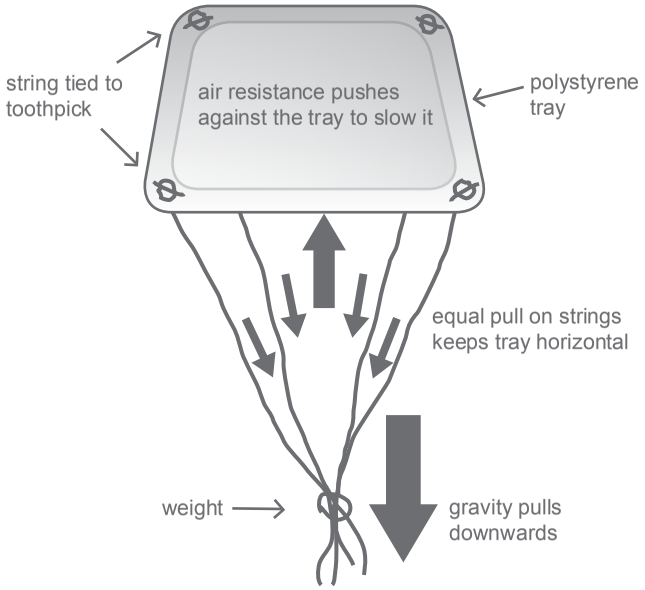
a) Explanation

Use a polystyrene tray, because it:

- stays flat (maximum air resistance)
- is lightweight (not much force of gravity pulling it down).

There still needs to be a weight on the strings to keep it horizontal. The weight and the length of the strings are variables that will affect the speed.

b) Diagram showing forces



Model response

Designing an investigation

- Think about the variables that would affect the speed of a parachute.
- Select **one** variable that you could test to see how much difference it made.

8. Design an investigation to test the effect of your selected variable.

Investigation plan
a) Complete the question for investigation: **How will changing the** ..... length of string ..... **change the speed of my parachute?**
b) Hypothesis: Longer strings are more vertical so will be better at forcing the parachute to stay horizontal (maximum air resistance) and make it fall more slowly.
c) What will you change in your investigation? I will change the length of string between the parachute and the weight.
d) What will you measure or observe? Record which parachute lands last.
e) What things will you keep the same to make it a fair test? Make two identical parachutes. Keep one the same and change only the string length on the other. Drop at the same time from the same height.
f) List the materials and equipment you will need. • 2 x polystyrene trays 30 x 30 cm • 2 x weights (metal bulldog clips) • 8 x 1 metre lengths of string • 8 x toothpicks to tie string onto • a high verandah with clear landing space below it

g) List the steps for carrying out the investigation and collecting data.

Step 1. Attach a 1 m length of string to each corner of both tiles.

Step 2. Use the clip to fasten the strings together at 50 cm on Parachute 1 and at 75 cm on Parachute 2.

Step 3. Make a table to record data.

Step 4. Drop both parachutes at the same time and record which lands first. Do this three times. Don't count the drop if a parachute hits anything on the way down.

Step 5. Move the clip on Parachute 2 to change the string length to 1 m and repeat Step 4.

Reflecting

In this assessment, you have:

- carried out **fair tests** with your air buggy
- planned a **fair test** to investigate parachute design.

9. a) What is a fair test?

A fair test is where you change one variable and measure its effect on a different variable. It's only "fair" if all other variables are kept the same.

b) When investigating the effect of changing a variable, why would a scientist use a fair test?

A fair test lets us see only one "cause and effect" in an investigation. If a test changes more than one variable, you can't tell which one made the "effect". If something important is being tested (like "Does this medicine work?"), a fair test allows us to be certain about the effect of each variable.

Guide to making judgments — Year 6 Science

Name .....

Focus: Design, carry out and interpret scientific investigations relating to forces and motion.

Knowledge and understanding	Investigating	Communicating	Reflecting	
Demonstrates understanding of how forces affect the motion of objects. Questions 2 (Explain), 4, 6b, 7	Collects and interprets data to draw scientific conclusions. Identifies elements of a fair test, including variables to be changed or controlled, when planning and analysing investigations. Questions 1–3, 5, 6, 8, 9a	Uses scientific terminology and annotated diagrams to communicate ideas, data, and evidence. All questions, but specifically — Scientific terminology: Questions 2, 4, 6, 7 Diagrams: Questions 4a, 7b	Reflects on learning to apply understanding to new contexts. Questions 6c, 7, 9	
◀ Explains the role of opposing or supporting forces in changing the motion of objects.	◀ Uses data and scientific concepts to justify conclusions. Explains how variables are controlled. Designs a scientifically valid investigation.	◀ Clearly conveys meaning and uses precise scientific terminology in annotated diagrams, conclusions and explanations.	◀ Provide a justified explanation of the importance of fair tests in science.	**A**
◀ Makes detailed, accurate descriptions of the action and direction of forces on objects.	◀ Accurately collects and records data. Links findings to relevant scientific concepts.		◀ Explains how new learning about forces, motion and fair tests applies to a new context.	**B**
◀ Links forces to different contexts.	◀ Links findings to evidence. Identifies relevant variables. Designs an investigation with elements of a fair test.	◀ Uses scientific terminology appropriately in explanations and conclusions. ◀ Clearly and accurately presents information in diagrams and tables.	◀ Refines procedure by applying learning from investigation. ◀ Identifies science learning relevant to new contexts.	**C**
◀ Describes the action of forces.	◀ Plans an investigation.			**D**
◀ Identifies forces.	◀ Records data.	◀ Uses everyday language and rudimentary diagrams.	◀ Recounts procedures followed.	**E**

Feedback .....

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