Investigation 1
Ripper rides

About the Investigation

This Investigation involves the design of a geometric pattern featuring triangles; horizontal, vertical, parallel and intersecting lines; angles and tessellating and transformed shapes. The Investigation is highly engaging as surfboards, skateboards and snowboards appeal to many students. Students will enjoy investigating various designs to produce a colourful model with a geometric pattern that fits the design brief.

Planning the Investigation

Expected duration of Investigation:
3 to 4 weeks

Recommended group size:
2 to 3 students

Students will need:
- ☆ **BLMs 1.1–1.3** – *Blank board shapes*
- ☆ internet access
- ☆ coloured pencils
- ☆ paints
- ☆ ruler
- ☆ surf, skate or snowboard magazines

Topics for this Investigation

Before starting the Investigation, teach the following Topics...

NA23 Equivalent fractions
NA33 Investigating patterns
MG12 Area
MG13 Area of irregular shapes
MG14 Angles
MG16 Tessellation

ISBN 978 1 74135 172 9

Curriculum match for Investigation 1

The table below shows how the Topics in Investigation 1 match the content requirements of the Australian Curriculum.

Content descriptions	iMaths 4 Topics
Number and Algebra	
Fractions and decimals	
• Investigate equivalent fractions used in contexts.	**NA23** Equivalent fractions
Patterns and algebra	
• Explore and describe number patterns resulting from performing multiplication.	**NA33** Investigating patterns
Measurement and Geometry	
Using units of measurement	
• Compare objects using familiar metric units of area and volume.	**MG12** Area
Shape	
• Compare the areas of regular and irregular shapes by informal means.	**MG12** Area **MG13** Area of irregular shapes
Location and transformation	
• Create symmetrical patterns, pictures and shapes with and without digital technologies.	**MG16** Tessellation
Geometric reasoning	
• Compare angles and classify them as equal to, greater than or less than a right angle.	**MG14** Angles

The table below shows how students will apply the proficiency strands during each task in this investigation.

Proficiency strands	Investigation 1 criteria
Understanding, Fluency and Problem Solving	**Step 3:** Calculate $\frac{3}{4}$ of the area of the board. **Step 4:** Plan a board design using all of the required geometric elements. **Step 4:** Transfer the design onto a template of a board.
Reasoning	**Step 5:** Explain the design. **Step 5:** Prove that $\frac{1}{4}$ of the board has been left blank for a solid colour. **Step 5:** Justify the choice of boards. Explain how they have included all of the geometric elements that were required.

ISBN 978 1 74135 172 9

Investigation 1 Ripper rides

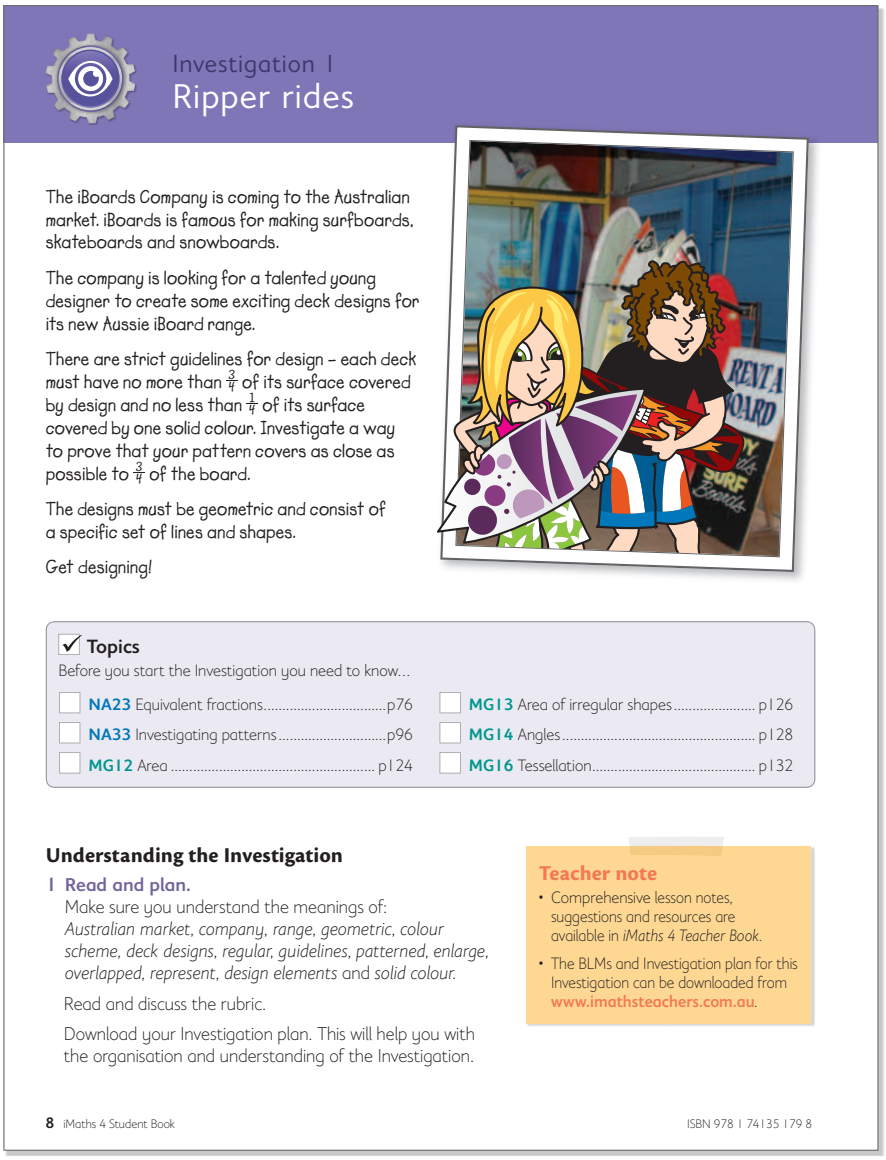
Essential word list

Students will need to understand the following terms:

- ☆ Australian market
- ☆ company
- ☆ range
- ☆ geometric
- ☆ colour scheme
- ☆ deck designs
- ☆ regular
- ☆ guidelines
- ☆ patterned
- ☆ enlarge
- ☆ overlapped
- ☆ represent
- ☆ design elements
- ☆ solid colour

The rubric

Read and discuss the rubric. Discuss the criteria and have students identify which step of the Investigation each one is describing. The rubric should be revisited after the *Understanding the Investigation* stage, both during and after the *Using maths* stage and during the *Reasoning and reporting* stage.



Investigation 1
Ripper rides

The iBoards Company is coming to the Australian market. iBoards is famous for making surfboards, skateboards and snowboards.

The company is looking for a talented young designer to create some exciting deck designs for its new Aussie iBoard range.

There are strict guidelines for design – each deck must have no more than $\frac{3}{4}$ of its surface covered by design and no less than $\frac{1}{4}$ of its surface covered by one solid colour. Investigate a way to prove that your pattern covers as close as possible to $\frac{3}{4}$ of the board.

The designs must be geometric and consist of a specific set of lines and shapes.

Get designing!

Topics

Before you start the Investigation you need to know...

- NA23 Equivalent fractions p76
- NA33 Investigating patterns p96
- MG12 Area p124
- MG13 Area of irregular shapes p126
- MG14 Angles p128
- MG16 Tessellation p132

Understanding the Investigation

1 **Read and plan.**

Make sure you understand the meanings of: *Australian market, company, range, geometric, colour scheme, deck designs, regular, guidelines, patterned, enlarge, overlapped, represent, design elements* and *solid colour.*

Read and discuss the rubric.

Download your Investigation plan. This will help you with the organisation and understanding of the Investigation.

Teacher note

- Comprehensive lesson notes, suggestions and resources are available in *iMaths 4 Teacher Book.*
- The BLMs and Investigation plan for this Investigation can be downloaded from www.imathsteachers.com.au.

8 iMaths 4 Student Book

ISBN 978 1 74135 179 8

1 Read and plan.

Read the introductory text and discuss the premise of the Investigation.

Teach the Topics (concepts) that provide the knowledge required to complete the Investigation.

Re-read the introductory text and each step of the Investigation. Discuss any procedures to be used, how data will be organised and how solutions will be communicated.

Discuss new terms in the context of the Investigation.

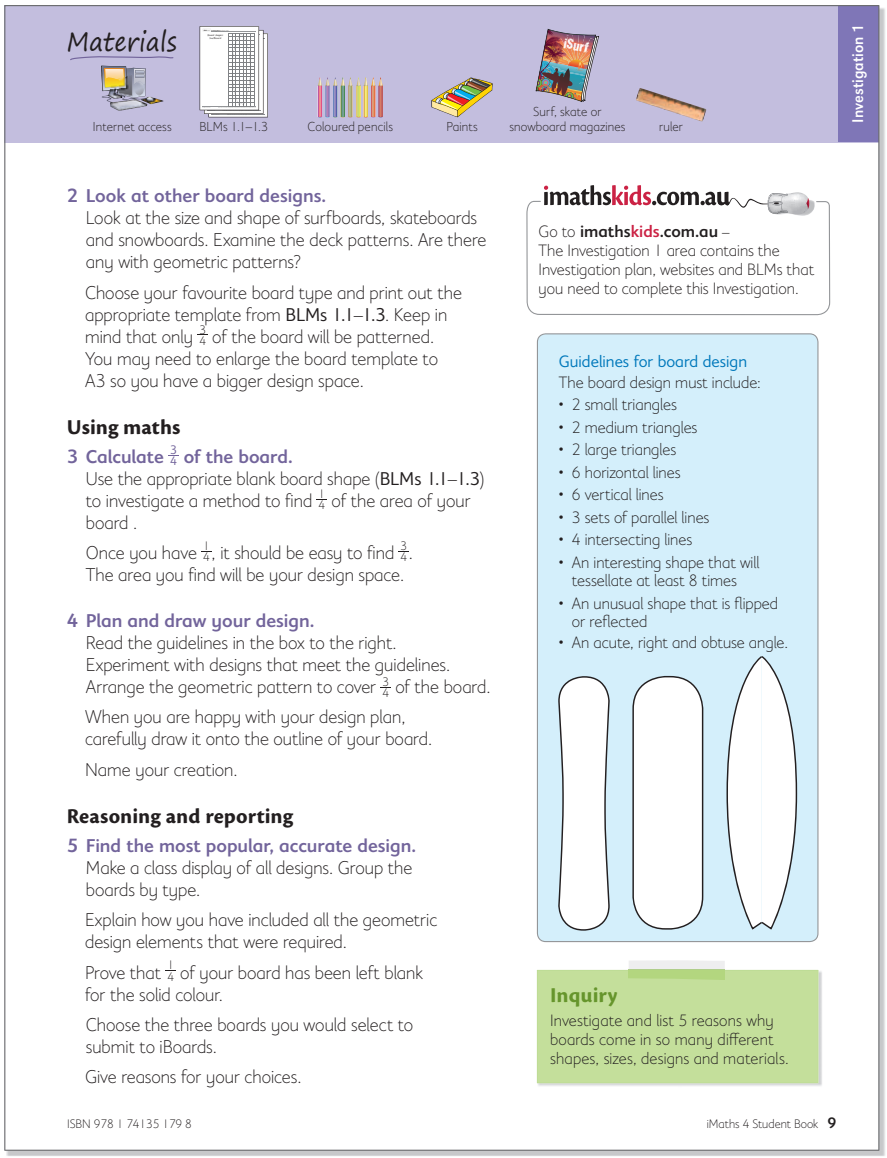
Read and discuss the rubric. Clarify the criteria to be assessed. This rubric should be revisited throughout the investigative process.

Go to imathsteachers.com.au and print a copy of the Investigation plan for each student. Work through the plan as a class, in small groups or individually.

Focus questions

- What is this Investigation asking you to do?
- Which Topics are really important to this Investigation?
- What do you think you will be good at?
- What do you think you will need help with?
- Do you understand the meanings of the words on page 8?

ISBN 978 1 74135 172 9



Materials

Internet access BLMs 1.1–1.3 Coloured pencils Paints Surf, skate or snowboard magazines ruler

Investigation 1

2 Look at other board designs.

Look at the size and shape of surfboards, skateboards and snowboards. Examine the deck patterns. Are there any with geometric patterns?

Choose your favourite board type and print out the appropriate template from **BLMs 1.1–1.3**. Keep in mind that only $\frac{3}{4}$ of the board will be patterned. You may need to enlarge the board template to A3 so you have a bigger design space.

Using maths

3 Calculate $\frac{3}{4}$ of the board.

Use the appropriate blank board shape (**BLMs 1.1–1.3**) to investigate a method to find $\frac{1}{4}$ of the area of your board .

Once you have $\frac{1}{4}$, it should be easy to find $\frac{3}{4}$. The area you find will be your design space.

4 Plan and draw your design.

Read the guidelines in the box to the right. Experiment with designs that meet the guidelines. Arrange the geometric pattern to cover $\frac{3}{4}$ of the board.

When you are happy with your design plan, carefully draw it onto the outline of your board.

Name your creation.

Reasoning and reporting

5 Find the most popular, accurate design.

Make a class display of all designs. Group the boards by type.

Explain how you have included all the geometric design elements that were required.

Prove that $\frac{1}{4}$ of your board has been left blank for the solid colour.

Choose the three boards you would select to submit to iBoards.

Give reasons for your choices.

imathskids.com.au

Go to **imathskids.com.au** – The Investigation 1 area contains the Investigation plan, websites and BLMs that you need to complete this Investigation.

Guidelines for board design

The board design must include:

- 2 small triangles
- 2 medium triangles
- 2 large triangles
- 6 horizontal lines
- 6 vertical lines
- 3 sets of parallel lines
- 4 intersecting lines
- An interesting shape that will tessellate at least 8 times
- An unusual shape that is flipped or reflected
- An acute, right and obtuse angle.

Inquiry

Investigate and list 5 reasons why boards come in so many different shapes, sizes, designs and materials.

ISBN 978 1 74135 179 8

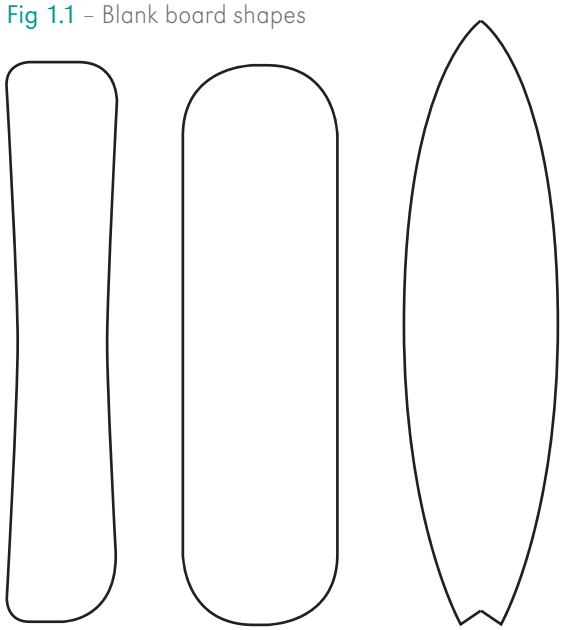
2 Look at other board designs.

For this part of the Investigation, print some sample copies of the blank board shapes from **BLMs 1.1–1.3**. Students will choose which board shape they want to use. It is suggested that you enlarge these to A3 size for the students.

Students can visit imathskids.com.au, click on Investigation 1 and follow the links to the websites listed to find pictures of boards and their deck patterns. Encourage students to only use these websites to find samples of board designs. These sites have been carefully selected for their suitability. If students are doing a random search of board designs on the internet, it is advisable to carefully monitor the use of these sites as some designs, especially those on commercially produced skateboards, may be unsuitable for students to view.

Ask students to choose which board they would like to design and enlarge a copy of the blank board shape to A3 for them to use (see Fig 1.1). Some students may prefer to design their own board shape.

Fig 1.1 – Blank board shapes



ISBN 978 1 74135 172 9

Investigation 1 Ripper rides

3 Calculate $\frac{3}{4}$ of the board.

Students have been asked to investigate a way to cover $\frac{3}{4}$ of their chosen board with their pattern. Revise the concept of quarters with the class.

Visually represent $\frac{1}{4}$, $\frac{2}{4}$, $\frac{3}{4}$ and $\frac{4}{4}$. Brainstorm ways students could divide the board into four equal sections (quarters).

If the board is standing upright, it could be divided roughly into four equal parts by ruling down the centre line and then across the middle, forming a cross.

Because of the irregular shape of the boards, it will be difficult to find equal quarters if students rule all horizontal lines or all vertical lines. Lead students to discover this concept by visual demonstration.

The blank board shapes (**BLMs 1.1**–**1.3**) have a superimposed squared grid. In order to determine $\frac{1}{4}$, students should count the total squares that cover the board. Some students might be able to join some part squares to form full squares and adjust the total accordingly. The total then needs to be divided by 4. This number of squares will represent $\frac{1}{4}$. Students should multiply this number by 3 to find $\frac{3}{4}$.

Figs 1.2–1.4 show calculations of the areas of the three blank board shapes, based on the number of grid squares that cover each one. Students may calculate different areas, depending on how they estimate the coverage of partial squares.

Before designing their geometric patterns, students should identify the positioning and shape of the area that their design will cover. This will inform the dimensions of their design.

Encourage students to colour (mask) the $\frac{1}{4}$ area of the board that won't contain the design. The remaining area will make up the space for their design.

Focus question

- How could you divide the area of your board into four equal parts?

Fig 1.2 – Area of surfboard shape

57 whole squares

30 part squares
= approx 15 squares

Total squares = 72

$\frac{1}{4}$ = 18 squares

$\frac{3}{4}$ = 54 squares

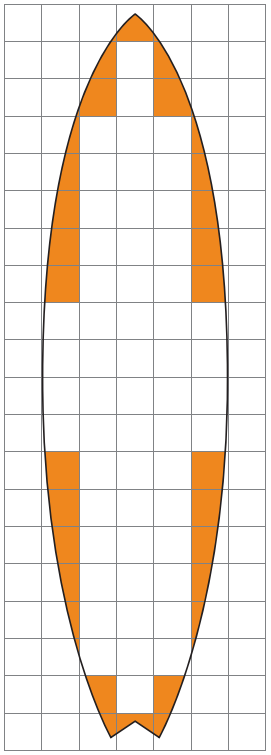


Fig 1.3 – Area of snowboard shape

50 whole squares

20 part squares
= approx 4 squares

Total squares = 54

$\frac{1}{4}$ = $13\frac{1}{2}$ squares

$\frac{3}{4}$ = $40\frac{1}{2}$ squares

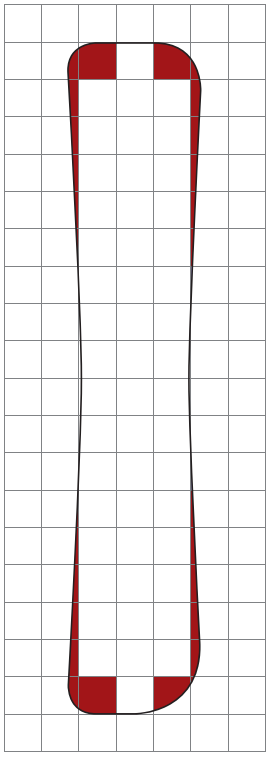


Fig 1.4 – Area of skateboard shape

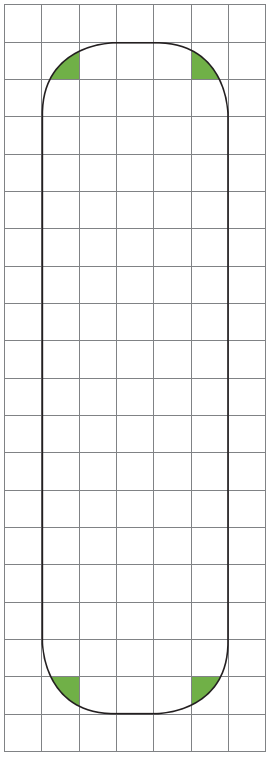
86 whole squares

4 part squares
= approx 2 squares

Total squares = 88

$\frac{1}{4}$ = 22 squares

$\frac{3}{4}$ = 66 squares



ISBN 978 1 74135 172 9

4 Plan and draw your design.

Students have been asked to create a geometric design that will cover $\frac{3}{4}$ of their boards. This task therefore is multidimensional.

Students must consider where and how to place all the necessary geometric features, which include:

2 small triangles
2 medium triangles
2 large triangles (these might look interesting overlapped!)
6 horizontal lines
6 vertical lines
3 sets of parallel lines
4 intersecting lines
An interesting shape that will tessellate at least 8 times
An unusual shape that is flipped or reflected
An acute, right and obtuse angle.

Students must also consider the fact that the design must only cover $\frac{3}{4}$ of the board.

Encourage thoughtful placement of design elements. Placements must have an aesthetic purpose, and not just occur randomly. Geometric features might make an abstract picture or a symmetrical design. Words or symbols might be formed by lines, angles or shapes. The size and shape of the area left after $\frac{1}{4}$ of the board shape has been masked will inform the composition of the design.

Problem solving

Students could use the *draw a picture or diagram* problem solving strategy in the design stage to get a better feel for their overall design.

By drawing a rough sketch first and delineating the $\frac{3}{4}$ of the board they are going to design, students can more easily see how large or small each geometric design element needs to be.

Rough diagrams should be reworked and discarded until students are happy with the overall concept.

Allow students plenty of time to experiment with the use of the geometric elements listed. Students should think about balance, colour, effect and appeal. Students could use a drawing program, basic shapes in a word processing program or hand draw and colour each element.

Encourage students to reflect on the suitability of their designs and check off each of the required elements. They may like to make several sketches before they decide on the final design. Remind students that their designs may contain elements other than those listed, as long as all the listed elements are included.

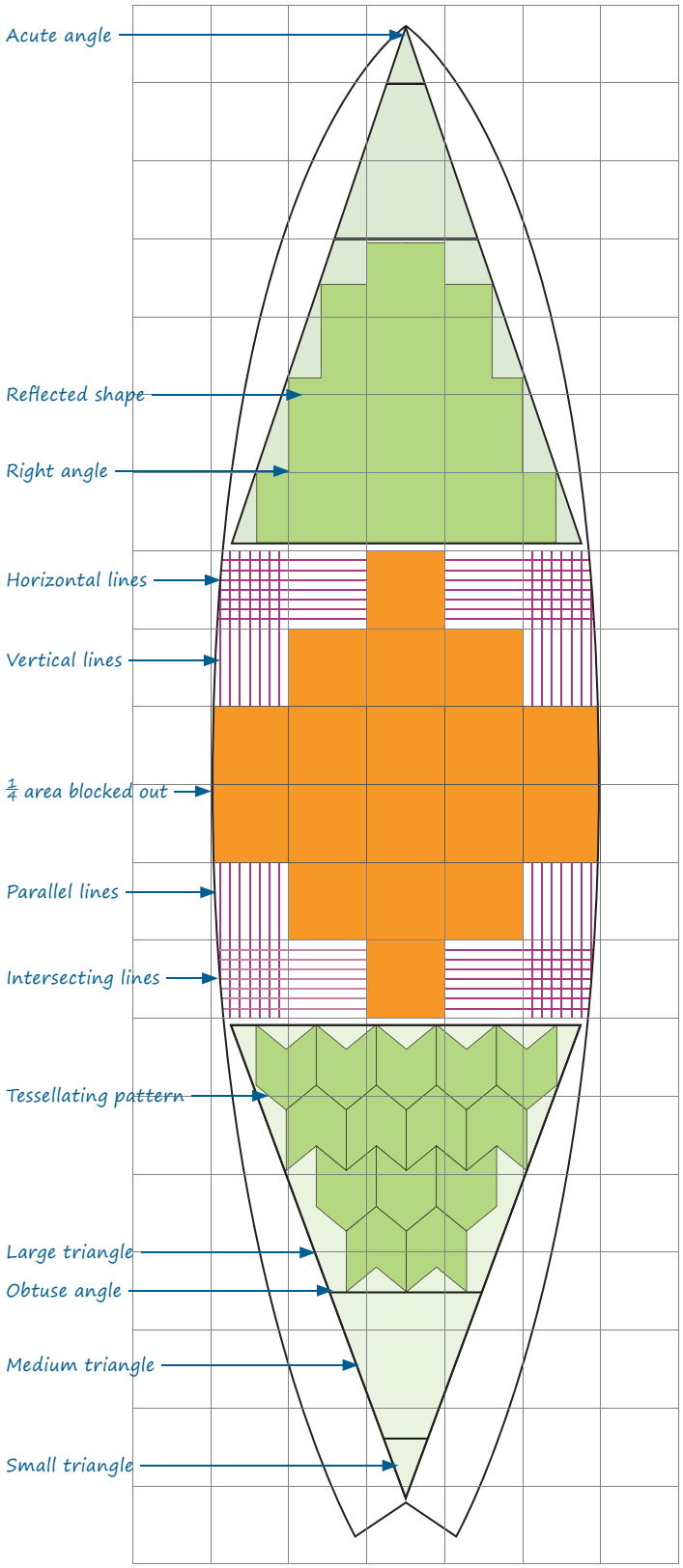
Final design

The final design could be drawn onto the enlarged board shape template (see Fig 1.5), or transferred onto a solid base of cardboard or plywood. Ply or solid card could be painted a base colour. The design could be drawn and cut out, and then glued onto the ply or solid card.

Encourage students to take care when producing their final designs. They should use a ruler to ensure lines are straight.

Before the creations are named, brainstorm vocabulary associated with surfboards, skateboards and snowboards. From these, the students could name their creation, for example *Surf Skimmer*, *Speed Skate* or *Snow Swish*. Allow students to look at samples of brand names before they choose a name and place it on their design.

Fig 1.5 – Example design



ISBN 978 1 74135 172 9

5 Find the most popular, accurate design.

The class will arrange a display of their boards grouped by type. The final product should reflect mathematical accuracy and design appeal.

Students could make a table listing all the geometric design elements that were required.

Students should explain the method they used to ensure only $\frac{3}{4}$ of the board was covered.

As a class or group, students will select three boards to submit to iBoards. Individually, students should offer reasons for these choices.

Making connections
Discuss the following questions to encourage students to apply what they have learned in this Investigation to other everyday situations.

- Why do you think skateboards, surfboards and snowboards have designs on them?
- What other items contain pattern designs?
- How do design artists use font and colour to create brand names?
- Which of your favourite logos or designs use geometric patterns?

Communicating and reflecting

The following questions are designed to help you assess students' understanding of what they have learned in this Investigation. When conferencing with students about their designs, ask:

- Which of your shapes is tessellating? What properties does it have that allow it to tessellate?
- How could you show or prove that these elements are: parallel, tessellating or reflecting?
- How is your design geometric?
- What method did you use to ensure that $\frac{1}{4}$ of the board was left?
- How much of the board would $\frac{1}{3}$ be?
- If iBoards was really going to turn one of the student designs into a board, why should they choose yours?

Students should submit:

- ☐ draft design plans for their iBoard
- ☐ final iBoard design, including all required elements
- ☐ proof that $\frac{1}{4}$ of the board has been left blank
- ☐ written statement justifying the selection of three iBoards.

Inquiry

Students who need an extra challenge could be engaged in the following activity, which extends the application of the Topics used in this Investigation.

Investigate and list 5 reasons why boards come in so many different shapes, sizes, designs and materials.

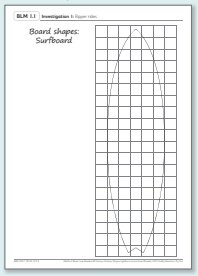
A board manufacturer needs to take into account a variety of conditions, such as:

- the age, size, mass and ability of user
- the surf, snow or park conditions
- the type of use (speed, leisure, accuracy, tricks, technique etc)
- transport requirements (light but strong)
- the cost
- whether they are mass produced
- changing trends and fashions
- the need for durability, ruggedness and toughness
- the appeal of colour, logo and design.

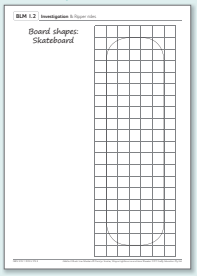
Black Line Masters

Black Line Masters are exclusive to classes that booklist iMaths Student Books.
Download them from imathsteachers.com.au.

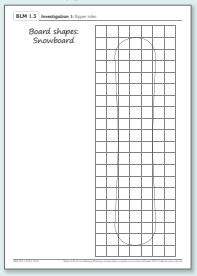
BLM 1.1



BLM 1.2



BLM 1.3



ISBN 978 1 74135 172 9

ISBN 978 1 74135 172 9

Investigation 1 Ripper rides

Name: _____ Due date: _____

Rubric

Proficiency strands		Step	Ability to...	A	B	C	D	E
Understanding, Fluency and Problem Solving			Calculate $\frac{3}{4}$ of the area of the board.	Independently found and used an efficient method to identify $\frac{3}{4}$ of the board. Accurately counted both whole and part squares.	Needed prompting to find the most efficient way to find $\frac{3}{4}$ of the board. Made very few errors when counting the whole and part squares.	Used a simple method to divide the board into 4 equal parts. Counted the whole squares but needed help to accurately count the part squares and find $\frac{3}{4}$.	Needed teacher guidance to find a way to divide the board into 4 equal parts. Counted the whole squares but was unable to include the part squares to find $\frac{3}{4}$.	Could not find a way to divide the board into equal parts. Counted an estimated number of whole squares only. Did not count any part squares.
			Plan a board design using all of the required geometric elements.	Independently used all the geometric elements accurately to draw a plan of the design. Formed a complex and visually appealing pattern.	Needed prompting to use all the geometric elements to draw a plan of the design. The elements formed a clearly defined pattern.	Needed some help to use all the geometric elements to draw a plan of the design. The elements formed a simple, uncomplicated pattern.	Needed teacher guidance to use all the geometric elements in the design plan. The elements formed a very basic pattern.	Did not understand what the geometric elements looked like. The design was random with no clear pattern.
			Transfer the design onto a template of a board.	Transferred the design plan neatly and accurately onto the template.	Was able to fix any problems identified when transferring the design plan onto the template.	Made some errors when transferring the design plan onto the template.	Had difficulty transferring the design plan accurately onto the template.	The final result was untidy and did not contain the geometric elements.
Reasoning			Explain the design.	Used clear, concise and appropriate mathematical terms to explain the elements of the board design.	Described the elements of the design clearly. Made only minor errors when using mathematical terms to describe the pattern.	Gave a simple description of the elements of the design. Made some errors when using mathematical terms to describe the pattern.	Described some of the elements of the design, but did not always use the correct mathematical terms when describing the pattern.	Did not understand what the geometric elements looked like and was therefore unable to describe the design elements.
			Prove that $\frac{1}{4}$ of the board has been left blank for a solid colour.	Gave a clear and detailed description of an efficient method used to calculate $\frac{1}{4}$ of the board.	Described a reasonable method for calculating $\frac{1}{4}$ of the board.	Gave a simple description of the method used to calculate $\frac{1}{4}$ of the board.	Had difficulty describing the method used to calculate $\frac{1}{4}$ of the board.	Was unable to describe the method used to calculate $\frac{1}{4}$ of the board.
			Justify the choice of the best three board designs. Explain how the elements combined to form an appealing and well balanced design.	Gave well reasoned and detailed arguments for their choice of the best three designs.	Briefly described why the elements on the three boards chosen combined to form an appealing and well balanced design.	Gave a simple explanation of the elements which helped them choose the best three designs.	Reasons for choosing the best three designs did not always relate to the elements.	The reasons for choosing the three best designs were confused and unrelated to the design elements.

Teacher comments

_____

_____

Overall rating