Investigation 5

Ramp champ

About the Investigation

Length and measurement using informal units are the key themes in this scientific investigation, which looks at ways of making toy cars move faster and therefore travel further when placed on a ramp. This process will include trial and error and manipulating variables that affect the distance the car will travel, such as the inclination of the ramp, mass of the car, and type and size of wheels.

Planning the Investigation

Expected duration of Investigation:

2 to 3 weeks

Recommended group size:

Small groups

Students will need:

- ☆ **BLMs 5.1–5.2** – *Car distance tables*
- ☆ internet access
- ☆ coins or washers
- ☆ toy cars
- ☆ materials to make car ramps
- ☆ craft materials

Topics for this Investigation

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

NA1 Count in ones

NA5 Read and write two-digit numerals

MG1 Measuring length

MG2 How long is a metre?

MG5 How heavy is it?

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Curriculum Match for Investigation 5

The table below shows how the Topics in Investigation 5 match the content requirements of the Australian Curriculum.

Content descriptions	iMaths 1 Topics
Number and Algebra **Number and place value** • Develop confidence with number sequences to and from 100 by ones from any starting point. Skip count by twos, fives and tens starting from zero. • Recognise, model, read, write and order numbers to at least 100. Locate these numbers on a number line.	**NA1** Count in ones **NA5** Read and write two-digit numerals
Measurement and Geometry **Using units of measurement** • Measure and compare the lengths and capacities of pairs of objects using uniform informal units.	**MG1** Measuring length **MG2** How long is a metre? **MG5** How heavy is it?

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

Proficiency strands	Investigation 5 criteria
Understanding, Fluency and Problem Solving	**Step 2:** Identify and test a suitable unit of measurement for the distance a toy car travels off the end of a ramp. **Step 4:** Conduct trials, measuring and recording the distances a toy car travels off the end of a ramp, with different variables.
Reasoning	**Step 5:** Describe their trials and explain their results.

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Essential word list

Students will need to understand the following terms:

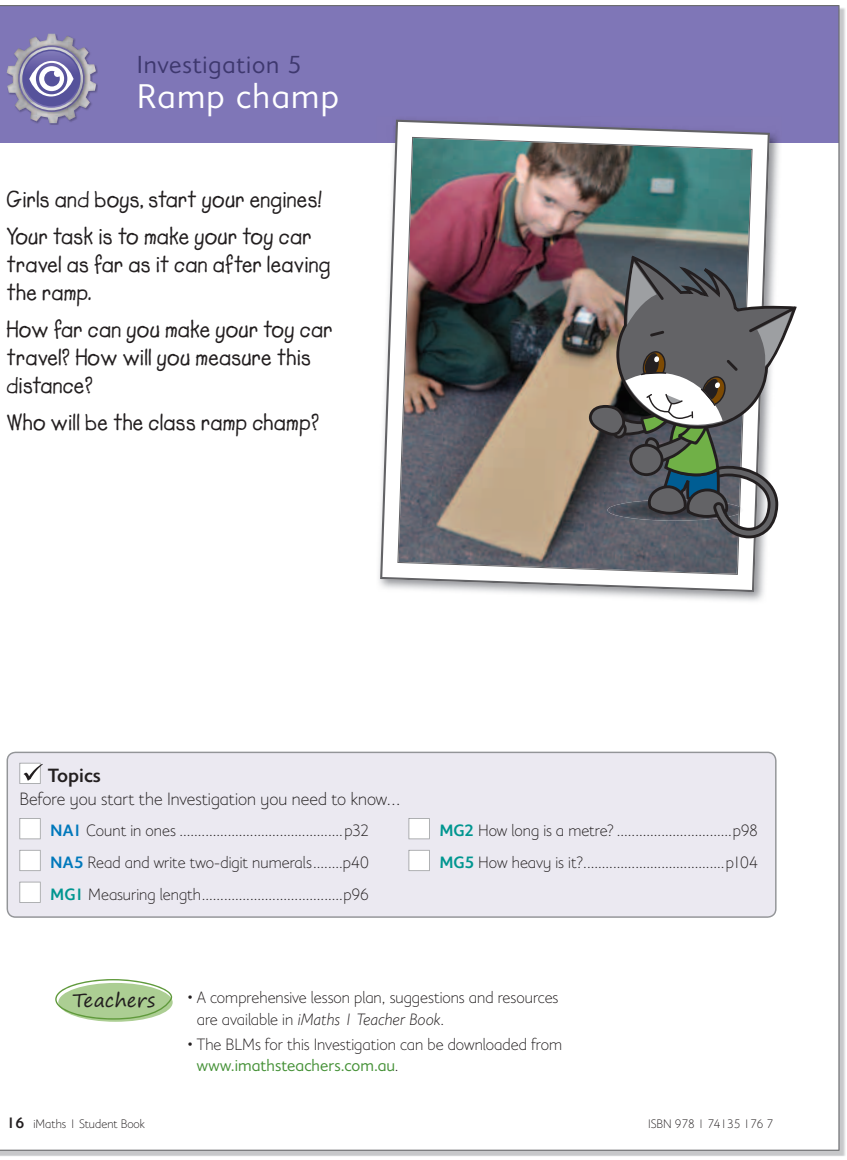
- ☆ ramps
- ☆ trials
- ☆ distance travelled
- ☆ further
- ☆ steep/steeper
- ☆ fast/faster/fastest
- ☆ function/purpose
- ☆ units of measurement
- ☆ compare
- ☆ variables
- ☆ constant

The rubric

Read and discuss the rubric. Discuss the criteria and show students which step of the Investigation each one is describing. The rubric should be revisited after each step.

Students will submit

☆ **BLMs 5.1** – **5.2** – *Car distance tables*



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Girls and boys, start your engines!

Your task is to make your toy car travel as far as it can after leaving the ramp.

How far can you make your toy car travel? How will you measure this distance?

Who will be the class ramp champ?

1 Exploring ramps.

Identify students' prior knowledge of ramps and discuss their experiences with ramps, as well as their purpose and function in everyday life.

Demonstrate how a ramp works by placing a piece of stiff cardboard or a large picture book on an angle against a phone book, and allowing a toy car to roll down its surface. Make students aware of the distance the car rolls on the flat surface after it leaves the ramp.

Provide a selection of toy cars and trucks. You could also ask students to bring toy cars and trucks from home.

Also, have available materials with which to make ramps, such as wooden blocks and thin panels of plywood or masonite, sheets of smooth heavy card, long cardboard tubes, old phone books, shoe boxes and commercially available toy car ramps.

Allow groups of students the time, space and freedom to play and experiment with toy cars and ramps, using a variety of materials, in the classroom or a covered outdoor area.

Focus questions

- What is a ramp?
- Where have you seen a ramp?
- How is a ramp useful?
- How can you make a ramp?

Explore and play

You may choose to add depth to the Investigation by engaging students with other fun activities, such as:

- Design a figure eight car track for toy cars using black cardboard, marking the roads with chalk.
- Create garages to fit a variety of toy cars of various shapes and sizes.
- Use recycled materials, such as small boxes and cardboard rolls, to create your own model of a racing car.
- Create car jumps for toy cars in the sandpit.

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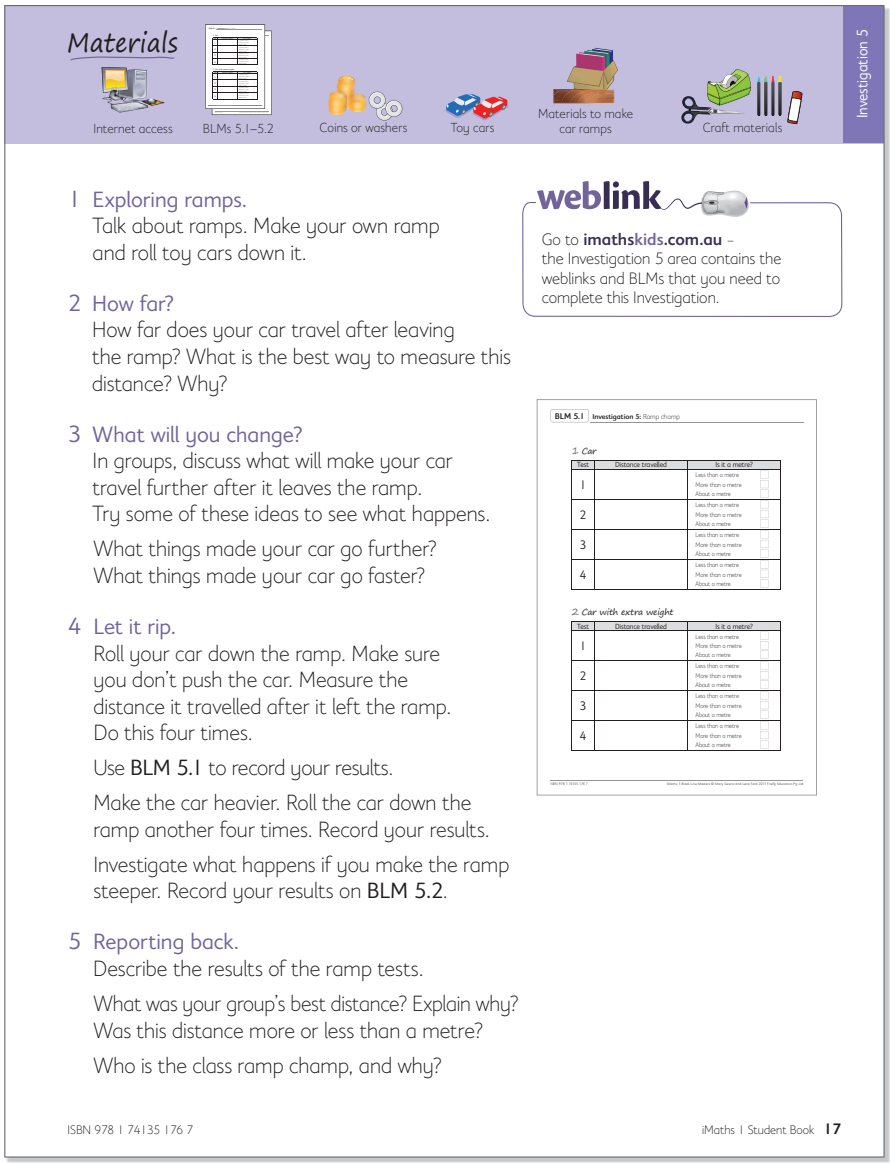

Materials

Internet access | BLMs 5.1–5.2 | Coins or washers | Toy cars | Materials to make car ramps | Craft materials

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1 Exploring ramps.
Talk about ramps. Make your own ramp and roll toy cars down it.

2 How far?
How far does your car travel after leaving the ramp? What is the best way to measure this distance? Why?

3 What will you change?
In groups, discuss what will make your car travel further after it leaves the ramp. Try some of these ideas to see what happens.

What things made your car go further?
What things made your car go faster?

4 Let it rip.
Roll your car down the ramp. Make sure you don't push the car. Measure the distance it travelled after it left the ramp. Do this four times.

Use BLM 5.1 to record your results.

Make the car heavier. Roll the car down the ramp another four times. Record your results.

Investigate what happens if you make the ramp steeper. Record your results on BLM 5.2.

5 Reporting back.
Describe the results of the ramp tests.

What was your group's best distance? Explain why? Was this distance more or less than a metre?

Who is the class ramp champ, and why?

weblink

Go to **imathskids.com.au** – the Investigation 5 area contains the weblinks and BLMs that you need to complete this Investigation.

BLM 5.1 Investigation 5: Ramp champ

1. Car

Test	Distance travelled	Is it a metre?
1		Less than a metre / More than a metre / About a metre
2		Less than a metre / More than a metre / About a metre
3		Less than a metre / More than a metre / About a metre
4		Less than a metre / More than a metre / About a metre

2. Car with extra weight

Test	Distance travelled	Is it a metre?
1		Less than a metre / More than a metre / About a metre
2		Less than a metre / More than a metre / About a metre
3		Less than a metre / More than a metre / About a metre
4		Less than a metre / More than a metre / About a metre

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2 How far?

Ask students how we could mark, measure and explain how far our toy cars have travelled off the end of the ramp.

Creative thinking strategy
Brainstorm ideas for measuring units using the Alphabet Thinkers Key. Tony Ryan's Alphabet Thinkers Key is a sorting process that clarifies student thinking on a topic by considering one aspect at a time. Using words from A–Z, brainstorm a list of non-standard units of measurement that can be used to measure length or distance (see Fig 5.1).

Discuss the suitability of each idea as a unit for measuring length. For example: marbles would be too difficult to use because of their shape; a yoghurt cup would be more appropriate for capacity; popsticks would be appropriate as they are a standard size and can be laid end to end.

Focus questions

- Would footsteps be a reliable unit of measurement? Why or why not?
- What about leaves or sticks?
- What else could we use to measure the distance travelled?
- What are some things that are always the same size?

Fig 5.1 – Example Alphabet Thinkers Key

Unit of measurement	
A	armspans
B	beanbags, books, bananas
C	cards, candles, crayons
D	dominoes
E	envelopes, egg cartons
F	footprints, feathers
G	giant steps
H	handspans, horseshoes

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2 How far? *(continued)*

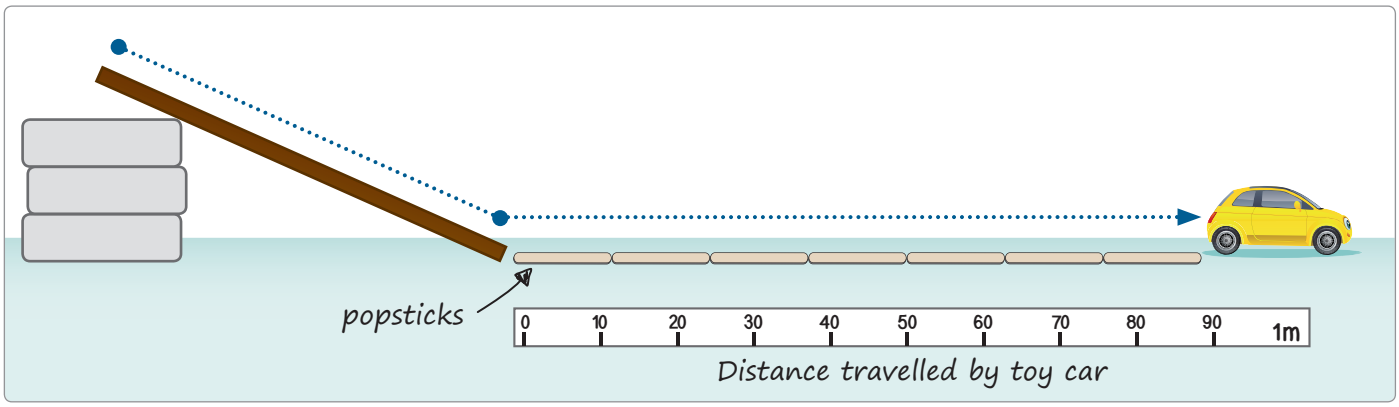
Demonstrate to the whole class how to measure the distance by running a toy car down a ramp, marking the distance travelled with masking tape, and then measuring from the bottom of the ramp. Use straws, popsticks or another standard measuring tool.

As a class, decide which standard unit of measurement will be used. Record the distance in these units, eg 16 popsticks.

Please note: Popsticks are a good choice for a unit of measurement. Try to organise the ramp so that it sends the car more than 10 popsticks from the bottom of the ramp. This will give students practice with two-digit numbers.

This is also an opportune time to revise knowledge of the metre. Compare the distance travelled to a metre, by placing a metre ruler or a piece of string from Topic **MG2** How long is a metre? (Student Book page 98) alongside the popsticks. Are 16 popsticks about the same, more, or less than a metre?

Tell students that when it comes time to conduct their trials, they will need to know approximately how many of their units of measurement make up a metre.



3 What will you change?

Explain to students that their group's task is to find ways to make their toy car travel further. Identify and discuss variables that will affect the distance a car travels off the ramp, such as length of ramp, type of surface, slope of ramp and mass of cars.

Divide the class into groups and have them discuss how they are going to organise their Investigation. For example, for one test they might want to see whether the inclination of the ramp affects the distance the car goes. They need to talk about the things they will change in each trial (variables) and the things they will keep the same (constants). Students will use problem solving strategies of *guess and check* and *act out the problem* as they make informal trials.

Allow students to conduct some informal trials to try some of their ideas for making the car travel further. It is important to note that there are some things that they have to keep the same when they are doing their trials. For example, they must let the car go at the same position on the ramp each time, and they must let the car go and not push it downwards (ask them why and how these things could change the results).

It would be appropriate at this point in the Investigation to ask students how the type of surface over which the car will run will affect how far the car travels. Students might suggest that every group does the tests on one particular surface, say a concrete path, or on a linoleum floor. Avoid thick carpet or pavers with cracks between them.

Following these informal trials, some early associations between variables and their affect on the results could be discussed. Variables such as the height of the ramp, size and mass of toy cars, and their affect on the distance travelled could be discussed at this stage. For example: "It went a really long way when I lifted the ramp more. When I put the ramp up too high, the car fell off the side. The truck went further than the car. My big car went a long way."

Focus questions

- How will the length of the ramp make a difference?
- How will the type of ramp surface used make a difference?
- How will the size or mass of the car make a difference?
- How will the slope of the ramp make a difference?
- How will the type of wheels make a difference?

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4 Let it rip.

Each group chooses a toy car and the materials necessary to make their ramp and to add weight to the car, such as coins, washers or Blu-Tack.

Firstly, have students run their car down the ramp. They should do this four times and measure the distance each time, using their chosen unit of measurement. Students record each of these initial trial distances in the *Car* table on **BLM 5.1** (See Fig 5.2).

Ask them to identify whether their car travelled less than a metre, about a metre, or more than a metre, and record it in the check boxes on the table. They should have a good idea about how long a metre is from their investigations in Step 2. For example, popsticks are about 11.5 cm long, so a distance of 9 popsticks would be about a metre.

Ask students to identify the best distance, and colour in that row on the table.

Next, students make the car heavier and run it down the ramp four times. Record the results in the *Car with extra weight* table on **BLM 5.1**, identifying whether the car travelled less than, more than, or about a metre. Colour the row with the best distance.

Students can then investigate what happens to the distances travelled by the two types of cars when they change the inclination of the ramp. Have them record the distances for these trials on the relevant tables on **BLM 5.2**, and colour the best distances.

Throughout the trials, allow students to share and explain what they are doing. Encourage other students to comment, suggest or help with any challenges. Use the rubric to record observations of individual contributions. Also, use a digital camera to record students working throughout the Investigation.

Fig 5.2 – Car distance tables

1 Car

Test	Distance travelled	Is it a metre?
1	7 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐
2	10 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐
3	9 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐
4	8 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐

2 Car with extra weight

Test	Distance travelled	Is it a metre?
1	14 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐
2	12 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐
3	16 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐
4	14 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐

3 Car on a steeper ramp

Test	Distance travelled	Is it a metre?
1	15 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐
2	16 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐
3	13 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐
4	14 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐

4 Car with extra weight on a steeper ramp

Test	Distance travelled	Is it a metre?
1	20 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐
2	19 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐
3	18 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐
4	22 popsticks	Less than a metre ☐ More than a metre ☐ About a metre ☐

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5 Reporting back.

Ask students to show and share their ramps and the results of their car trials.

Students report their best distances for each test. They need to describe what they did and what effect this had on their results.

Communicating and reflecting

The following questions are designed to help you assess students' proficiency in reasoning.

- What did you use to measure the distances?
- Was this unit of measurement easy to use? Why?
- What could you have done to make counting the (popsticks) easier?
- What was your group's best distance?
- Was the distance more, less, or about the same as a metre?
- Did adding weight to the car make any difference?
- What happened when you made the ramp steeper?
- What could you do to find out if your car was heavier or lighter than another group's car?

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.

What modifications do you need to make in order for a toy car to travel over 5 metres?

Black Line Masters

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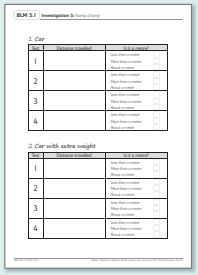
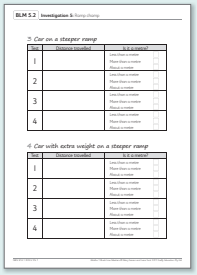
BLM 5.1



BLM 5.2



Notes and strategies

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Name: _____ Due date: _____

Proficiency strands	Step	Ability to...	A	B	C	D	E
Understanding, Fluency and Problem Solving	2	Identify and test a suitable unit of measurement for the distance a toy car travels off the end of a ramp.	Independently identified the best unit to use to measure the distance a toy car travels after leaving a ramp. Conducted accurate tests. Without help used the unit of measurement to correctly record the distances travelled.	With prompting correctly identified a suitable unit to measure the distance a toy car travels after leaving a ramp. Corrected any errors when using the measurement unit to record the distances travelled.	With help identified a suitable unit to measure the distance a toy car travels after leaving a ramp. Needed help to conduct tests with this unit of measurement and correctly record the distances travelled.	With teacher guidance identified a suitable unit to measure the distance a toy car travels after leaving a ramp. Needed guidance to conduct tests with this unit of measurement.	Did not understand the concept of finding suitable units to measure the distance a toy car travels after leaving a ramp.
	4	Conduct trials, measuring and recording the distances a toy car travels off the end of a ramp, with different variables.	Accurately measured the distance for each test. Independently recorded each measurement without errors.	Measured the distance for each test. Needed prompting to correctly record the measurements.	Needed help to accurately measure the distance for each test and record the measurements.	Needed guidance to measure the distance for each test and record the measurements.	Had difficulty measuring the distance for each test. Was unable to record the measurements.
Reasoning	5	Describe their trials and explain their results.	Correctly and confidently described the procedure and results of their trials. Clearly identified the effect of the variables on the results.	Described the procedure and results of their trials. Identified the effect of the variables on the results.	Briefly described the procedure and results of their trials. Identified the effect of some of the variables on the results.	Had difficulty describing the procedure and results of their trials. Identified some variables but was unable to link them to the effect on the results.	Could not clearly describe the procedure and results of their trials. Did not understand how the variables effected their results.

Teacher comments

_____

_____

Overall rating