Get a grip

Student booklet

6

Science

Queensland Comparable Assessment Tasks (QCATs) 2010

Given name: .....

Family name: .....

School: .....

Queensland Government

Queensland Studies Authority

Queensland Studies Authority

Setting the scene: Group discussion

Friction in sport and recreation — useful or not?

The force of friction is very useful in some sports. You need friction to catch a ball or grip a bat. In other sports it can be a problem — friction slows down swimmers and makes balls roll to a stop.

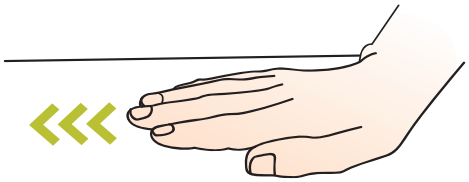
Talk about the pictures below:

- What forces are at work?
- What direction is each force working in?
- Where do these people want more friction, and where do they want less?

Images (left to right, top to bottom) shown here and on page 14 are Creative Commons: Attribution 2.0 Generic licensed photos <http://creativecommons.org/licenses/by/2.0> accessed 31 Mar 2010. **Skateboarding**: mikebaird's photostream, "5 of 6 national slalom skateboarding", <www.flickr.com/photos/mikebaird/2659707104>; **Rockclimber**: indywriter's photostream, "rock-climber", <www.flickr.com/photos/indywriter/3398967763>; **Cyclist**: sillygwailo's photostream, "Racer Turns the Corner at Giro di Burnaby 2007", <www.flickr.com/photos/sillygwailo/8566591>; **Runner**: Lochnagarth's photostream, "David Miller", <www.flickr.com/photos/87464242@N00/2380499669>; **Waterslide**: dichohecho's photostream, "The biggest, scariest slide", <www.flickr.com/photos/dichohecho/2677136998>; **Tug-of-war**: Steve Weaver's photostream, "Pull!", <www.flickr.com/photos/steveweaver/2915792034>.

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

Feel the friction



Place your hand flat on your desktop and push it across the surface.

Discuss these questions:

- Why does it grip the surface?
- If you press down harder, does that change the amount of grip?

Now try sliding your hand on different surfaces, such as wood, concrete, carpet, plastic.

- What differences do you notice?
- Which surfaces have the most grip, or make the most heat?

Make a class list of all the surface materials that were tested.

- Talk about which materials you think caused the most friction.
- Number the materials in order of the amount of friction you could feel.
  - Was it easy to agree on that order?
  - What could be a more scientific way to measure the force of friction?

Think about these questions and add some of your own, then discuss with the class.

Forces

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

Motion

- What makes things move?
- Why do they stop?
-

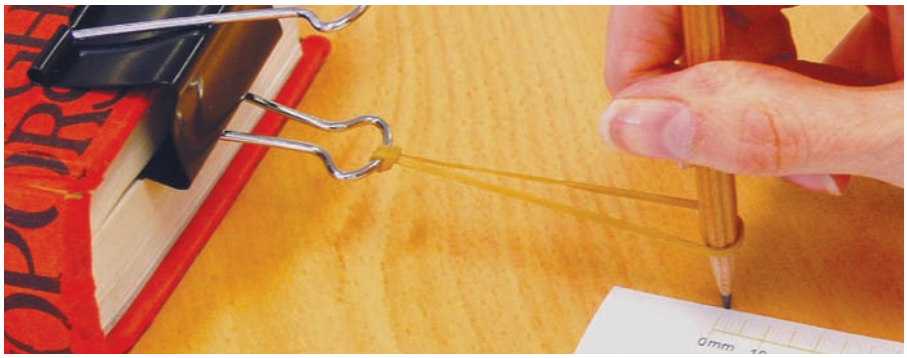
Science investigations

- When we measured friction with our hands, was it a fair test?
- How could we measure friction more accurately?
-

Stop here: Wait for your teacher's directions.

Measuring

Let's try a more scientific way to measure friction.

Investigation
Question for investigation: **How will changing the surface change the amount of force needed to slide an object?**
Materials 3 x surface materials: desktop, carpet, and one other (e.g. concrete, plastic), heavy book, ruler, rubber band, bulldog clip, pencil
Method This method uses a rubber band to measure different amounts of force. The more the rubber band stretches, the greater the force pulling on it. 1. Place the book on your desktop, then attach a clip to the book and loop a rubber band onto the clip. 2. Use a pencil to pull the rubber band out straight, but not stretched. Using the ruler on the next page, line up the "0" of the ruler with the end of the rubber band (see photo below). 3. Slowly stretch the rubber band until the heavy load *just* starts to move. 4. Write how many millimetres the rubber band stretched in Table 1. Do this three times. 5. Using the same load, repeat Steps 2 to 4 for each surface material. 

Predict

1. Before you start, make a prediction about what will happen.

a) I think that when the load is on ..... **it will need the most force**
(surface material)

to move it because .....

.....

b) I think that when the load is on ..... **it will need the least force**
(surface material)

to move it because .....

.....

Observe

2. Carry out the investigation and record your data in the table below.

Table 1: Comparing friction of different surface materials

		Variable changed: Surface material		
		desktop	carpet	other .....
Distance rubber band stretched (mm)	**Test 1**			
	Test 2			
	Test 3			
Total				
Average (Total ÷ 3)				

Explain

3. a) Order the surfaces from least to most friction on the line below.

....

least **most**

b) Tick (✓) the boxes below to show whether each variable was changed, measured, or kept the same in the investigation.

Variables	change	measure	keep the same
rubber band	☐	☐	☐
surface material	☐	☐	☐
mass of book	☐	☐	☐
distance rubber band stretched	☐	☐	☐
direction of pull	☐	☐	☐

c) Use your data to explain your answer to the question:
How will changing the surface change the amount of force needed to slide an object?

Use these words in your answer: **force**, **friction**, **surface**.

.....

.....

.....

d) Why was each surface tested three times?

.....

.....

.....

Reducing friction

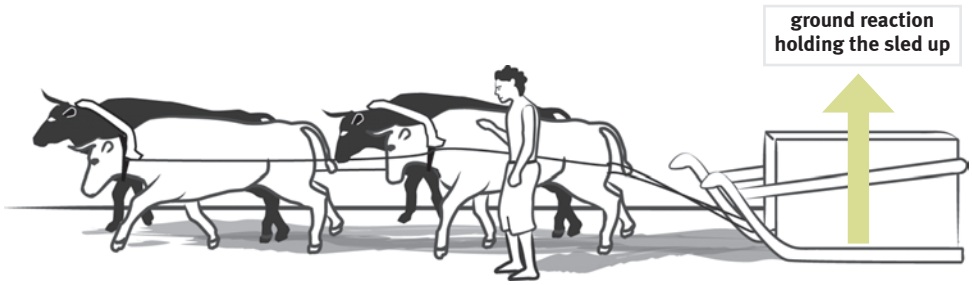
When the ancient Egyptians were building the pyramids, one of their methods for moving the massive blocks of stone was a sled pulled by oxen.

In the diagram below, one of the forces at work has been shown.

4. a) Add arrows and labels to the drawing to show:

- **the other forces at work**
- **the direction they are acting in.**

Include the forces due to: **gravity**, **friction** and **pull of rope**.



b) Use the words "force", "motion" and "friction" to explain what is happening in the diagram above.

.....

.....

.....

.....

.....

The Egyptians reduced friction by sprinkling water or sand under the sled, or by using wooden rollers.

c) Repeat the investigation from page 4 using your desktop as the surface, but this time put some round pencils or pens under the load. Record your data in the table.

Table 2: Moving a load on rollers

How far will the rubber band stretch?		Load resting on rollers
Distance rubber band stretched (mm)	**Test 1**	
	Test 2	
	Test 3	
	Total	
	Average (Total ÷ 3)	

d) When the load was on rollers, there was more / less **friction.**
(circle one)

I think this was because .....

.....

.....

.....

.....

How useful is friction?

Rub your hands together hard for 10 seconds.

Discuss these questions:

- Why do they feel warmer?
- Where do you think the heat comes from?

You have felt how friction can make things hot.

Indigenous Australians can use friction to make fire.

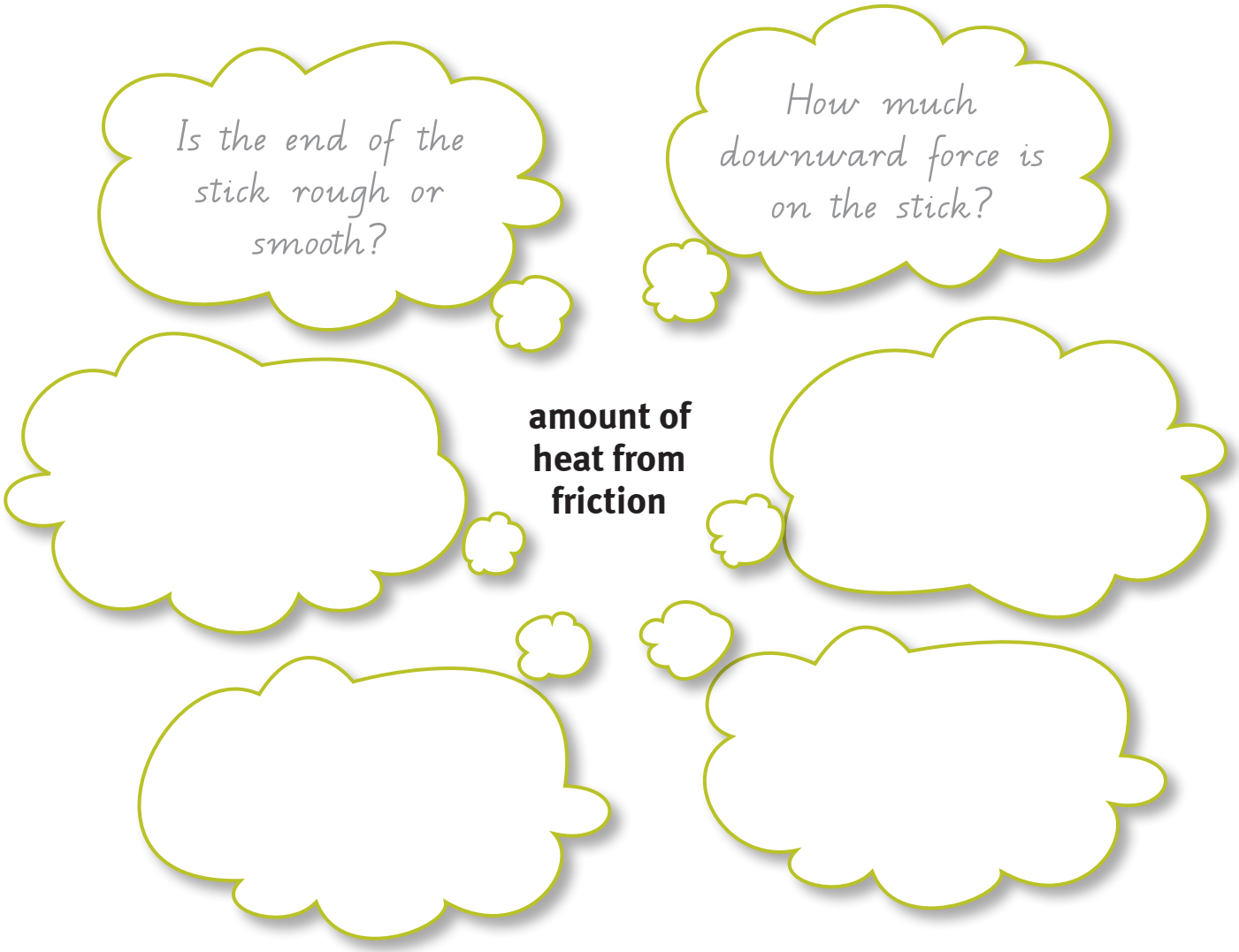
Making fire

Read about the traditional way to make fire using two sticks.

- Twirl a straight stick between the hands, with the end in a hollow in a piece of soft wood.
- Spin it fast and push down hard at the same time.
- Lay a bunch of very dry grass around the hollow.
- When a glowing ember forms in the hollow, tip it onto the dry grass and blow on it until flames appear.

There are many variables that affect the heat from rubbing two sticks. Two are written below.

5. a) Add some more questions about variables that would affect the amount of heat from friction.



b) Select one variable from Question 5a and explain how it changes the amount of heat.

I think ..... **affects the amount of heat**

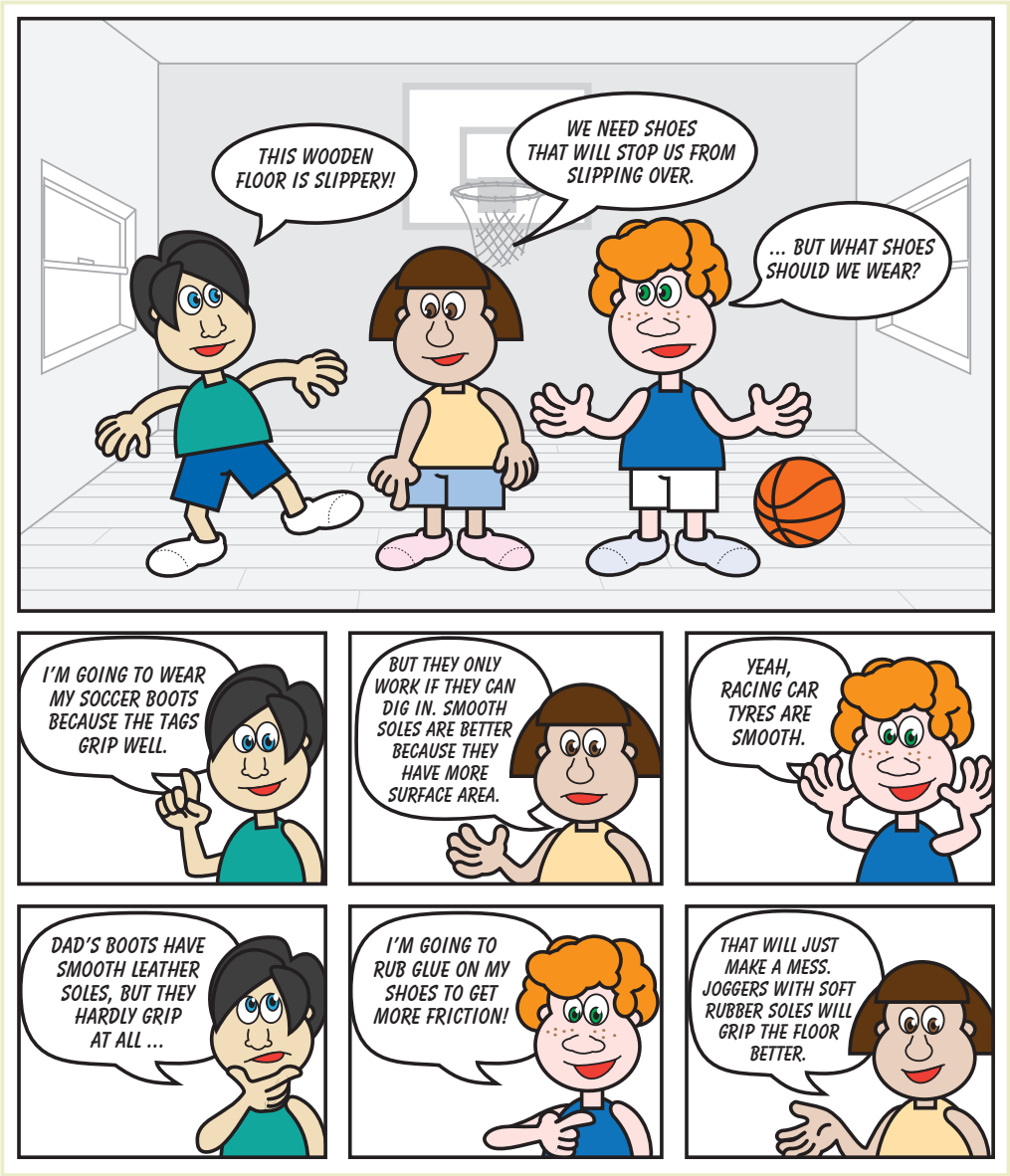
because .....

.....

Stop here: Wait for your teacher's directions.

Which shoes grip best?

In this section, you will use your knowledge of force, motion and of scientific investigation to solve a problem about friction.



6. Think about how science could help these children decide which shoes are best.

- Circle one idea in the comic strip that you agree or disagree with.
- Use scientific ideas to explain why you think it is right or wrong.

I agree / don't agree (circle one) **that**.....

because .....

.....

.....

Think about what you know about forces and about investigating.

7. What scientific ideas could help solve the problem "Which shoes grip the floor best?"

Look back over the earlier pages of this booklet.

a) Ideas about force and motion	b) Ideas about planning an investigation
•	•

Choose your shoes

In the next section, you will design a fair test to compare the grip of two shoes.

8. Decide on two different types of shoe you could test.

- Draw the soles of the shoes.
- Label your drawings to show how they are different.

Shoe 1	Shoe 2

Investigation

9. Plan an investigation to test the friction of shoes.

Design an investigation comparing two types of shoe to find which one grips the floor best.

Investigation plan		
a) Complete the question for investigation. **Question for investigation:** **How will changing the type of shoe change** .... **?**		
b) Hypothesis:		
c) What scientific ideas can you use to justify your hypothesis? (Your notes in Question 7 may help.) •		
d) What will you **change** in your investigation?	e) What will you **measure** or **observe**?	f) What things will you keep the **same**?

g) List the materials and equipment you will need.

h) Draw a labelled diagram to show how you will set up the investigation.

i) List the steps for carrying out the investigation.

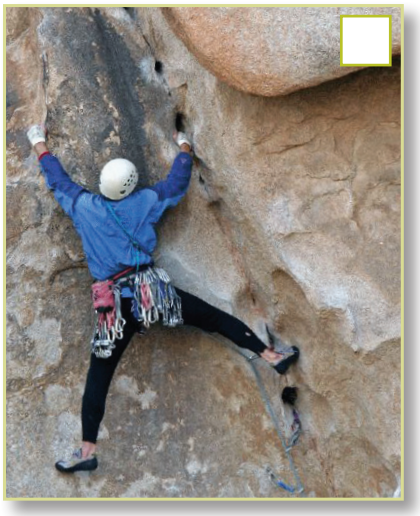
1.

j) Explain how you will ensure that this is a fair test.

Think about how friction affects performance in the activities shown below.

10. Tick one of the pictures. Explain how friction could be increased or decreased to improve performance in that activity.

- Use scientific words and ideas.
- Present your ideas in the spaces on the opposite page.



Annotated diagram showing forces

Explanation

.....

.....

.....

.....

.....

.....

.....

.....

.....

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 forces and motion. Questions 1, 4a, 4b, 5b, 6, 7a, 9c, 10	Collects and interprets data to draw scientific conclusions. Identifies elements of a fair test when planning and analysing investigations. Questions 2, 3, 4c, 4d, 5a, 7b, 9	Uses scientific terminology, tables and diagrams to communicate information, explanations, conclusions and investigation plan. Scientific terminology: Questions 1–10 Tables: Questions 2, 4c Diagrams: Questions 4a, 8, 9h, 10	Reflects on learning to apply understanding to new contexts. Questions 6, 7, 10	
◀ Demonstrates understanding of opposing or supporting forces in explanations.	◀ Designs a scientifically valid investigation. Applies and explains elements of a fair test including identification of variables to be changed, measured and controlled.	◀ Clearly conveys meaning and makes extensive use of scientific terminology in detailed diagrams, tables, conclusions and justifications.	◀ Provides detailed explanations of the way new learning about forces, motion and fair tests applies to new contexts.	A
◀ Makes detailed, accurate descriptions of the action of forces on moving objects.	◀ Accurately collects and records data. Explains findings by applying relevant scientific concepts.	◀ Uses scientific terminology appropriately in explanations and conclusions.	◀ Links diverse contexts to the same scientific idea.	B
◀ Correctly describes action of forces in different contexts.	◀ Designs an investigation with most elements of a fair test. Links findings to scientific concepts of force or motion.	◀ Clearly and accurately presents data in diagrams and tables.	◀ Identifies science learning relevant to problem scenarios.	C
	◀ Plans an investigation.			D
◀ Identifies forces in a given context.	◀ Collects data. Identifies variables in an investigation.	◀ Uses everyday language and rudimentary diagrams.	◀ Bases ideas on personal opinion or preconceptions.	E

Feedback .....

.....