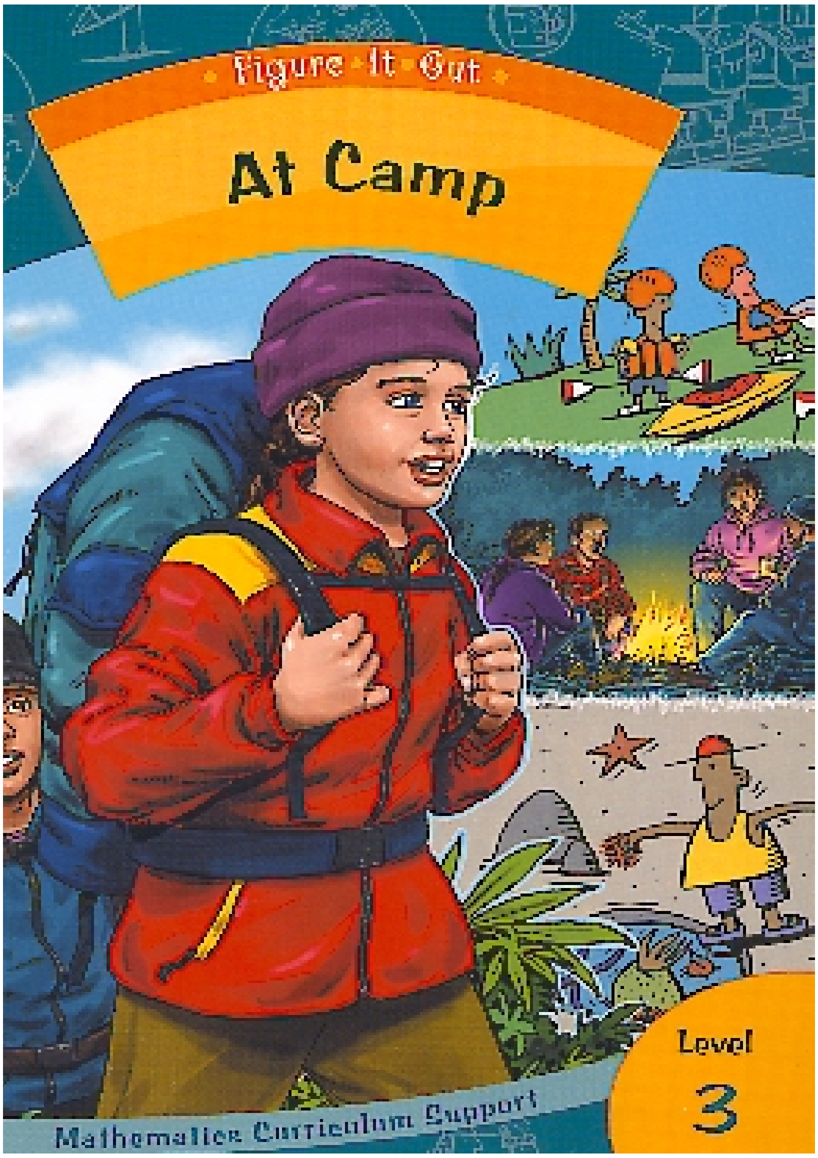
Answers and Teachers' Notes



MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

Contents

Introduction

The Figure It Out series is designed to support *Mathematics in the New Zealand Curriculum*. The booklets have been developed and trialled by classroom teachers and mathematics educators. The series builds on the strengths of a previous series of mathematics booklets published by the Ministry of Education, the School Mathematics supplementary booklets.

Figure It Out is intended to supplement existing school mathematics programmes and can be used in various ways. It provides activities and investigations that students can work on independently or co-operatively in pairs or groups. Teachers can select particular activities that provide extension to work done in the regular classroom programme. Alternatively, teachers may wish to use all or most of the activities in combination with other activities to create a classroom programme. The booklets can be used for homework activities, and the relevant section in the teachers' notes could be copied for parents. These notes may also provide useful information that could be given as hints to students.

There are eight booklets for level 3: one booklet for each content strand, one on problem solving, one on basic facts, and a theme booklet. Each booklet has its own *Answers and Teachers' Notes.* The notes include relevant achievement objectives, suggested teaching approaches, and suggested ways to extend the activities. The booklets in this set (level 3) are suitable for most students in year 5. However, teachers can decide whether to use the booklets with older or younger students who are also working at level 3.

The booklets have been written in such a way that students should be able to work on the material independently, either alone or in groups. Where applicable, each page starts with a list of equipment that the students will need to do the activities. Students should be encouraged to be responsible for collecting the equipment they need and returning it at the end of the session.

Many of the activities suggest different ways of recording the solution to a problem. Teachers could encourage students to write down as much as they can about how they did investigations or found solutions, including drawing diagrams. Where possible, suggestions have been made to encourage discussion and oral presentation of answers, and teachers may wish to ask the students to do this even where the suggested instruction is to write down the answer.

> The ability to communicate findings and explanations, and the ability to work satisfactorily in team projects, have also been highlighted as important outcomes for education. Mathematics education provides many opportunities for students to develop communication skills and to participate in collaborative problem-solving situations.
>
> (*Mathematics in the New Zealand Curriculum,* page 7)

Students will have various ways of solving problems or presenting the process they have used and the solution. Successful ways of solving problems should be acknowledged, and where more effective or efficient processes can be used, students can be encouraged to consider other ways of solving the problem.

At Camp

Answers

Page 1: Where To?

Activity

1. First choice: Lake Waihonu
   Second choice: Mount Albury
   Third choice: Mārama Island
2. Answers will vary depending on the method used to work out the favourites, for example, based on the most popular first choice, based on the least popular third choice, or using a weighting system. There is no clear favourite.

Page 2: Pick the Place

Activity

Answers will vary.

Page 3: Raising the Money

Activity

1. **a.** $1,200
   b. $800
   c. $600
   d. $800
   e. $400
   f. $400
2. $26.67 each if paid by cheque or Eftpos, or $26.70 in cash

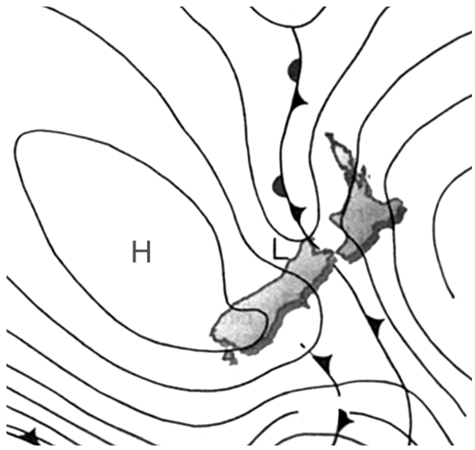
Pages 4–5: When and Weather

Activity

1. Answers will vary. One likely answer is 12–16 March because there is suitable weather for each activity and for putting up and taking down tents.
2. Answers will vary.

Investigation

1. Although the forecasters cannot say for sure that there will be no rain, they are confident that on at least 75% of days with a weather pattern like this there is no rain.
2. **a.** Usually there will be a low over most of the country. Isobars are close together, indicating a change of air pressure within a short distance and therefore stronger wind.



   b. The probability of rain is not usually 100%. If a probability of 80–90% is given, forecasters are very confident it will rain.
3. Research activity

Pages 6–7: Maths to Munch On

Activity

Answers will vary.

Page 8: Inventing Tenting

Activity

Practical activity

Page 9: Getting There

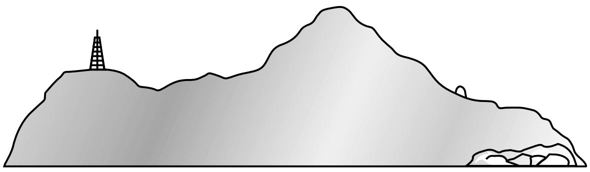
Activity

The cheapest option is Benny's Buses ($256) and the Fat Cat Tours boat ($180).

Page 10: They're Off!

Activity

1. Discussion will vary. As a starting point, you need to work out where north is in relation to the view in each picture. Mount Mārama is in the west, the radio transmitter is in the north, and the lighthouse is in the south-east.
2. See the map on page **15** of the students' booklet.
3.



Page 11: Seated for Dinner

Activity

1. Answers will vary. Eight per table would allow for generous elbow room. Ten per table would still be reasonable.
2. **a.** A possible solution: going clockwise around the table, Fatu, Allan, Connie, Waiārani, Eric, and Mae Li
   b. Answers will vary.

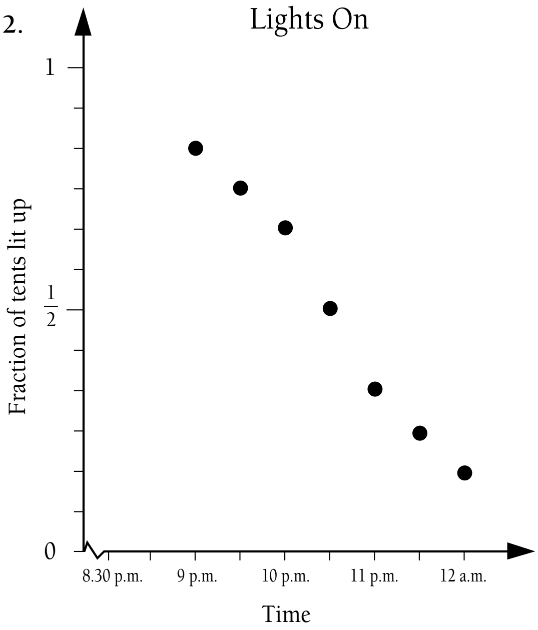
Pages 12–13: Lights Out

Activity One

1. **a.** $\frac{27}{36}$ ($\frac{3}{4}$)
   b. $\frac{24}{36}$ ($\frac{2}{3}$)
   c. $\frac{18}{36}$ ($\frac{1}{2}$)
   d. $\frac{12}{36}$ ($\frac{1}{3}$)
2. $\frac{9}{36}$ ($\frac{1}{4}$)
3. 6

Activity Two

1. $\frac{10}{12}$ ($\frac{5}{6}$)
2.



3. Graph **a**: Tuesday
   Graph **b**: Thursday (concert)
   Graph **c**: Wednesday

Pages 14–15: Planning the Tramp

Activity

a. Answers will vary according to the routes chosen.
b. Answers will vary.
c. About $4\frac{1}{2}$ to $5\frac{1}{2}$ hours

Page 16: Reflecting on Scenes

Activity

Individual sketches by students. Each landscape should be mirrored in the water.

Page 17: Orders

Activity

1. Connie
2. **a.** No peaches: $\frac{2}{3}$, a 2 in 3 chance
   b. Orange instant pudding: $\frac{1}{3}$, a 1 in 3 chance
   c. Apricot with chocolate instant pudding: $\frac{1}{9}$, a 1 in 9 chance

Page 18: Gaining Confidence

Activity

1. Yes
2. One possibility is blocking off n–r and s–w.
3. Practical activity

Page 19: Can You Kayak?

Activity

1. **a.** 2

   b. If 2 dinghies and 2 kayaks hold 10 people, then 1 dinghy and 1 kayak must hold 5 people.
   If the kayak holds 1 person and the dinghy 4, then 3 dinghies and 1 kayak would hold 3 x 4 + 1 = 13 people. So this can't be correct. Another possibility is that the kayak holds 2 people and the dinghy holds 3. This means 3 dinghies and 1 kayak hold 3 x 3 + 2 = 11 people, which agrees with the information given.
2. 6 dinghies and 9 kayaks

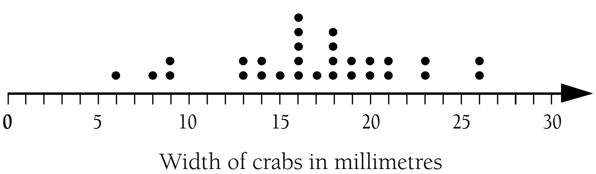
Pages 20–21: Claws!

Activity

1. Between approximately 11.30 a.m. and 1 p.m. today or between 12.45 p.m. and 2.15 p.m. tomorrow. (Both times would clash with lunch, but the programme could be altered to suit.)
2. Practical activity. Measuring the crabs accurately is difficult, so measurements may vary from student to student.

   A dot plot of the crab sizes could look like this:

Crab Sizes



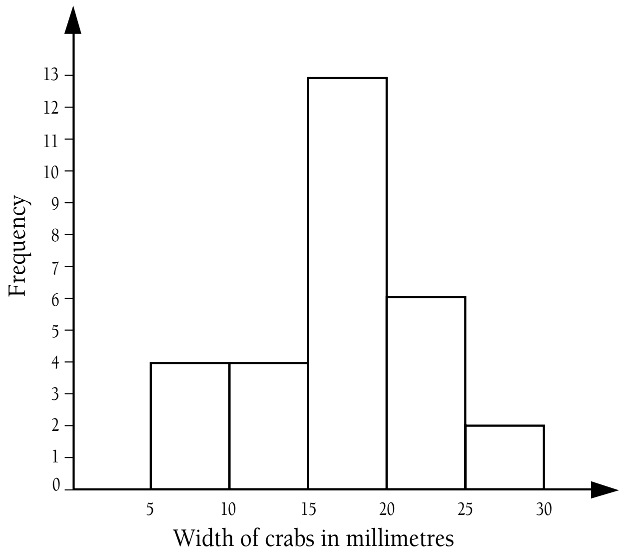
A stem-and-leaf graph could look like this:

Crab Sizes

0	6 8 9 9
1	3 3 4 4 5 6 6 6 6 6 7 8 8 8 8 9 9
2	0 0 1 1 3 3 6 6
cm	mm

A histogram could look like this:

Crab Sizes



Page 22: Moa Mystery

Activity

Students may measure the moa as it stands in the illustration. The moa in the illustration is approximately 153 mm from its head to the ground. So its actual height would have been 153 ÷ 69 x 110 = 244 cm (2.44 m). Students could discuss whether the moa raised its head higher on occasions.

Page 23: Knot Tying

Activity

1. Practical activity
2. **a.** Two half hitches, the clove hitch, and the cow hitch. (The bowline does not fasten tightly enough.)

   b. Reef and fisherman's knots
3. Practical activity
4. Practical activity

Page 24: Bean Bag Antics

Activity

1. 14, 18, 22, 26, 30, 34
2. **a.** 4, 7, 10, 13

   b. 33, 26, 19, 12

   c. 1, 6, 11, 16
3. Answers will vary.

Figure It Out

At Camp

Teachers' Notes

Overview: At Camp

Title	Content	Page in students' book	Page in teachers' notes
Where To?	Handling data	1	7
Pick the Place	Exploring probability	2	8
Raising the Money	Solving problems with money	3	8
When and Weather	Solving problems with time and probability	4–5	9
Maths to Munch On	Solving problems with measurement and money	6–7	10
Inventing Tenting	Investigating nets for solids	8	11
Getting There	Solving problems with rates	9	13
They're Off!	Interpreting pictures of three-dimensional shapes	10	13
Seated for Dinner	Exploring length and position	11	15
Lights Out	Finding fractions of whole numbers Drawing and interpreting graphs of relationships	12–13	16
Planning the Tramp	Using scale, measuring speed	14–15	18
Reflecting on Scenes	Practising mapping and reflection	16	19
Orders	Exploring combinations and probability	17	20
Gaining Confidence	Investigating networks	18	21
Can You Kayak?	Solving problems with variables	19	22
Claws!	Measuring lengths and displaying data in graphs	20–21	23
Moa Mystery	Using scale to solve measurement problems	22	24
Knot Tying	Interpreting diagrams of three-dimensional objects	23	25
Bean Bag Antics	Interpreting instructions	24	25

Page 1: Where To?

Achievement Objective

- make sensible statements about an assertion on the basis of the evidence of a statistical investigation (Statistics, level 3)

Activity

To solve this problem, students will first have to interpret the tally charts that show how many first, second, and third choices each location received. Some students may not realise that 卌 is the tally mark for five. Its likely origin is a hand of fingers with the thumb crossed over the palm to signify a complete five.

Students can decide which campsite is most popular in a number of ways. These include:

- based on the most popular first choice
  (In this case, Mārama Island would win because it has 14 first votes to Lake Waihonu's 12 votes and Mount Albury's 10 votes. Under this system, Mārama Island is preferred by a narrow margin.)
- based on the least popular third choice
  (Using this system, Mount Albury would win because only 10 people voted for it as third choice, as opposed to 11 people for Lake Waihonu and 15 people for Mārama Island.)
- based on a weighting given to each vote, for example, three points for a first choice, two points for a second choice, and one point for a third choice.

	1st choice	2nd choice	3rd choice	Total
Mount Albury	10 x 3 = 30	16 x 2 = 32	10 x 1 = 10	72
Lake Waihonu	12 x 3 = 36	13 x 2 = 26	11 x 1 = 11	73
Mārama Island	14 x 3 = 42	7 x 2 = 14	15 x 1 = 15	71

Under this system, Lake Waihonu would win by a narrow margin.

Students should realise that, as these three methods show, there is no clear favourite.

Page 2: Pick the Place

Achievement Objective

- predict the likelihood of outcomes on the basis of a set of observations (Statistics, level 3)

Activity

The ideas shown on this page illustrate different points about gathering data on a chance event. Rolling the dice is an unbiased method of choosing the camp. This means that the chances of each place being selected are the same. There are six faces that may come up, so each location has a two out of six or one-third chance of success. The response to the dice method concerns the effects of sample size. An interesting discussion point is whether one throw, best of 10 throws, best of 100 throws, and so on will make any difference to the outcome. Students may note that one throw will always produce a winner. The likelihood of each venue winning is the same, so there is no need to take more throws. An interesting experiment is to find out how often the best of 10 throws results in a winner other than the winner of the first throw.

Spinners are a geometric method to randomly generate outcomes. They involve quite complex ideas of fractional area and angles. However, spinners are easy to make and are excellent for finding probabilities by experiment. The only way to determine whether the starting point of the paper clip has any effect on outcomes is to try it. In this case, the sample size is important. For example, 30 spins from each given starting position will produce far more reliable results than five spins in each position.

There is potential bias in the fortune cookies method that students may like to discuss. How appetising the fortune cookies look and their size may have some impact on the likelihood of being selected. Students could bake a batch of cookies of varying sizes to study this potential for bias further.

When students design their own method to pick the camp by chance, they will need to take account of the issues of bias and sample size. For example, they could put cubes of three different colours, one for each location, in a paper bag. Two issues are significant:

- equal numbers of each colour (to avoid bias)
- total number of cubes (a large enough sample size to give reliable results).

Page 3: Raising the Money

Achievement Objectives

- perform measuring tasks, using a range of units and scales (Measurement, level 3)
- write and solve problems which involve whole numbers and decimals and which require a choice of one or more of the four arithmetic operations (Number, level 3)

Activity

The problem asks students to interpret a cumulative total on a linear scale. This is the same as reading a thermometer or finding the distance between numbers on a number line.

Some students may need help to read the scale. An essential principle of scale is that a linear measure has been reduced or, in some cases, enlarged. Due to this shrinking, not all unit marks can be shown on the scale. In this fund-raising scale, the marks shown represent differences of $200. Students will need to read up or down from the nearest $1,000 mark and subtract each previous total from the new total to work out how much money was raised during each event.

You could ask supplementary questions about the fund-raising activities. For example:
"How many cars did they wash? How much did they charge for each car? How much did the sponges, buckets, shampoo, and other materials cost?"

"How many bins of apples do you think the students picked? How long would they have picked for to fill that many bins?"
"What would you charge students at your school to get into a disco? How many students do you think went to the disco at Te Kauri School?"

For question **2**, encourage students to estimate the solution first. They will need to understand that only the 30 students will pay the remaining $800, not the adults. Expect students to give answers like: "If there were $600 to raise, that would be $20 each, and if there were $900 to raise, that would be $30 each. So the answer must be closer to $30 than $20, say $27."

Although an absolutely accurate answer is $800 \div 30 = 26.\dot{6}$, this is not an actual monetary amount. The closest cash amount possible is $26.70, although $26.67 could be paid by cheque or Eftpos.

Pages 4–5: When and Weather

Achievement Objective

- read and construct a variety of scales, timetables, and charts (Measurement, level 4)

Activity

In considering which 5 days would be best to choose for the camp, students need to think about a number of issues. They need to avoid windy conditions on the days when Te Kauri School will be travelling by boat to and from Mārama Island and on the kayaking day. They should also avoid rainy days on the first and final days of camp because putting up tents in the rain and packing wet tents is difficult. For these reasons, students can eliminate a number of days as possible first and final days. The chart below is based on the assumption that students (and teachers!) want the camp to be on weekdays, not weekends.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

This leaves a small number of strings of 5 days where the eliminated days are not days 1 and 5. If the camp is to be on weekdays only, 12–16 March are the only dates feasible.

Students will need to work out which activities can fit into which time slots. For example, an activity that takes $1^1/_2$ hours can go in the 9.00–10.30, 11.00–12.30, or 4.00–5.30 time slot.

Encourage students to work out which activities they should place first. The cookout must take place from 4.00–5.30 p.m., and therefore cannot be on the same day as the tramp. Nor would you want it to be! The tramp day should preferably be on an overcast day, to minimise UV radiation (see "Burning Issues", *Measurement,* Figure It Out, Level 3, page 20 and the corresponding teachers' notes for information on UV radiation and weather conditions). Wet conditions would also be unsuitable for the tramp and for the cookout.

After the tramp day is allocated and the cookout set for a different day, students can place the other activities. They should try to have a mix of energetic and more restful activities on the same day. For example, kayaking (energetic) could be combined with sketching (restful) or caving combined with building with ropes and sticks.

The predicted weather in that week may influence the choice of days on which other events will occur. Kayaking and caving may not be affected too much by wet weather on Thursday, 15 March, but sketching will be.

Investigation

The answers section provides the information students need for this investigation, apart from the research exercise at question **3**. A useful website for this is www.metservice.co.nz/knowledge, which provides information for schools and weather enthusiasts.

Pages 6–7: Maths to Munch On

Achievement Objective

- write and solve story problems which involve whole numbers and decimals and which require a choice of one or more of the four arithmetic operations (Number, level 3)

Activity

Ask students to bring along empty cereal packets, cans, and containers to help them estimate how much of each item they will need to cater for the camp. Students may need to telephone, fax, email, or visit a local supermarket to become familiar with quantities. For example, the number of slices of luncheon sausage in 800 grams or how many carrots in 1 kilogram will be useful information.

Before students begin developing their menu, remind them that the timetable involves a tramp day and a cookout. They will need to include a cut lunch for the tramp day and food that is easy to cook over an open fire for the cookout. The actual menu is a matter of discretion, although students will need to ensure that the campers eat plenty of cereal, bread, fruit, and vegetables to meet the requirements of the food pyramid supplied on page **7**.

A computer spreadsheet would be a useful way to keep track of the quantities and cost of each food. It could be set out like this:

	A	B	C	D	E	F	G	H
1	Item	Cost	Monday	Tuesday	Wednesday	Thursday	Friday	Total cost
2	Muesli 1 kg	$6.15	0	4	3	2	2	$67.65
3	Loaf of bread	$2.25	8	6	6	10	6	$81.00

The formula for the total cost column in H2 is =sum(C2:G2)*B2

The formula in the total cost column can be copied into each cell in that column by using the Fill Down function. This function works on the information in each row to give the total cost of each row. When the total cost column is complete, the amounts can be added using the “sum” formula.

Page 8: Inventing Tenting

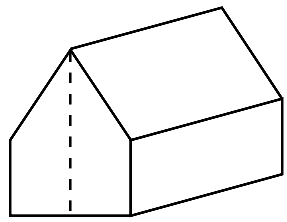
Achievement Objectives

- design and make containers to specified requirements (Geometry, level 3)
- model and describe 3-dimensional objects illustrated by diagrams or pictures (Geometry, level 3)
- perform measuring tasks, using a range of units and scales (Measurement, level 3)

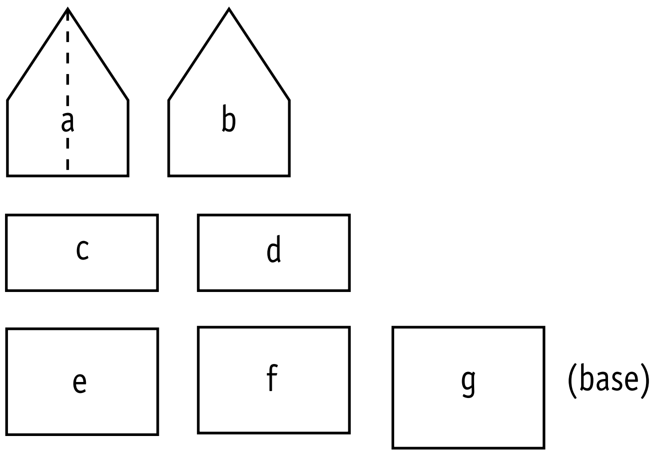
Activity

The tent designs will be three-dimensional solids. They will be polyhedra (solids with many faces) that have flat faces, or they will have curved surfaces, such as half-cylinders. Polyhedra are the easiest of the two types of tents to construct. Students could follow this process:

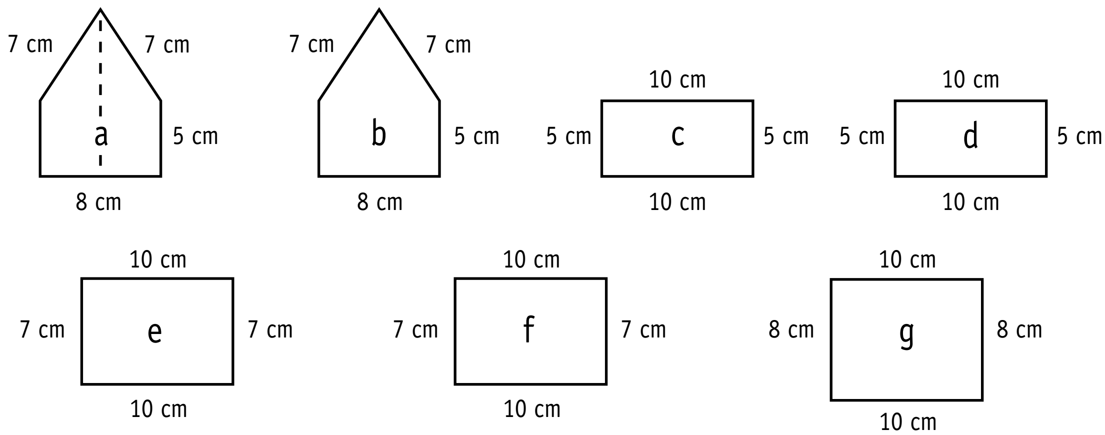
1. Sketch the tent they wish to make, for example:



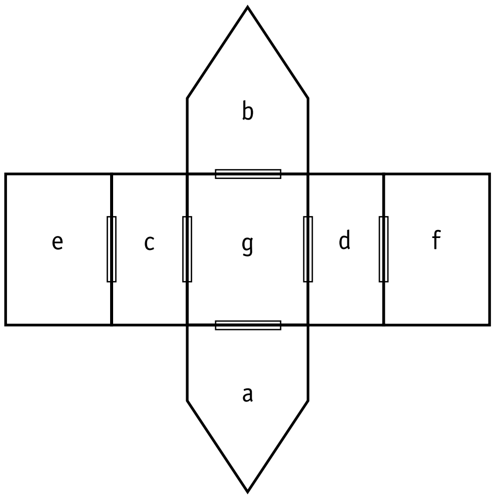
2. Draw and label the faces of the tent:



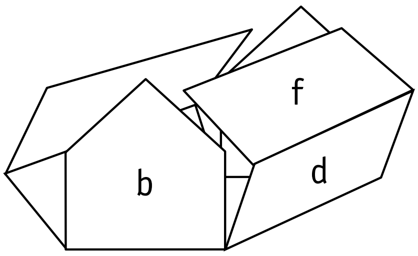
3. Mark any sides that must be the same length:



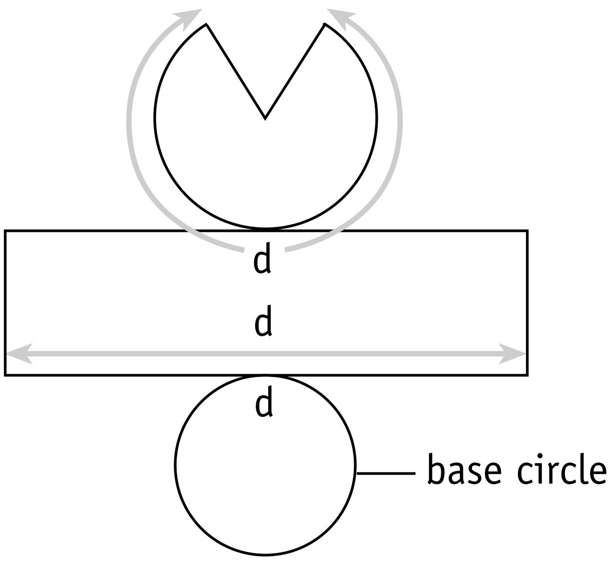
4. Measure and cut out the faces and tape them together to form a net:



5. Redraw the net on a piece of paper and then fold the net up to form the tent shape:



6. Add poles (thin sticks or pipe cleaners) and ropes (string). The main difficulty with curved surfaces, such as cones and cylinders, is measuring and designing the curved edges, for example, making the tent at the bottom of page **8**:



The distance around the outside of the part-circle must match the length of the side strip and the circumference of the base circle. The best way to make this net is to make the part-circle first and use string to measure the other lengths.

Page 9: Getting There

Achievement Objective

- state the general rule for a set of similar practical problems (Algebra, level 3)

Activity

Students will need to use the rules given for each operator and apply them to find the costs:

- Benny's Buses: two one-way trips of 64 kilometres at $2 per kilometre
  2 x 64 x $2 = $256
- Saltwater Charter Boats: round trip of 3 hours at $65 per hour
  3 x 65 = $195
- Fat Cat Tours: one return trip for 36 people at $5 per person
  36 x $5 = $180
- Kimbell Motors: two one-ways trips at $50 plus $3 per person
  2 x [$50 + ($3 x 36)] = $316

As an extension, you could suggest other possible operators to students, such as Amphibian Craft Ltd, which charges $70 per hour. Its vehicle takes 1 hour to travel the 64 kilometres by road and 4 hours to complete a round trip to Mārama Island.

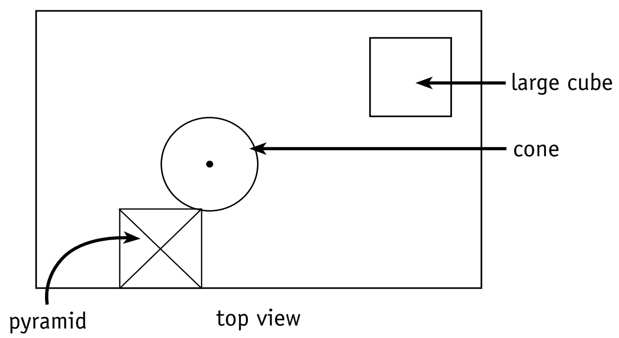
Page 10: They're Off!

Achievement Objective

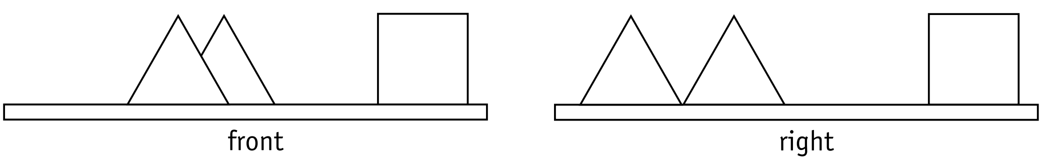
- model and describe 3-dimensional objects illustrated by diagrams or pictures (Geometry, level 3)

Activity

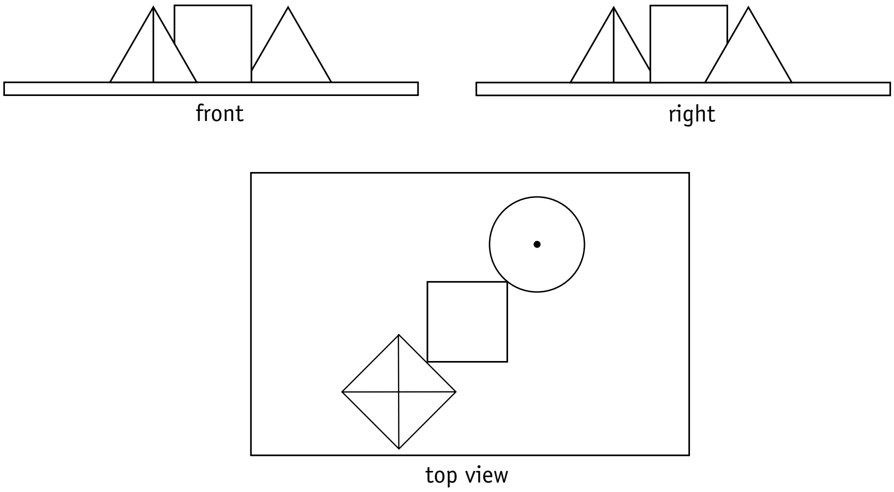
Students may need experience of simpler forms of this problem before attempting this page. Similar tasks can be modelled simply with objects on a desktop. For example, these objects are placed on a desk:



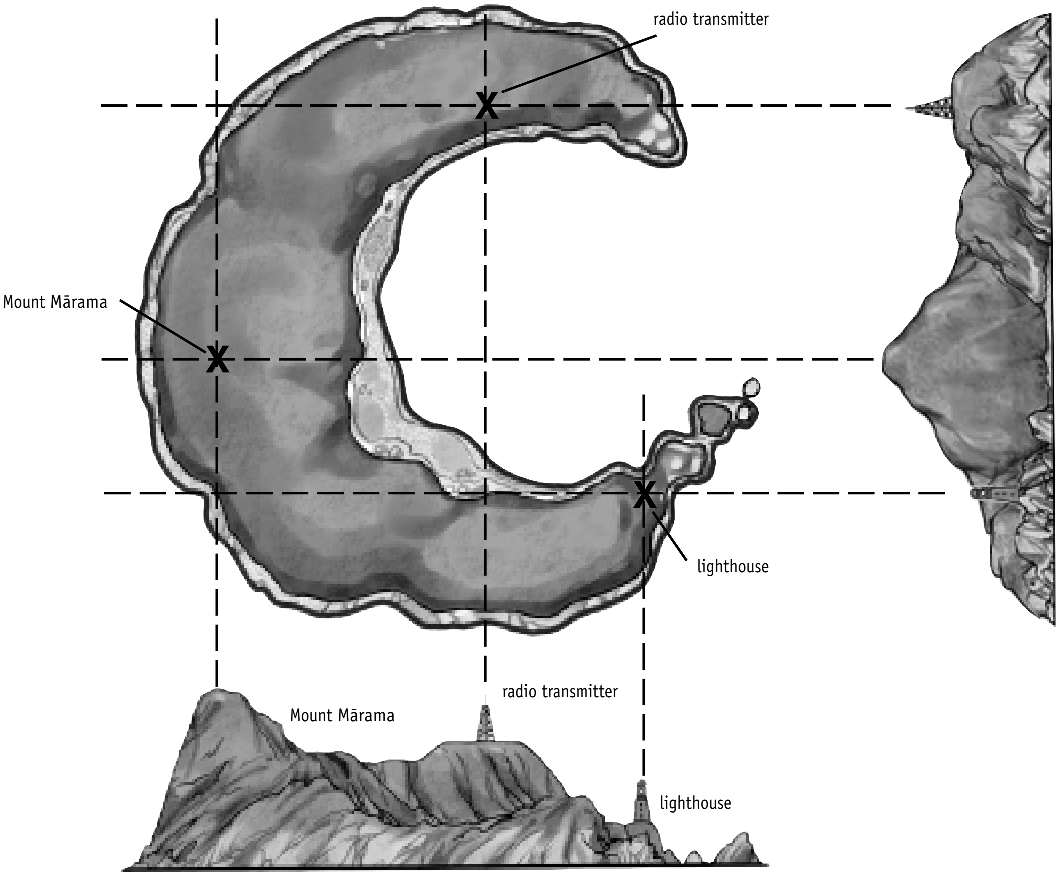
Students can sketch the views from desk level of the front, right, left, and back by crouching down until their eyes are at desk height.



Then reverse this exercise by giving students two views of objects that have been placed on a desk in a different position and ask them to recreate the view looking down. For example:



Transferred to the problem of Mārama Island, the method for finding the top view might be:



The location of each land feature can be found by intersecting gridlines as shown above.

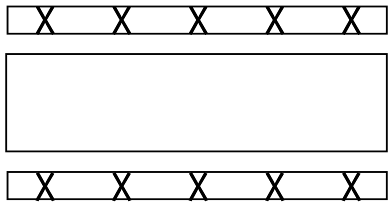
Page 11: Seated for Dinner

Achievement Objective

- devise and use problem-solving strategies to explore situations mathematically (Mathematical Processes, problem solving, level 3)

Activity

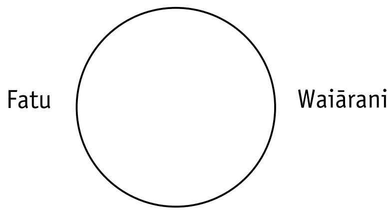
Students at years 5 and 6 will probably need about 80 centimetres of space, including elbow room. This means that 10 students could be seated at each table.



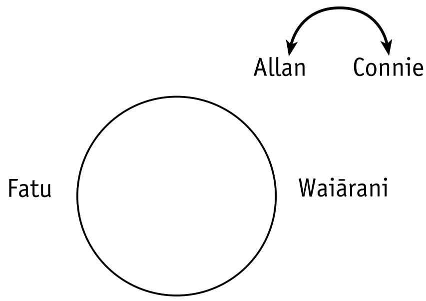
5 x 0.8 = 4.0 m

If each student is allowed 1 metre of space, including elbow room, only eight people can be seated at each table.

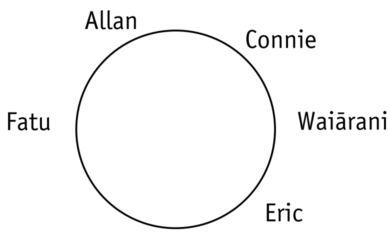
For question **2**, students are best to model the problem by writing the names on tabs and moving them around a circle as they consider each clue.



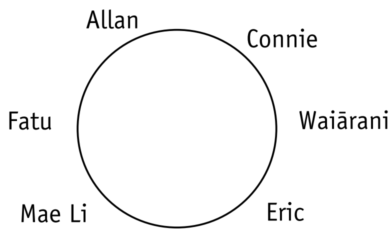
Fatu wants to sit opposite Waiārani.



Allan wants to sit next to Connie.

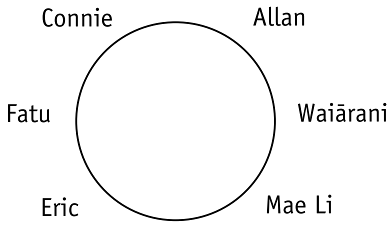


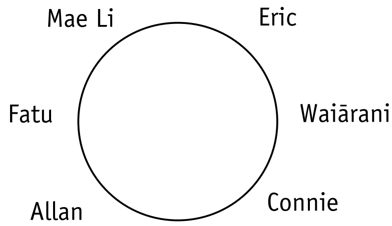
Someone has to sit between Eric and Connie.

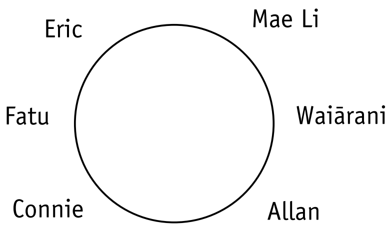


Don’t forget Mae Li!

There are several possible solutions based on variations of the third clue. Other possibilities are:







With the eight-person seating problems that students devise for one another, encourage them to develop clues that give only one solution. These problems will need to be trialled with other classmates.

Pages 12–13: Lights Out

Achievement Objectives

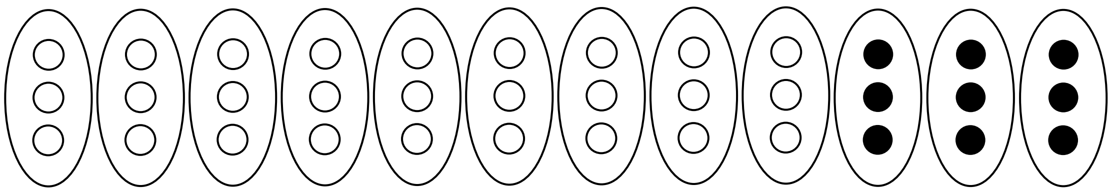
- find a given fraction or percentage of a quantity (Number, level 4)
- use graphs to represent number, or informal, relations (Algebra, level 3)

Activity One

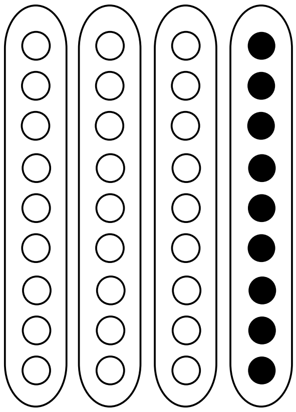
The tent lights problem on page **12** demonstrates the concept of equivalent fractions. This concept is critical to students' understanding of decimals and percentages.

Discussing the meaning of fractions is vitally important. For example, 27 of the 36 tents are lit up at 9.30 p.m. As a fraction, this is $^{27}/_{36}$, the denominator (bottom number) giving the number of members in the set, and the numerator (top number) giving how many of those members have been identified.

Note that $^{27}/_{36}$ can be simplified as follows:

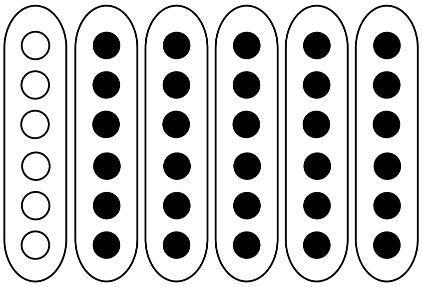


as $^{9}/_{12}$ by grouping in threes, so $$\underset{\div 3}{\overset{\div 3}{\frac{27}{36} = \frac{9}{12}}}$$



or as $^3/_4$ by grouping in nines, so $\frac{27}{36} \underset{\div 9}{\overset{\div 9}{=}} \frac{3}{4}$

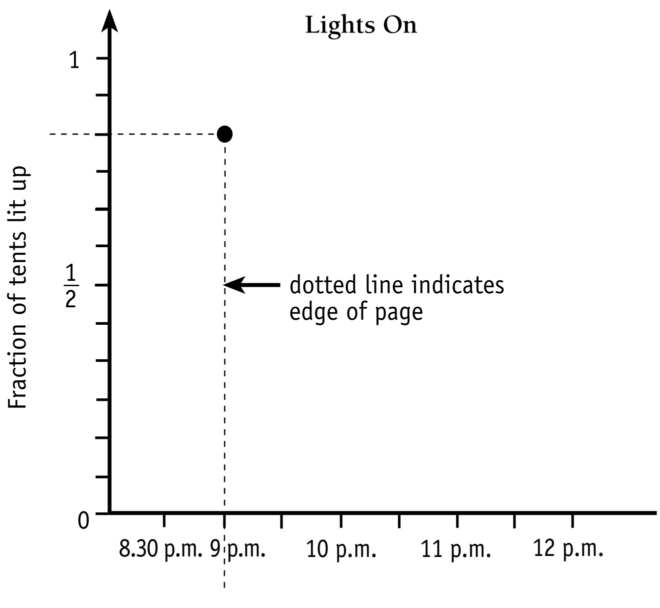
Students need to reverse this process to answer question **3**. The 36 tents must be grouped into six equal subsets. One of those subsets shows the lighted tents:



One-sixth of 36 is 6.

Activity Two

In this activity, students are asked to interpret and draw graphs to show the relationship between time and the fraction of tents lit up. Each point on the graph can be represented as an ordered pair. For example, (9, $^5/_6$) means $^5/_6$ of the tents are lit at 9 p.m. Using a corner of a sheet of paper is a good way to confirm the position of ordered pairs on a number plane:



The completed graph for Monday night is shown in the answers.

Pages 14–15: Planning the Tramp

Achievement Objectives

- perform measuring tasks, using a range of units and scales (Measurement, level 3)
- draw and interpret simple scale maps (Geometry, level 3)

Activity

Students will find a photocopy of the map useful for marking out routes, resting places, and a lunch site and for measuring distances. A copymaster of Mārama Island is provided at the back of this booklet.

Students will need some guidance before attempting this activity. You could discuss the following points:

- How are the distances on the map measured?

  Discuss what the scale line at the bottom of the page means. The scale is 1 centimetre : 200 metres, though it is easier for students to interpret distances in whole kilometres. Give students some simple distances to find to confirm their knowledge of scale.

- How fast will the trampers walk?

  Speed is a difficult concept for students to understand. This situation is simplified to include only two different speeds, 4 kilometres per hour for flat terrain and 2 kilometres per hour for steep terrain. The mountain track and walking track symbols in the key will help students work out when a climb begins. Check on their comprehension of speed by asking them questions such as:
  "How long will it take to climb from the base of Mount Mārama to the top?" (This is about 800 metres, which will take about 24 minutes at 2 kilometres per hour. This could be explained as: At 2 kilometres an hour, it takes 60 minutes to go 2 000 metres. So to go 1 metre, it takes $^{60}/_{2\,000}$ minutes. To go 800 metres, it takes 800 x $^{60}/_{2\,000}$ = 24 minutes.)
  "How long would it take to walk along the beach from the seal colony to Koura Bay?" (This is a distance of just over 1 kilometre, which will take just over 15 minutes at 4 kilometres per hour.)

- Where can the trampers walk?

  The walking tracks are shown by dotted lines. The beaches are also accessible for walking.

You could ask more capable students to use orienteering directions involving distance and compass bearings to explain their tramp route.

Page 16: Reflecting on Scenes

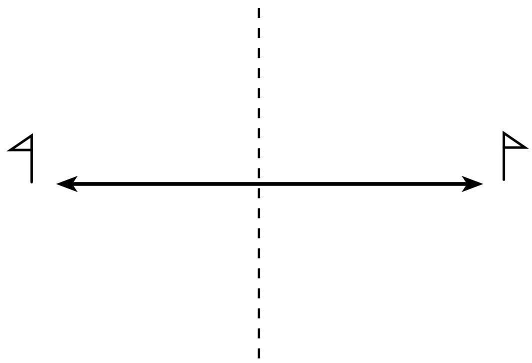
Achievement Objectives

- describe patterns in terms of reflection and rotational symmetry, and translations (Geometry, level 3)
- design and make a pattern which involves translation, reflection, or rotation (Geometry, level 3)

Activity

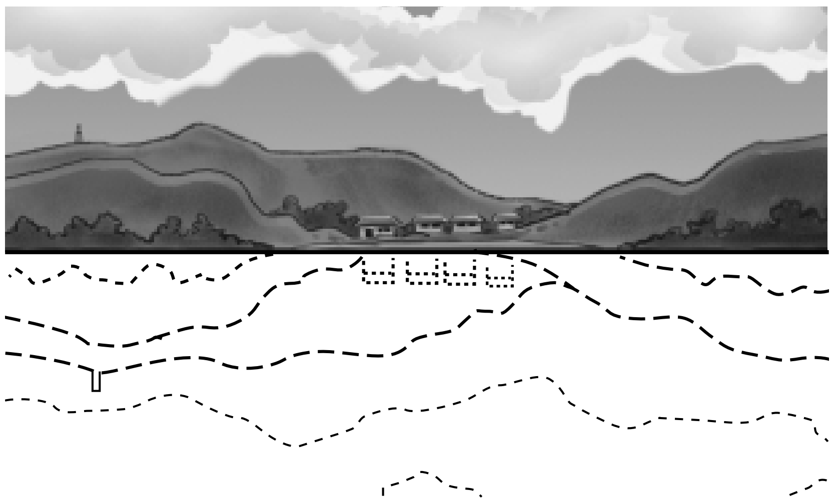
This activity uses mirror symmetry.

Students will need to know some rules about reflectional symmetry.



Distances stay the same. Orientation is reversed.

Students will need to apply these rules for each land structure and cloud formation reflected in the lake. For example, consider the view from the western shore:



Some students may need to use mirrors to help them visualise the image in the lake.

Page 17: Orders

Achievement Objectives

- devise and use problem-solving strategies to explore situations mathematically (Mathematical Processes, problem solving, level 3)
- use a systematic approach to count a set of possible outcomes (Statistics, level 3)

Activity

For problem **1**, students can use tabs labelled with the students' names as a model to consider each clue in turn.

Clue 1: Eric is three places behind Mae Li

Clue 2: All the girls are in front of all the boys

Allan Rangi Eric							Aroha Connie Mae Li

Clue 3: Aroha is next to Allan

		Allan	Aroha		

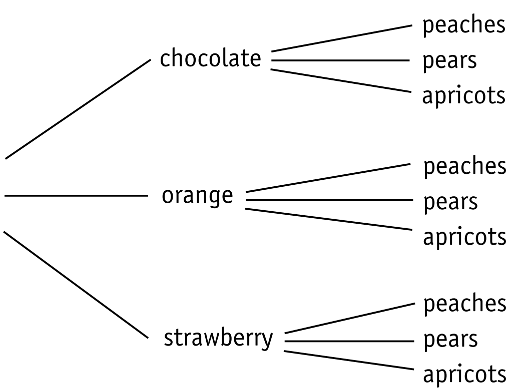
Mae Li must be in front of Aroha to make clue 1 work, so:

	Eric	Allan	Aroha	Mae Li	

Connie must be first in the queue

Rangi	Eric	Allan	Aroha	Mae Li	Connie

Question **2** involves probability. Students will first need to work out all the possible outcomes (combinations). They could use a tree diagram to do this:



Or they could use a table:

	peaches	pears	apricots
chocolate			
orange			
strawberry			

Then, considering each person's wishes:

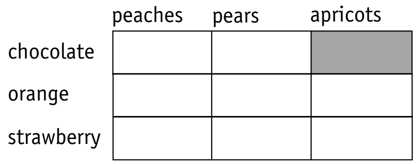
a. Please don't let me get peaches.

$^6/_9$ or $^2/_3$

b. I hope I get orange instant pudding.

$^3/_9$ or $^1/_3$

c. I'd love apricots with chocolate instant pudding.



$^1/_9$

The process of selecting puddings could be simulated by using two containers, one for the instant pudding (brown, orange, and red cubes) and one for the fruit (yellow, white, and orange cubes). Thirty-six combinations of one pudding and one fruit could be selected and the results checked against each person's wishes.

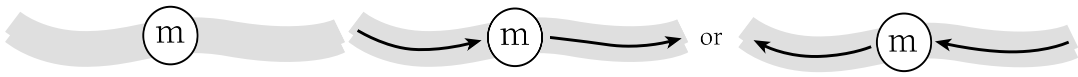
Page 18: Gaining Confidence

Achievement Objective

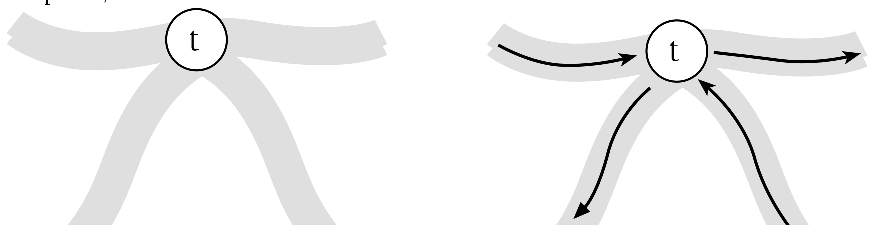
- classify objects, numbers, and ideas (Mathematical Processes, developing logic and reasoning, level 3)

Activity

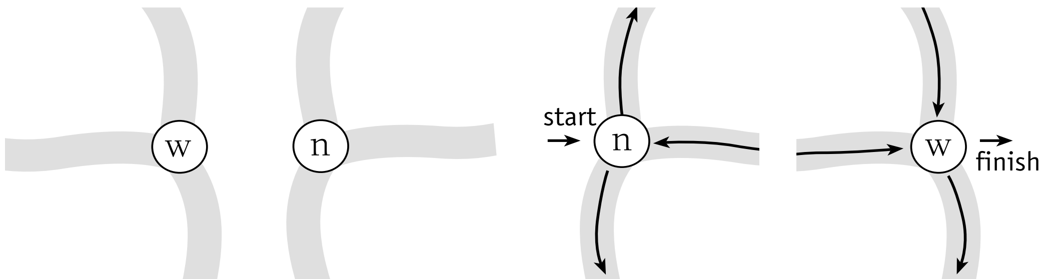
Students investigate networks in this activity. A critical factor in analysing networks is the number of paths leading to or from each obstacle. For example, on Monday's course …



The monkey bars obstacle has two paths, so … people come and then go once.



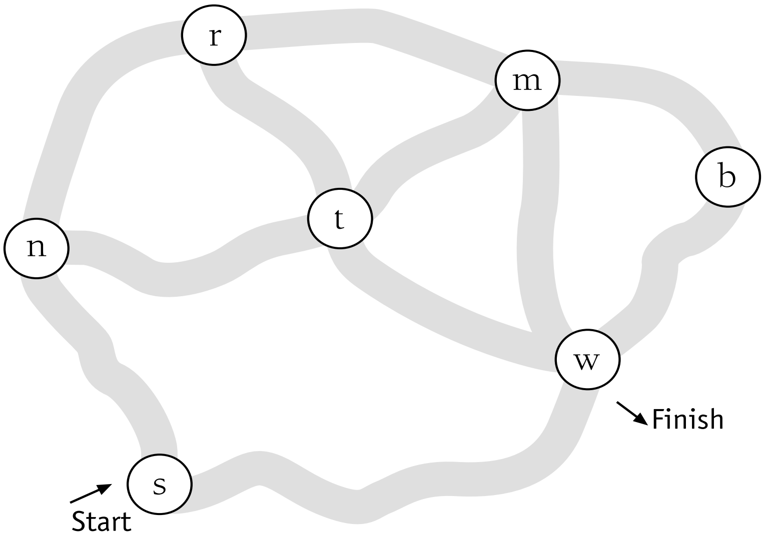
The tyres obstacle has four paths, so people must come and go twice.



The net and the climbing wall both have three paths, so … you start from there and then come and go again, or you come and go and return to finish.

Thus obstacles with an odd number of paths are starting and finishing points.

On Wednesday's course, the number of paths for each obstacle are:



If the course were to work, n and r would have to be the start and finish points because they have an odd number of paths. To make the track work, s and w each need to be adjusted to have an odd number of paths, and n and r each need an even number of paths. This can be achieved by closing path n – r and path s – w.

Page 19: Can You Kayak?

Achievement Objective

- record, in an organised way, and talk about the results of mathematical exploration (Mathematical Processes, communicating mathematical ideas, level 3)

Activity

Question **1** is a possibilities and constraints problem. Similar problems can be found in *Algebra,* Figure It Out, Levels 2–3. A variety of strategies could be used:

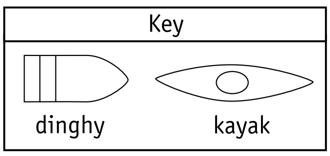
- trial and improvement

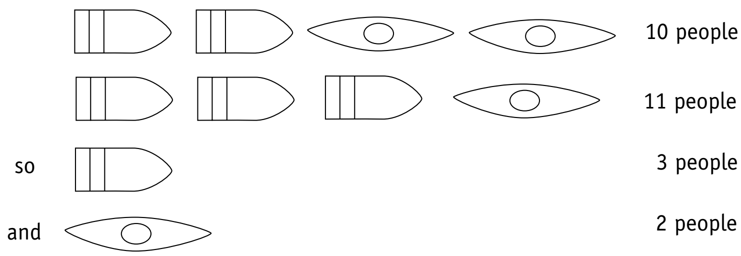
  Two dinghies and two kayaks can hold 10 people in total. So try a kayak holding one person and a dinghy holding four people …

- using a table to organise the information

People in kayak	People in dinghy	People in three dinghies and one kayak
1	4	13 too much
2	3 (to make the first clue work)	11 just right!

- using patterns





Question **2** builds on this answer and provides a more complex possibilities and constraints problem. Similar strategies can be used, for example, trial and improvement using a table:

Number of dinghies	Number of kayaks	Total number of people
15	0	45 too many!
14	1	44
13	2	43
:	:	:
:	:	:
6	9	36 Yes!

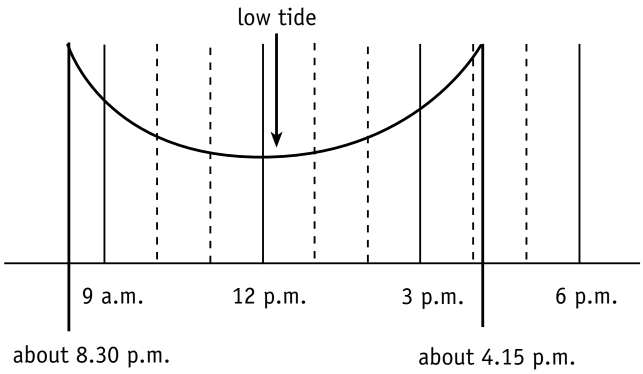
Pages 20-21: Claws!

Achievement Objectives

- read and interpret everyday statements involving time (Measurement, level 3)
- collect and display discrete numeric data in stem-and-leaf graphs, dot plots, and strip graphs, as appropriate (Statistics, level 3)

Activity

Students must interpret the scale of the tide timetable correctly to work out the actual time for low tide. This can be done using the symmetry of the tide curve. Look at a portion of the tide timetable:



The low-tide time gives the line of reflective symmetry in the curve. As can be seen from the portion of the curve above, this is just after 12 p.m., probably about 12.15 p.m. By similar reasoning, the low tide for tomorrow will be about 1.45 p.m. (The tides get a bit later each day, so the curve will not have perfect reflectional symmetry.) The period of time between 1 p.m. and 2.30 p.m. tomorrow is probably the best time to explore the pools because it does not clash with lunchtime. (See the Ministry of Education's *Making Better Sense of Planet Earth and Beyond* [Wellington: Learning Media, 1999] pages 94, 95, and 100 for cross-curricular links with tides and moons.)

For question **2**, be sure that students measure the crabs in millimetres. This is a good time to remind them that the prefix milli means one thousandth, so there are 1 000 millimetres in 1 metre. Centi means one hundredth, so there are 100 centimetres in 1 metre.

The data gathered is numeric, so the stem-and-leaf graph and dot plot are the most suitable graphs for students of this level. Students may like to draw different graphs for the two different species of crabs.

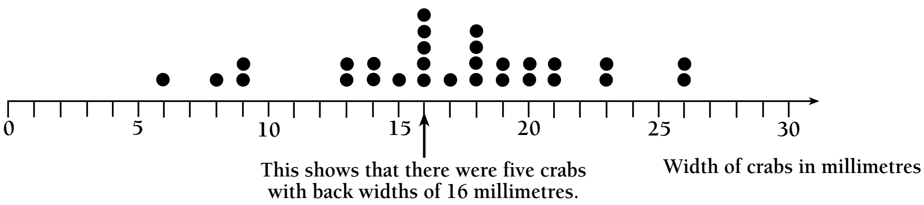
For the stem-and-leaf graph, all the measurements have a tens digit and a ones digit. The tens digits 0, 1, and 2 are the stem. The ones digits are the leaves:

Crab Sizes

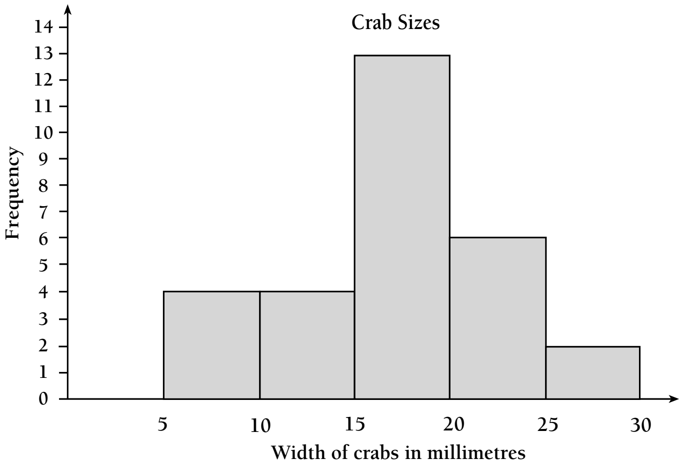
cm	mm
0	6 8 9 9
$\boxed{1}$	3 3 4 4 $\boxed{5}$ 6 . . .
2	

The boxed digits show how a 15 millimetre measurement would be recorded.

A dot plot resembles a number line with dots used to show the number of crabs that have measurements of that size.



A more advanced graph of this data is called a histogram. In this type of graph, the x axis (horizontal axis) shows the measurements divided into bands and the y axis (vertical axis) shows the numbers of crabs. The number of crabs in each band is known as the frequency. The band goes up to, but does not include, the number that starts the next band. For example, there are four crabs shown in the 10–15 band. This does not include the 15 millimetre crab.



Histograms are used to show continuous data, that is, data that can take any value within a range. Measurement data is usually continuous. Discrete numeric data has a restricted number of values. For example, the number of people in a household must always be a whole number (1, 2, 3, …), so this numeric data is discrete.

Page 22: Moa Mystery

Achievement Objectives

- demonstrate knowledge of the basic units of length, mass, area, volume (capacity), and temperature by making reasonable estimates (Measurement, level 3)
- perform measuring tasks, using a range of units and scales (Measurement, level 3)

Activity

In this activity, students will be applying techniques that are used by forensic scientists to estimate the size of people and animals. They will be using ratio or proportion.

Students will first need to calculate what part of the moa's height was taken up by the thigh bone. In the scale drawing of the moa, the thigh bone measures 69 millimetres.

The moa's height in the drawing is 153 millimetres. Generally, moa were over twice as tall as the length of their thigh bones, but 153 ÷ 69 = 2.22 is a more accurate scale factor for this activity.

The thigh bone found during the caving expedition is 110 centimetres long, so the moa's height would have been 110 x 2.22 = 244 centimetres or 2.44 metres.

Challenge students to work out how long the other major bones of the moa would have been, given the size of the thigh bone. They will need this information if they are to draw the life-size moa skeleton on the concrete or on paper.

Students will need to work out what fraction of 110 centimetres each bone is. For example, the lower leg bone is 30 millimetres long in the picture, and therefore it is less than half the 69 millimetre length of the thigh bone. 30 ÷ 69 = 0.435 gives the scale factor. 0.435 x 110 cm = 47.9 cm gives the actual real-life length of this moa's lower leg bone.

Page 23: Knot Tying

Achievement Objective

- model and describe 3-dimensional objects illustrated by diagrams or pictures (Geometry, level 3)

Activity

Knot tying provides a practical context for students to interpret diagrams. The knots shown are still commonly used by truck drivers, climbers, sailors, farmers, and in other occupations where rope is used. Make sure that students use cord of a good thickness. String is not adequate because it is difficult to undo. The most useful knots are those that tighten when tension is applied, which prevents slipping. The names of some of these knots give an indication of their original purpose. For example, the fisherman's knot was designed to join two lengths of fishing line. The bowline was designed to create a fixed loop of rope that looked rather like a bow.

In completing question **3**, encourage students to think about the best knots to use before building the equipment. For example, in constructing the swing, students might use cow hitches to tie the rope to the swing wood. This will provide a double rope on each side, which can be tied to the tree limb using either two half hitches tied with two pieces of rope or a reef knot if the two single lengths of rope are looped over the limb in opposite directions.

Page 24: Bean Bag Antics

Achievement Objective

- describe in words, rules for continuing number and spatial sequential patterns (Algebra, level 3)

Activity

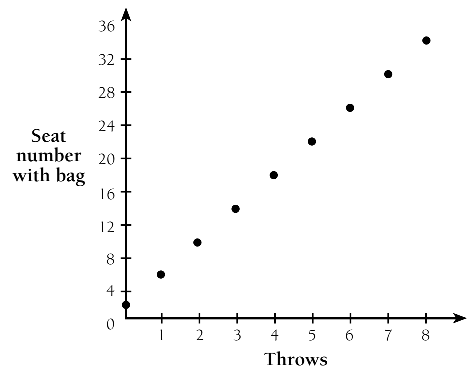
Students need to look for patterns in sequences of numbers to answer the problems on this page.

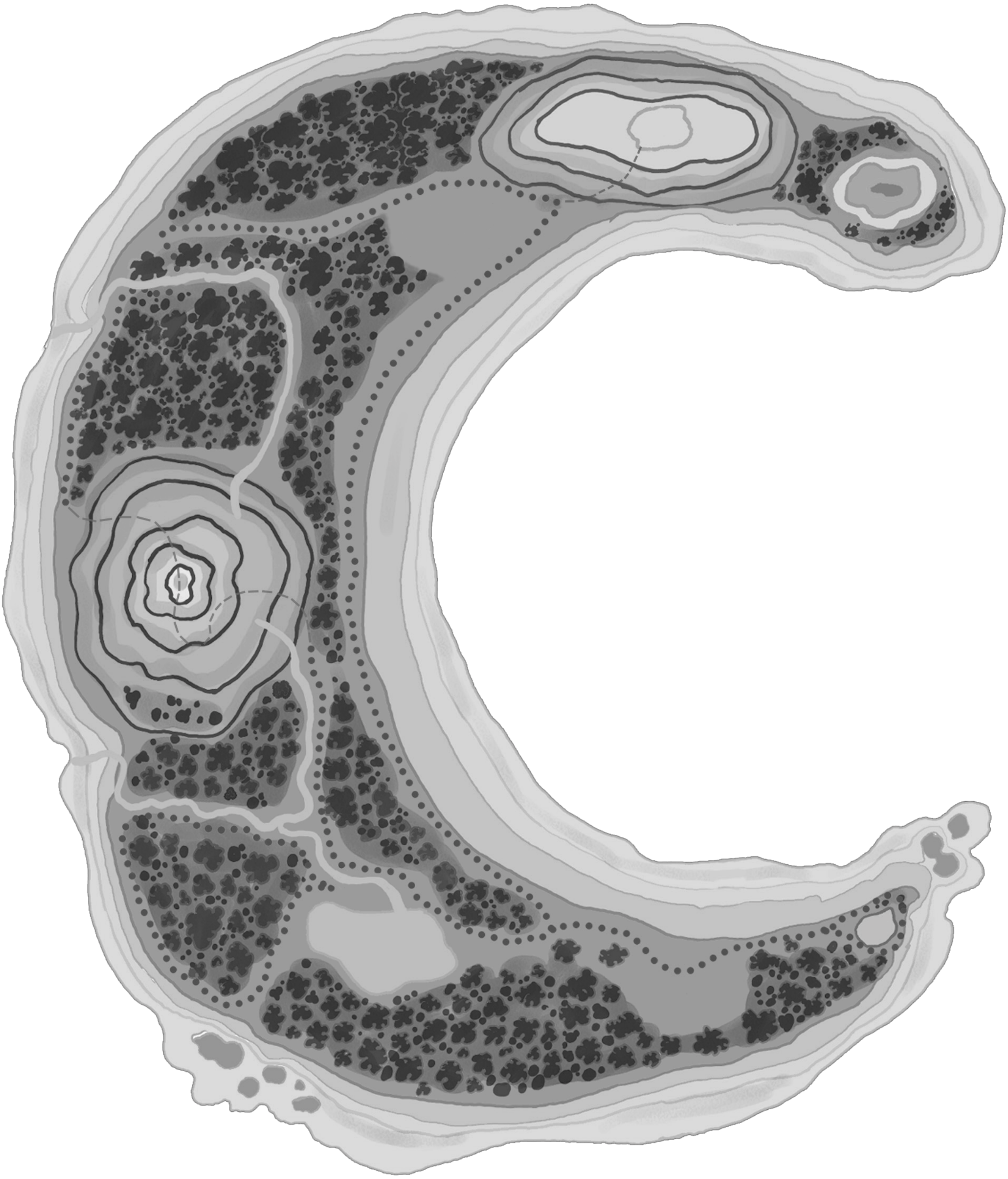
In the first pattern, the seat numbers increase by four with each bag throw:

Throws	0	1	2	3	4	5	6	7	8
Seat number with bag	2	6	10	14	18	22	26	30	34

+ 4 + 4 + 4 + 4 + 4

This pattern could be graphed on a number plane:





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The main illustration on the cover and contents page (except for the kayakers and the boy at the beach, which are by Fraser Williamson), the background picture of the girl building with sticks on the contents page and pages 2 and 6, and the views of Marama Island on pages 14, 19, and 26 are by Gus Hunter, and the line art on the page banners of the contents page and pages 2, 3, and 6, the background line art on the contents page and pages 2 and 6 (apart from the girl building with sticks), and the weather icons on page 9 are by Fraser Williamson.

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