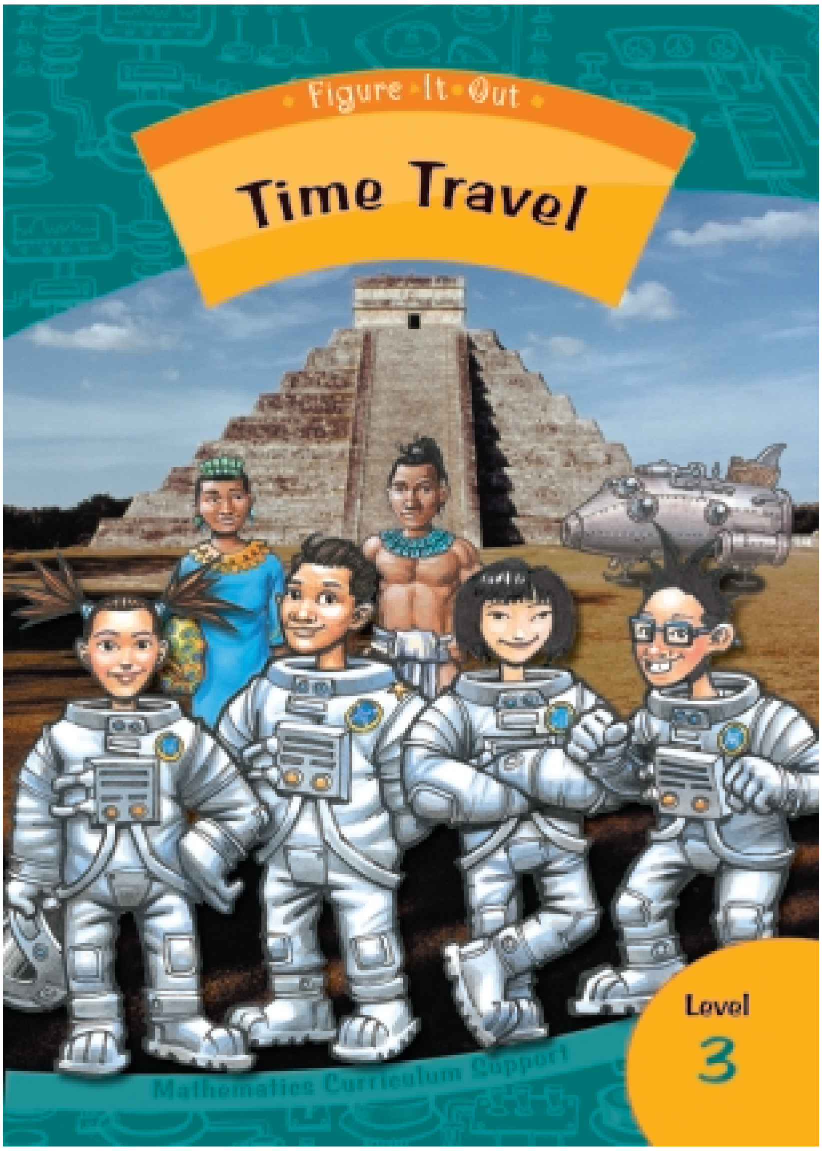
Answers and Teachers' Notes



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. The teachers' notes are also available on Te Kete Ipurangi (TKI) at www.tki.org.nz/community

There are now nine booklets for level 3: one booklet for each content strand, one on problem solving, one on basic facts, and two theme booklets. 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 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 their 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.

Figure It Out

Time Travel
Answers

Page 1: Learning to Drive

Activity One

1. a. Press the red button and the blue button the same number of times (in any order).

   b. Press the yellow button 3 times.

   c. Press the red button twice as many times as the yellow button and the blue button (in any order).

2. There are many ways. Three ways are:
   - Press the red button twice
   - Press the yellow button 5 times
   - Press the red button 5 times and the blue button 10 times

3. No, because it doesn't matter whether you move forwards or backwards first – the answer is still the same.

Pages 2–3: Into the Lions' Den

Activity One

1.

III	IV	V	VIII	X	**XIII**	**XIV**	XVII	XIX	XLIX
3	4	**5**	8	**10**	13	14	**17**	**19**	**49**

2. XII

3. 31

4. Practical activity

Activity Two

1. a. 25 senators + 50 soldiers + 100 slaves + 10 nobles = 185 people

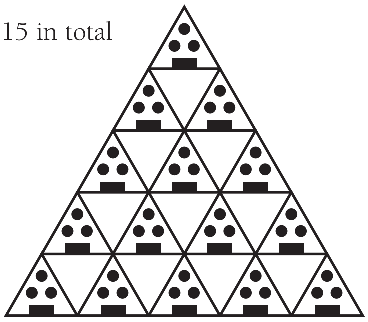
   b. CLXXXV

2. Answers will vary depending on the year.
   For example, 2002 is MMII.
   Teacher to check

Page 4: Delta Island

Activity

1. 7, to make 15 in total



2. No, there will only be enough housing for 300 people.

3. 25

4. a. No, there will only be enough housing for 200 people.

   b. Yes, there will be enough housing for 320 people.

Page 5: Getting Heavy

Activity

1. 40 Newtons

2.

Name	Weight on Earth	Estimated weight on Gargantor	Weight on Gargantor checked on calculator	Weight on Gargantor to 1 decimal place
Tūrei	525.57 N	2 000 N	2 102.28 N	2 102.3 N
Monica	476.13 N	**approx. 2 000 N**	**1 904.52 N**	**1 904.5 N**
Sam	423.92 N	**approx. 1 700 N**	**1 695.68 N**	**1 695.7 N**
Natalie	392.49 N	**approx. 1 600 N**	**1 569.96 N**	**1 570.0 N**

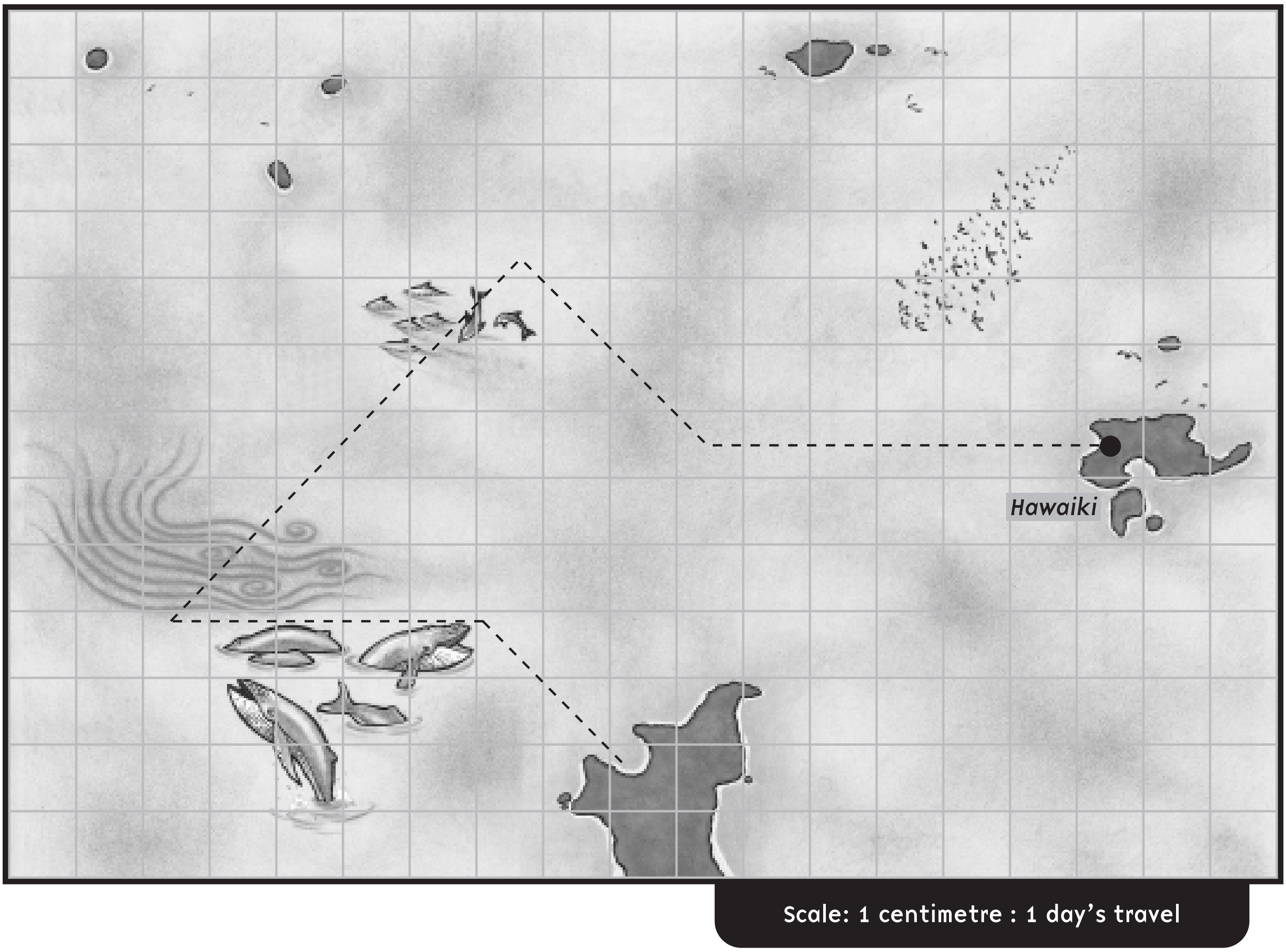
3. **a.** 725 N

b. No, as he would weigh exactly 730 N, and he must weigh less than 730 N to qualify as a middleweight.

Pages 6–7: Voyage from Hawaiki

Activity One

1.



2. Right
3. 25 days

Activity Two

a.–b. Answers will vary. Teacher to check

Pages 8-9: Roar!

Activity One

1. 7 times
2. a. once
   b. 3 times
   c. 4 times
3. 8 times

Activity Two

1. Estimates will vary but should be approximately 7 m for the theropod, 12 m for the mosasaur, and 3 m for the pterosaur.
2. Theropod – 7 m
   Mosasaur – 12 m
   Pterosaur – 3 m
3. a. Pterosaur
   b. So it can fly
4. Answers will vary. Examples are elephants, hippopotamuses, and whales.

Investigation

1.–3. Practical activities

4. 4 seconds
5. Practical activity
6. No.

Page 10: The Swinging Sixties

Activity

1. 2 hours
2. 2 hours
3. 90 hours
4. 80 hours
5. Answers will vary, but from this information, Monica and her dad have to work for about the same length of time to get the same things, so it's probably not any more or less expensive to live now than in 1969.

Page 11: Cost of Living

Activity

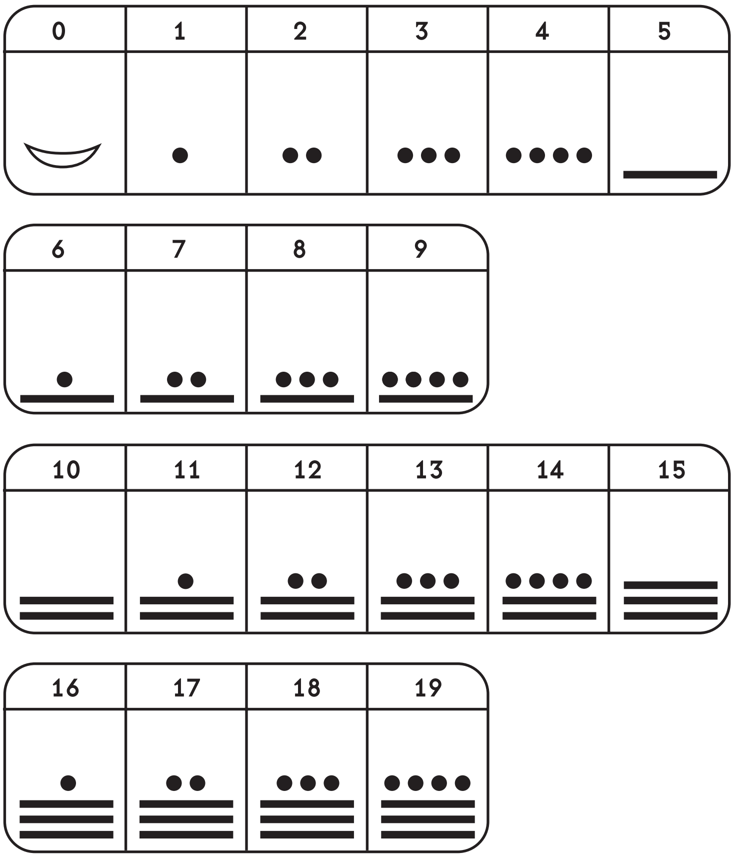
1.–3. Answers will vary. Teacher to check

4. Answers will vary. There may be less land for cultivation, and a larger population will increase the demand for wood and fresh food. This increased demand may push up the prices.

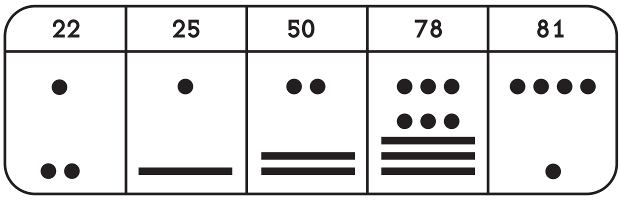
Pages 12-13: Mayan Adventure

Activity One

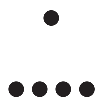
1.



2.

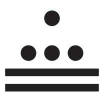


3. a.



b.

c.



d.

Activity Two

1. Practical activity. Teacher to check
2. a. 35

   b. 17.5 tonnes
3. a. Practical activity

   b. ●●●●

   ●●●●
4. a. (9 x 9) + (7 x 7) + (5 x 5) + (3 x 3) + (1 x 1) = 165

   b. Multiply the length of a side of the bottom layer by itself. Then subtract two from the length, and multiply that number by itself. Continue to do that until you reach 1. Then add the numbers.

Page 14: Zing!

Activity

1.

Name	Height (in cm)	Height (in laks)
Monica	144 cm	36 laks
Tūrei	152 cm	**38 laks**
Sam	**140 cm**	35 laks
Natalie	**136 cm**	34 laks
Your name		
Your classmate's name		

2. a. All of the crew are eligible to enter the Zigoura hoverboard competition.

   b. Answers will vary.

   c. Answers will vary.
3. $102 altogether (or $17 each)

Page 15: Kia Ora

Activity

1. It is not a good place to practise because the whare is not tall enough for Roimata to swing the poi in a complete circle. The whare would have to be more than 2 m high for Roimata to swing the poi in a complete circle.
2. a. Answers will vary. The dancers will have to stand approximately 2.5 m apart: 2 x (25 cm for arm length and 1 m for the poi string).

   b. Answers will vary. If there is just one row of poi dancers in the kapa haka group, they will have to stand approximately 1.5 m in front of the next row: 1 m for the poi string and 50 cm to allow for their arm moving backwards. If there is more than one row of poi dancers, they will have to stand approximately 3 m in front of the next row. They need to allow for their arm and poi length as well as the arm and poi length of the person behind them.
3. Practical activity

Page 16: Rosetta's Room

Activity

a. (4,4)

b. (7,4)

c. (8,7)

d. (1,7)

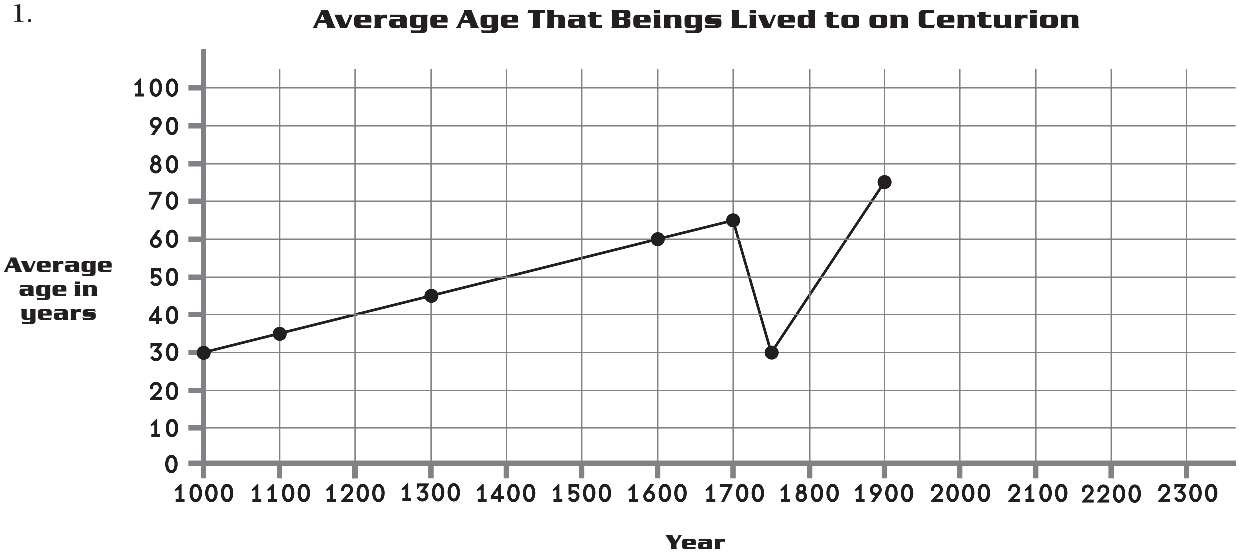
e. (0,9)

f. (7,2)

Page 17: Planet Centurion

Activity

1.



2. Around 1750 as this year lies outside the pattern formed by all the other years

3. 90 years

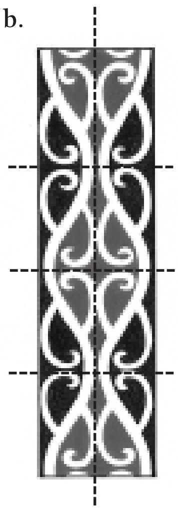
Pages 18–19: South Pacific Journey

Activity One

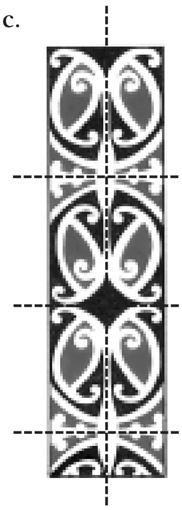
1. Yes, patterns b, c, and d.

2. a. No lines of symmetry

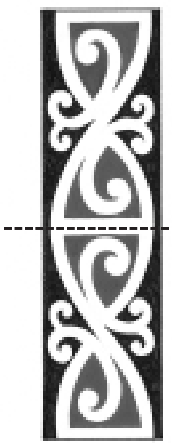
b.



c.



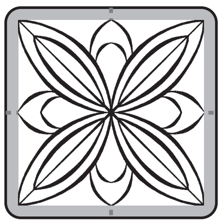
d.



Activity Two

a.

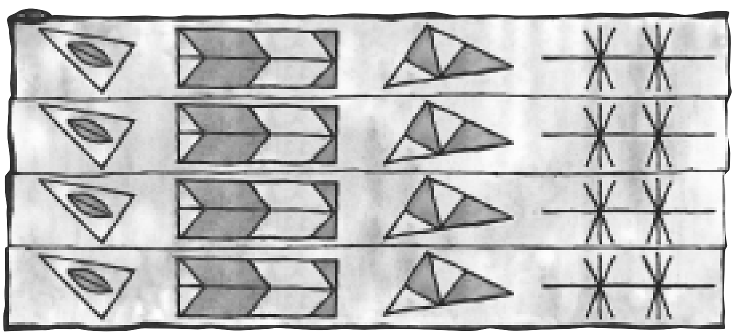
b.



c.

Activity Three

1.



2. 10 m

Pages 20–21: Epidemic!

Activity One

1.

Munster Deaths

Week 5	Week 6
16	32

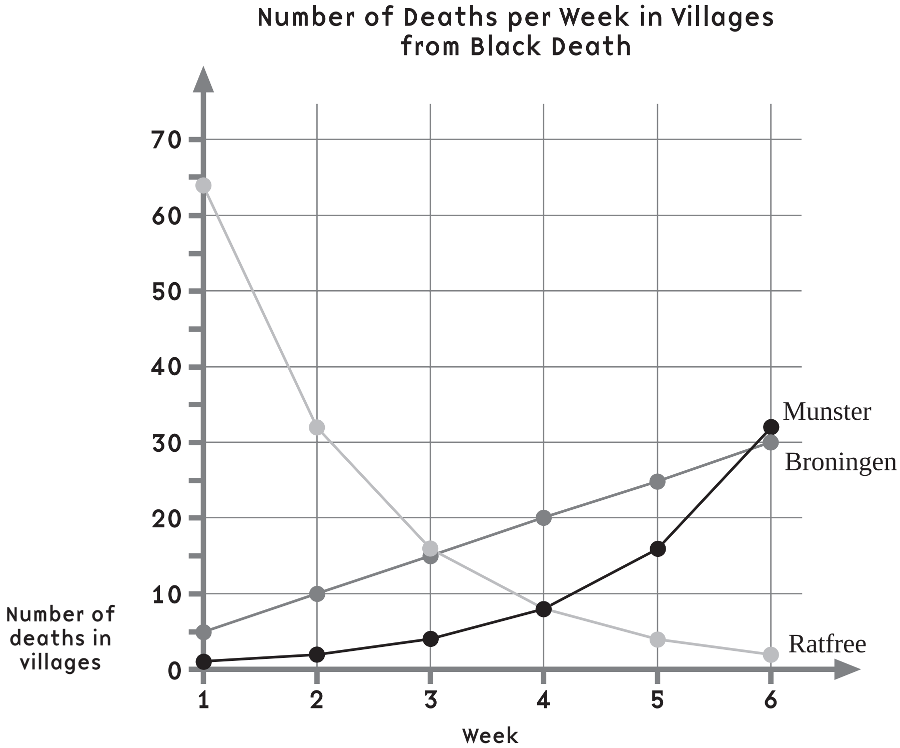
Broningen Deaths

Week 5	Week 6
25	30

Ratfree Deaths

Week 5	Week 6
4	2

2.



3. There will be 87 people left alive in Munster. There will be 45 people left alive in Broningen. There will be 24 people left alive in Ratfree.

4. Ratfree is the safest place to spend the night because the number of deaths is falling the most rapidly, even though more people have died from the plague so far in Ratfree than in Munster or Broningen.

Activity Two

1. a.

		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Munster	Villagers sent out	5	5	5	5	5	5	5	5	5	5
	Rats killed	50	50	50	50	50	50	50	50	50	50
Broningen	Villagers sent out	9	11	9	11	9	11	9	11	9	11
	Rats killed	90	110	90	110	90	110	90	110	90	110
Ratfree	Villagers sent out	whole village	0	0	0	0	0	0	0	0	0
	Rats killed	10	20	40	80	160	320	370	0	0	0

b. Answers will vary.

2. a. Broningen and Ratfree because they have killed at least 1 000 rats in the 10 days

b. Munster because they killed only 500 rats in the 10 days

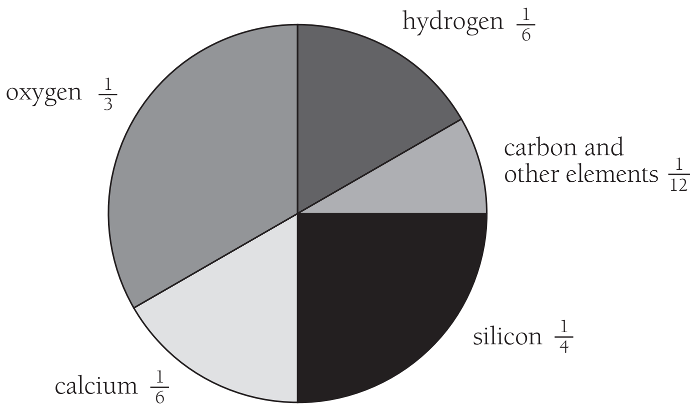
3. Discussion points will vary but should include the fact that each person kills 10 rats per day. To kill more rats and survive the plague, Munster needs to send more people out to kill rats or get some rat poison.

Pages 22-23: Body Analyser

Activity One

1. Teacher to check
2. a.

Body Analyser: Zerkonian



b. Teacher to check

c. $\frac{5}{6}$

Activity Two

10 games

Activity Three

Practical activity

Page 24: Back to the Present

Activity

1.

Destination	Years back or forward	Total years travelled there and back	Time points
Ancient Rome	2 000	4 000	40
Delta Island	**1 000**	2 000	**20**
Gargantor	**101***	**202***	**2.02***
Hawaiki	1 000	**2 000**	**20**
New Zealand dinosaurs	**70 000 000**	**140 000 000**	**1 400 000**
New Zealand 1969	**33***	**66***	**0.66***
New Zealand in 100 years	**100**	**200**	**2**
Mayan civilisation	2 000	**4 000**	**40**
Zigoura	500	**1 000**	**10**
Aotearoa 1500	**502***	**1 004***	**10.04***
Rosetta's year 3000	**998***	**1 996***	**19.96***
Centurion 2300	**298***	**596***	**5.96***
Pacific Islands	150	**300**	**3**
Medieval Europe	650	**1 300**	**13**
Zerkon	**572***	**1 144***	**11.44***
		Total time points	**1 400 198.08***

* Years travelled and time points will vary depending on the current date.

2. Answers will vary. You may decide to combine your time points with your classmate's to be able to get the mini space waka.

Figure It Out

Time Travel

Teachers' Notes

Overview: Time Travel

Title	Content	Page in students' book	Page in teachers' notes
Learning to Drive	Solving problems with operations	1	11
Into the Lions' Den	Understanding and using Roman numerals	2–3	12
Delta Island	Exploring triangles and solving problems	4	14
Getting Heavy	Working with unfamiliar units	5	15
Voyage from Hawaiki	Following directions and interpreting scale maps	6–7	17
Roar!	Using place value, measuring, and calculating	8–9	17
The Swinging Sixties	Working with rates of pay	10	19
Cost of Living	Understanding fractions and scale	11	20
Mayan Adventure	Investigating bases, number systems, and patterns	12–13	20
Zing!	Measuring and converting lengths and money	14	22
Kia Ora	Measuring and working with distances	15	23
Rosetta's Room	Plotting co-ordinates and using ordered pairs	16	23
Planet Centurion	Graphing and analysing data	17	24
South Pacific Journey	Identifying and completing symmetrical patterns	18–19	25
Epidemic!	Interpreting data	20–21	25
Body Analyser	Working with data displays and fractions	22–23	26
Back to the Present	Using basic operations with multidigit numbers	24	27

Page 1: Learning to Drive

Achievement Objective

- 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

In this activity, the students are required to add combinations of the integers ⁻100, 30, and ⁻40 in order to arrive at the totals given in the questions. This is an excellent introduction to integers and is an appropriate activity for students working at level 3. (Integers are explored more fully in level 4.)

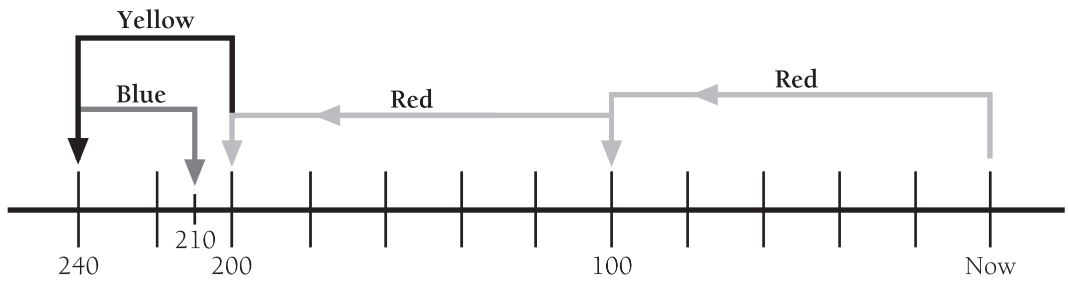
To introduce the activity to the students, ask them what buttons they would press to:

- travel back 200 years
- travel back 140 years

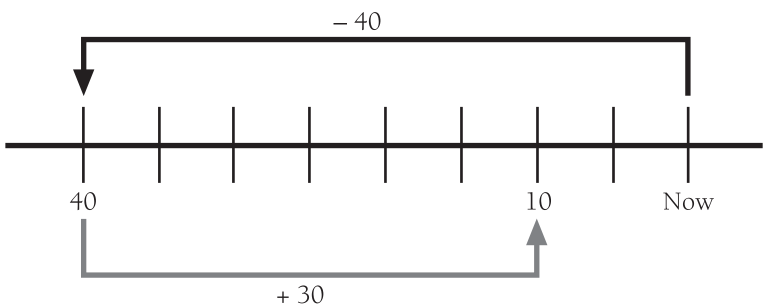
and then, as a slightly more complex option, to:

- travel back 10 years.

You could use a number line to model what is happening each time you press a button on the control panel. The students could then use number lines to work out their answers. For example, for question **1c:**



Be aware that some students may not take into account that the buttons specify whether they move us forwards or backwards in time. They may only consider the absolute value for each number. For example, some students may say that the answer to question **1a** should be blue and yellow, having calculated 40 + 30 = 70. However, those students will not have taken into account the fact that one button is going back in time while the other is going forward in time. The net effect of pressing these two buttons is a trip back in time of only 10 years:



The order in which the buttons are pushed does not matter. Going backwards in time for 100 years and then moving forwards by 50 years takes you to exactly the same point as going forwards 50 years first and then backwards for 100 years. In numbers, this could be written as

⁻100 + 50 = ⁻50 or 50 – 100 = ⁻50

Some students may have trouble with this concept. Have them walk it out. Draw a chalk timeline on the floor and mark a point as zero or the present. To one side, mark the years going backwards in time, and in the other direction, mark the years going forwards in time. Ask the students to pace out a combination of moves. Rearrange the same combination of moves and ask another student to pace this out. For example:

Student 1: forwards 10, backwards 20, forwards 40, and backwards 30
Student 2: forwards 40, backwards 30, forwards 10, and backwards 20.

Both students will arrive at the same destination (as long as they both start at the zero point).

As an extension, you could ask:

"How can you travel 20 years forward in time by using the blue and yellow buttons?" ($^{-}40 + 30 + 30$)

"How can you travel 20 years forward in time by using only the blue and red buttons?" ($^{-}100 + 30 + 30 + 30 + 30$)

You could also make up your own "control panel" and set questions accordingly, or you could add more "control buttons" to this panel and include larger numbers or numbers that are difficult to add and subtract.

Pages 2–3: Into the Lions' Den

Achievement Objectives

- explain the meaning of the digits in any whole number (Number, level 3)
- solve practical problems which require finding fractions of whole number and decimal amounts (Number, level 3)

Activity One

Discuss the Roman numeral system with the students to ensure that they can use it confidently before they start this activity. The Roman numeral system is a base 10 system that is additive, building numbers up through 5, rather than being founded on place value as our number system is. This means that numbers are built up by adding the values of the symbols together, for example, 6 = VI (5 + 1), 18 = XVIII (10 + 5 + 3). Some students may have difficulty with the "one before" idea of some of the numbers, for example, 4 = IV ("one before" five), 9 = IX ("one before" 10). For students who are having difficulty with this, point out that, in the Roman numeral system, a symbol cannot be used more than three times in a row, for example, 90 is XC, not LXXXX.

In the case of two-digit numbers, the students need to remember to build the Roman numeral for the tens digit first and then the ones digit, for example, 49 is XLIX (40 + 9), not IL.

Some students might like to do some more research on Roman numerals. One website that might be a useful start is: www.deadline.demon.co.uk/roman/front.htm

Note: *Number*, Figure It Out, Levels 2–3, page 4, Activity Two offers further exercises with Roman numerals.

As extension, the students could solve these problems:

a. XI + XII = b. IV + VI =

c. XVIII + XXVI = d. ILVIII – XXVII =

e. L – XXVII =

Discuss with the students whether they think the problems are easier to solve using our Arabic numerals or Roman numerals.

You can also extend this activity by asking the students to further investigate the Roman and Arabic numeral systems. For example, the numeral system that we use is known as the Arabic numeral system. The students may be interested to research how we came to use this numeral system.

Roman numerals are still used today. They are used on some clock and watch faces and for giving the date of TV programmes and films. The students could work out when the movies and TV programmes they watch were made. Lower case Roman numerals, such as i, ii, iii, and iv, are used as a numbering system in books such as the Figure It Out series.

You could ask more able students to write the year they were born in Roman numerals. This is more difficult than it seems because there are several different schools of thought about the correct way to write the 1990s in Roman numerals. The website mentioned above contains a useful discussion of how to write 1999 in Roman numerals (www.deadline.demon.co.uk/roman/1999.htm).

Activity Two

This activity helps to make explicit the link between fractions and decimals, which the students will encounter when they work at level 4. This is a sets model of fractions, that is, finding a fraction of a set of objects.

For example:

senators' section: $\frac{1}{4} = \frac{25}{100} = 0.25$

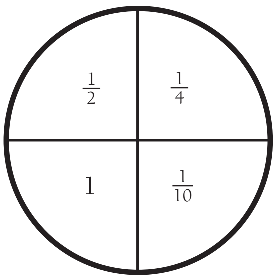
slaves' section: $\frac{1}{1} = \frac{100}{100} = 1$

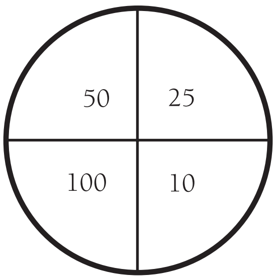
soldiers' section: $\frac{1}{2} = \frac{50}{100} = 0.5$

nobles' section: $\frac{1}{10} = \frac{10}{100} = 0.1$

The students could use a variety of strategies to answer question **1a**, for example:

- a diagram:





- both additive and multiplicative strategies:

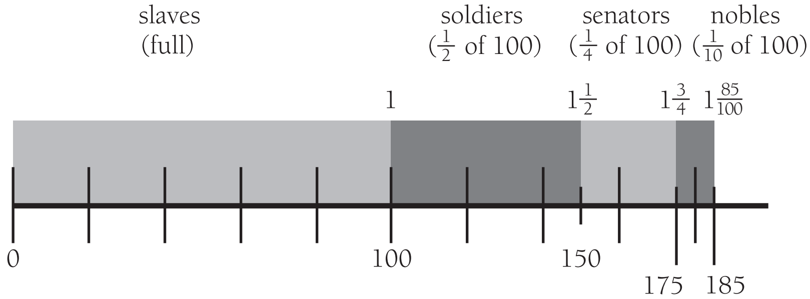
$\frac{1}{4} + \frac{1}{2} + 1 = 1\frac{3}{4}$ (still need to add $\frac{1}{10}$)

$(1\frac{3}{4} \times 100) + (\frac{1}{10} \times 100) = 175 + (\frac{1}{10} \times 100)$

$= 175 + 10$

$= 185$

- a double number line:



The top number line shows the fractions to be added. The bottom number line shows the numbers of people that correspond to the fractions.

Page 4: Delta Island

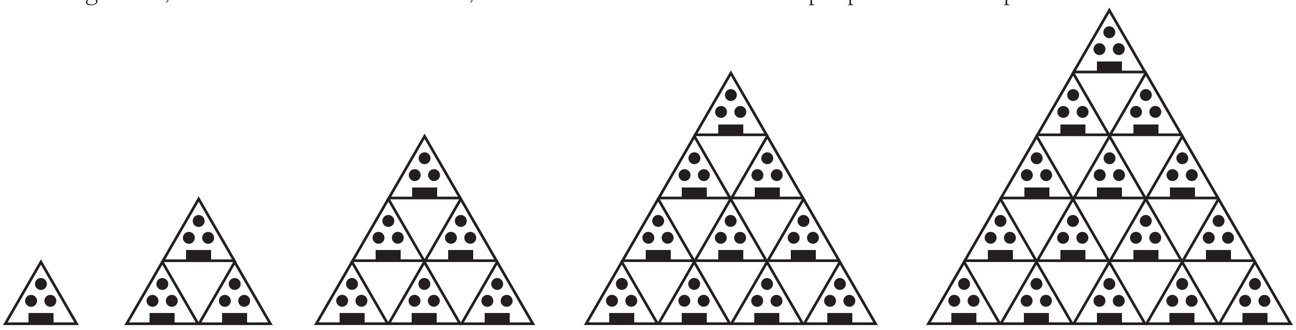
Achievement Objectives

- draw pictures of simple 3-dimensional objects (Geometry, level 3)
- describe in words, rules for continuing number and spatial sequential patterns (Algebra, level 3)

Activity

In this activity, the students investigate number patterns generated from triangular numbers. They will need to use problem-solving strategies, such as drawing diagrams and making tables, to identify and continue the number patterns.

Encourage the students to look for patterns in the number of houses. For example, without the anti-gravity device, the number of houses are triangular numbers. Question **1** asks the students to use triangles or draw a diagram. Ensure the students read the question properly and say *how many more* houses could be built. They could then add to their diagram the number of houses along the ground, the total number of houses, and the maximum number of people. For example:



Number of houses along the ground	1	2	3	4	5
Total number of houses	1	3	6	10	15
Maximum number of people	20	60	120	200	300

The students will need to make up a different table to complete the anti-gravity problems in questions **3** and **4**.

Number of houses along the ground	1	2	3	4	5
Total number of houses	1	4	9	16	25
Maximum number of people	20	80	180	320	500

From this table, the students may see a pattern developing where the total number of houses is the number of houses along the bottom multiplied by itself (that is, $t = n \times n$), and the maximum number of people is the total number of houses multiplied by 20 (that is, $p = t \times 20$). Using this reasoning, they would be able to calculate the maximum number of people for any number of houses along the ground.

Extension activities could involve looking at different "islands", each with different bases. For example, an island called Gamma has room for only six A-frame houses along the ground.

As an extension to question **3**, you could ask the students this question: "Anti-gravity houses cost half the price of normal houses. Each normal house costs 100 Delta dollars. What are all the houses worth altogether?"

Page 5: Getting Heavy

Achievement Objectives

- make sensible estimates and check the reasonableness of answers (Number, 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)
- solve practical problems which require finding fractions of whole number and decimal amounts (Number, level 3)
- perform measuring tasks, using a range of units and scales (Measurement, level 3)

Activity

In this activity, the students estimate, round, and multiply numbers within a context of weights differing because of different forces of gravity on Earth and on another planet.

The unit of measurement Newtons is used in this activity. In the English language, we talk about a person weighing 40 kilograms. Although we accept it and use this way of speaking quite freely, it is not scientifically correct. Kilograms are a measure of **mass**. Newtons are a measure of **weight**. Newtons are named after Sir Isaac Newton, who first discovered the laws of forces and gravity.

The body material of a person (bones, flesh, blood, and so on) has what is called **mass**. **Mass** is a measure of the amount of material a body has. It is measured in kilograms. Somebody with a mass of 60 kilograms has more body material than somebody with a mass of 50 kilograms. So what is **weight**? We are all kept on Earth by a force due to gravity. Gravity affects everything. However, the more mass an object has, the greater the force must be to keep it on Earth. So if we look at the two people of 60 kilograms and 50 kilograms, a greater force is needed to keep the 60 kilogram person in place. This force can be roughly calculated using the formula:

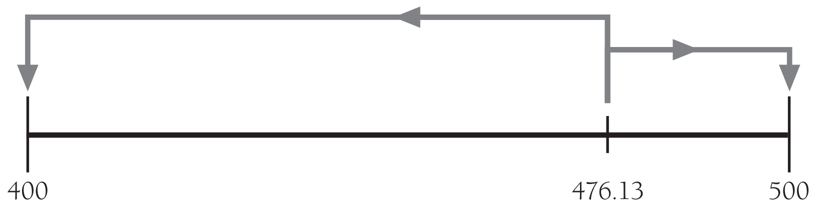
Weight (force) = mass $\times$ 10

So the gravitational force holding the 60 kilogram person on Earth is $60 \times 10 = 600$ Newtons. The 50 kilogram person is held by $50 \times 10 = 500$ Newtons, weight being a force that acts on a mass. That's why, strictly speaking, weight should be measured in Newtons, not kilograms.

What happens when the *Space Waka* crew go to Gargantor? That planet has a mass four times that of Earth, so the gravitational force that the *Space Waka* crew experience is four times greater than Earth's. So the crew weighs four times as much on that planet as they would on Earth, but their mass is exactly the same.

Pages 17, 106, and 120–122 of *Making Better Sense of the Physical World* (Ministry of Education, 1999) contain useful information about forces and weights.

The students may use a variety of different strategies to complete the calculations for question **2**. Discuss the idea of rounding numbers to the nearest 10 or to the nearest 100 to estimate weights on Gargantor. Some students may round to the nearest five, which is also acceptable. A number line may help the students to work out which number is best to round to:



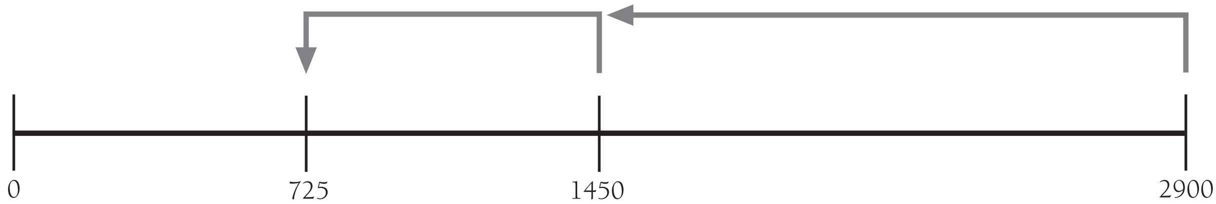
476.13 is closer to 500 than it is to 400.

The students then need to multiply the rounded numbers by 4 to estimate the crew's weights on Gargantor.

Some students may have difficulty rounding the answer they obtain on a calculator to one decimal place. Once again, the process of rounding can be modelled most effectively on a number line, for example:

1904.52 is closer to 1904.5 than it is to 1904.6.

For question **2**, you will need to discuss strategies for finding a quarter of an amount. Those students who have difficulties finding a quarter of Zingor's weight might find it easier to halve his weight and then halve it again to find a quarter. Once again, this can be modelled on a number line to show the students a visual model of the relative size of the numbers, for example:



The students might use a multiplicative strategy using known facts, for example,

$\frac{1}{4}$ of 2900 $= 2900 \div 4$

I know that $7 \times 4 = 28$, so $700 \times 4 = 2800$, and $20 \times 4 = 80$, and $5 \times 4 = 20$, so,

$2900 = 2800 + 80 + 20$

$= (700 \times 4) + (20 \times 4) + (5 \times 4)$

So it follows that $2900 \div 4 = 725$ (that is, seven hundreds, twenty tens, and five ones).

It is important to show the links between multiplication and division and for students to use the facts that they know to calculate the unknown.

In question **3b**, the boxer must weigh less than 730 Newtons, which means that he will not qualify if he weighs exactly or more than 730 Newtons.

Here are several possible extension activities:

- The students could use a computer spreadsheet to multiply the Earth weights of objects by four and then round to one decimal place.
- The students could investigate weights of objects on a planet that is the same size as Earth but that has a mass exactly one-third that of Earth's mass.
- Sir Isaac Newton developed mathematical laws for gravity. The students could research Sir Isaac Newton by using the Internet or a library.

Pages 6–7: Voyage from Hawaiki

Achievement Objectives

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

Activities

These pages are based on fact although this event is fictional.

The students are required to follow a set of directions to record a journey on a scale map. They will need to accurately measure distances with a ruler. To find the direction to travel in, the students will need to use a protractor.

Discuss the concept of scale with the students. Point out the difference between a scale diagram and a sketch and emphasise the importance of accurate measurements when using a scale diagram or map. In this activity, the students will need to use the key piece of information that 1 day's travel equals 1 centimetre.

If necessary, show the students how to use a protractor to measure angles. Some of them may need to practise this skill before applying it practically in this task. The grid enables the students to orient their protractor correctly. Ensure, though, that they measure distances with a ruler rather than just counting grid squares. Counting grid squares will only give an accurate measurement when travelling in the directions Tautoru setting and Tautoru rising. Moving diagonally one square along the grid does not correspond with 1 centimetre.

Make sure that you don't change the size of the map when photocopying it for the students because the answers supplied rely on the scale matching to the map at this size.

As an extension, the students could draw a scale diagram of the classroom or playground. They could also use a real map of the Pacific to make up and plot journeys between the Pacific Islands. They could also investigate how ocean-going vessels find their way now. Do they still use the stars or are there other navigation methods, for example, a Global Positioning System (GPS)?

As a link to the Culture and Heritage strand, level 3, and the Time, Continuity, and Change strand, level 3, of *Social Studies in the New Zealand Curriculum*, the students could find out more about voyaging waka. *The Discovery of Aotearoa* by Jeff Evans (Auckland: Reed, 1998) provides a lot of information about voyaging waka.

Pages 8–9: Roar!

Achievement Objectives

- explain the meaning of the digits in any whole number (Number, level 3)
- make sensible estimates and check the reasonableness of answers (Number, 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)
- describe in words, rules for continuing number and spatial sequential patterns (Algebra, level 3)
- perform measuring tasks, using a range of units and scales (Measurement, level 3)
- read and interpret everyday statements involving time (Measurement, level 3)

Activity One

This activity explores the link between place value and multiplying a number by 10, which is a key idea in developing an understanding of place value.

The students could use the constant function on their calculators for this activity. To set up multiplying by 10 as a constant function, they will have to press the [10] [x] [7] and then the [=] sign as many times as they want to multiply by 10. (Some calculators may require the [x] key to be pressed twice, that is, [10] [x] [x] [7] [=].)

Page 16 of *Answers and Teachers' Notes: Number*, Figure It Out, Level 3, discusses concepts relevant to this page, that is, multiplying and dividing by 10 and understanding place value.

This activity can be extended by investigating what happens when you press 70 000 000 into the calculator and divide by 10. "How many times do you have to press the [=] key to get to 7? What happens if you press the [=] key 10 times?"

Activity Two

This activity helps to develop estimation and measuring skills. The students also need to use scale to calculate lengths and to order decimal numbers.

Students need practice at estimating measurements. Using an item with a known length, for example, a table top, ask the students to estimate the length of the whiteboard, the width of the room, and other items in the classroom. They can then check their estimates. (See also *Measurement*, Figure It Out, Levels 2–3, pages 1 and 3.)

When the students are measuring the Pterosaur, make sure that they measure its length, from the tip of its beak to the end of its tail, and not its wingspan.

Converting the measurements from centimetres to metres is fairly straightforward because the scale is 1 centimetre : 1 metre, so students only need to change the units of their measurements.

The following books contain some interesting information about New Zealand dinosaurs:

Hayward, B. (1998). *Trilobites, Dinosaurs, and Moa Bones: The Story of New Zealand Fossils.* Auckland: Bush Press.

Long, J.A. (1998). *The Dinosaurs of Australia and New Zealand and Other Animals of the Mesozoic Era*. Sydney: UNSW Press.

Stevens, G., McGlone, M., and McCulloch, B. (1998). *Prehistoric New Zealand*. Auckland: Heinemann Reed.

Wiffen, J. (1998). *Valley of the Dragons: The Story of New Zealand's Dinosaur Woman*. Glenfield, New Zealand: Random Century, 1991.

Investigation

Discuss the idea of speed with the students. They should all be familiar with the speed of cars and speed limits. Talk about the term "kilometres per hour" as a common measure of speed and also introduce the term "metres per second". You could perhaps compare the speed of 100 metre sprinters with 1 500 metre runners. The students could calculate the speeds in metres per second at which these distances are run and discuss why the speeds are so different.

Discuss with the students how they could calculate how long the theropod would take to run 20 metres. A diagram or double number line might help the students to work through this problem, for example:

Scientists can estimate a dinosaur's speed from a formula that has been developed that involves calculating leg and stride length (Alexander, R.M. [1976]. "Estimates of Speeds of Dinosaurs". *Nature*, no. 261, pp. 129–130). The students could measure their own stride and leg length and see if there is a correlation with their own velocity.

Page 10: The Swinging Sixties

Achievement Objective

- 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)
- read and interpret everyday statements involving time (Measurement, level 3)

Activity

In this activity, the students perform calculations within the context of money and rates of pay and compare the cost of living now with that in the sixties.

The concept of pay rates in dollars per hour may be unfamiliar to students. Discuss this concept with the students.

After the students have read Monica's and her dad's statements in the speech bubbles at the top of the page, you could ask them question **5**, that is, "Is it more or less expensive to live now?" They can compare this initial response to their response after they have completed the other questions. Make sure that the students understand that how much Monica and her dad earn per hour is not the only thing they need to take into account. The students need to work out what Monica and her dad can buy for that amount of money. Some students might leap to the conclusion that Monica is a lot better off than her dad because she earns 10 times more, but the students need to understand that she can't actually buy 10 times more, and her buying power isn't very different from her dad's.

Students will need to perform two steps in their calculations to solve questions **1** and **2**. First, they need to calculate the cost of a visit to the movies, an ice cream, and a soft drink. The students then need to calculate how many hours Monica and her dad will need to work to earn this amount of money.

The students may use a range of strategies to solve questions **3** and **4**. The three strategies shown below are arranged in increasing levels of complexity.

- Additive strategy

50c + 50c = $1 so that's 2 hours' work for Monica's dad.
To earn $5: 2 hours + 2 hours + 2 hours + 2 hours + 2 hours = 10 hours' work.
So at 10 hours for every $5: $5 + $5 + $5 + $5 + $5 + $5 + $5 + $5 + $5 = $45
= 10 hours + 10 hours + 10 hours + 10 hours + 10 hours + 10 hours + 10 hours + 10 hours + 10 hours
= 90 hours' work.

If students use this strategy, you could point out the link between multiplication and repeated addition and that multiplication is more efficient.

- Multiplicative strategy

If Monica's dad earned $1 an hour, it would take him 45 hours to earn enough to buy the $45 bike.
Doubling 50 cents (x 2) gives us $1.
If we double the money amount, we also need to double the time, so
45 x 2 = 90 hours' work.

- Division strategy

Using known facts for question **4**:
$400 at $5 per hour = 400 ÷ 5 hours (I know that 40 ÷ 5 = 8, so 400 ÷ 5 = 80.)
= 80 hours

Page 11: Cost of Living

Achievement Objective

- solve practical problems which require finding fractions of whole number and decimal amounts (Number, level 3)

Activity

Discuss with the students the strategies that they could use to calculate first the cost of an item that increases by a factor of 10 and then the cost of an item that is one-quarter the price.

As the prices that the students will be working with involve decimals, the students need to practise and discuss multiplying decimals by 10. There is a high likelihood that the prices the students will be working with will lead to fractions of cents when halved and quartered. Discuss with students rounding prices to the nearest 5 cents.

A strategy that may be useful for finding a quarter of a price is by halving and then halving again.

Discuss question **4** with the students. They could investigate recent price trends in these products as well as changes in the population. The Statistics New Zealand website (www.stats.govt.nz) and the Consumers' Institute may provide useful information. They might also like to investigate recent price trends (for example, the price 5 years ago compared with now) of appliances such as computers and cellphones.

This could lead to an interesting discussion about items that were used in the past, such as gas lamps or dial phones, and things that we use now that may or may not exist in the same form in the future, for example, cars, bicycles, computers, and televisions.

As an extension, you could ask the students to solve this problem:

"You buy a T-shirt, a hamburger, and a bag of lollies some time in the future. In total, these items cost $14 more than they would in our time. How much does each item cost?" The students will probably solve this using trial and improvement. One possible answer is that the future prices are $5 for a T-shirt, $30 for a hamburger, and $4 for a bag of lollies.

Statistics New Zealand carries out regular comparisons of the price change of goods in order to calculate the consumer price index (CPI). The students could investigate the CPI and find out what items are covered in the index.

Pages 12–13: Mayan Adventure

Achievement Objectives

- explain the meaning of the digits in any whole number (Number, 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)
- describe in words, rules for continuing number and spatial sequential patterns (Algebra, level 3)
- state the general rule for a set of similar practical problems (Algebra, level 3)

Activity One

The Mayan number system is built up using only three symbols: a stylised shell for 0 (), a dot for 1 (•), and a horizontal line for 5 (—). Point out to the students that this is a base 20 system with 5 being a significant number.

These exercises are very good for whole-part thinking because the numbers are expressed in terms of ones, fives, twenties, and so on, with these terms being added together to arrive at the total.

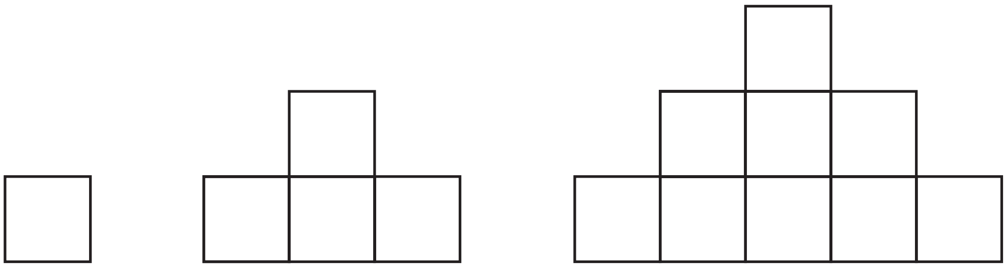
The students will probably do Mayan addition and subtraction in one of two ways: either all in "Mayan" without converting, or else they will convert to base 10, perform the operation, then convert the answer back into Mayan. Both ways are fine.

Activity Two

In this activity, the students investigate patterns in the number of blocks used to build Mayan pyramids.

Page 11 of *Geometry*, Figure It Out, Levels 2–3 and pages 8–9 of *Geometry*, Figure It Out, Level 3 give students experience in interpreting views of buildings from the top and the side and in using this experience to make multilink cube models. You may also find the teachers' notes for these activities useful in preparing the students for this *Time Travel* activity.

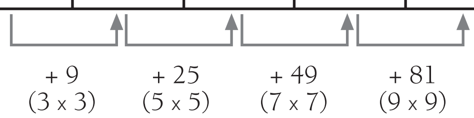
If the students are having difficulty identifying the number patterns, encourage them to draw diagrams. They can then add to their diagram the number of blocks along the base of the pyramid, the total number of blocks, and the mass of the pyramid.



Number of blocks along base of pyramid	1	3	5
Total number of blocks	1	10	35
Mass of pyramid	0.5	5	17.5

The students could also use a table for question **4** and look for patterns in the numbers, for example,

Number of blocks along base of pyramid	1	3	5	7	9
Total number of blocks	1	10	35	84	165



When a new layer is added to a pyramid, the base is made larger. This is done by adding a row of single blocks to each side of the old base. This makes each side of the new base two blocks longer than each side of the old base. So for each successive pyramid, the total number of blocks added is given by the number of blocks in the new base. The easiest way of calculating this is to take the number of blocks along one side of the new base and then multiply this number by itself.

Note that this activity and its answers are based upon the assumption that the pyramids are solid structures with no interiors. In reality, the pyramids are very intricately constructed with a maze of rooms and passages running through them.

The Mayans invented a calendar and used a type of matrix multiplication system. Some interesting Mayan structures still exist (mainly in Mexico), and some students may like to copy these structures and build models of them. There are a large number of interesting websites available on the Internet that look more fully into Mayan mathematics and culture, for example:

www.niti.org/mayan
www.civilization.ca/civil/maya/mmc05eng.html
www.saxakali.com/historymam2.htm
http://mathforum.org/alejandre/numerals.html

The students could also investigate (using the websites above) how to represent numbers greater than 99 in Mayan numbers. For example, 100 is represented by a line at the same level as the dots that represent 20s.

Page 14: Zing!

Achievement Objectives

- 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)
- perform measuring tasks, using a range of units and scales (Measurement, level 3)

Activity

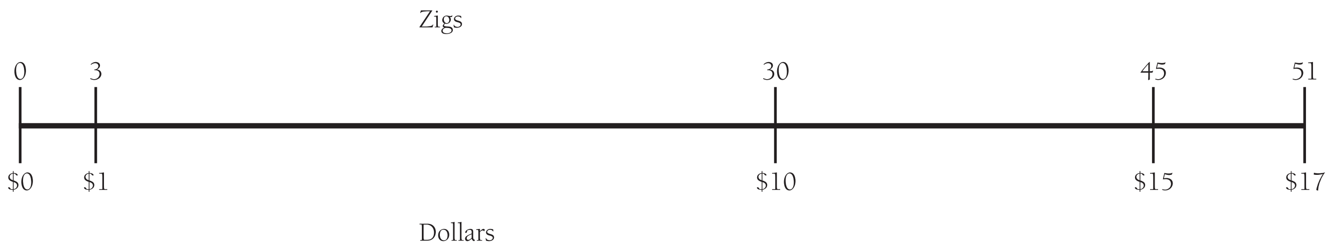
In this activity, the students will use multiplication and division to convert measurements from the units of measurement used on the planet Zigoura to the units of measurement used on Earth. Remind the students to read the information about converting Zigoura measurement units to our measurement units carefully.

We are told that 25 laks equals 100 centimetres (1 metre) and that 5 laks equals 20 centimetres. While the students at this level aren't yet working with ratios, they should see that they multiply the number of laks by 4 to get the number of centimetres. Conversely, they divide the centimetres by 4 to get laks. Students who are not confident in multiplying and dividing by 4 might use the strategy of double and double again to convert laks to centimetres and half and half again to convert centimetres to laks.

In question **3**, $1 is worth 3 zigs, so the students will multiply the dollars by 3 to get zigs and divide the zigs by 3 to get dollars. Another strategy the students may use to convert zigs into dollars is to express 51 zigs as a combination of numbers that are easily divisible by 3. For example,

51 zigs = 30 zigs + 21 zigs
51 zigs = $(30 ÷ 3) + $(21 ÷ 3)
= $10 + $7
51 zigs = $17

Using a double number line is another useful strategy to help the students solve this problem:



Make sure that the students then multiply the $17 by 6 to get the cost in dollars of *six* hoverboards.

Page 15: Kia Ora

Achievement Objectives

- describe the features of 2-dimensional and 3-dimensional objects, using the language of geometry (Geometry, level 3)
- 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, the students measure and estimate the lengths of a variety of things, for example, poi strings and arms. The activity also uses their understanding of circle geometry and how the length of the poi string relates to the size of the circle. The students may use a range of problem-solving strategies, for example, acting out the problem or drawing a diagram, in order to see the relationship between the length of the string and the diameter of the circle.

The most effective method to help students visualise question **2** is to have them working in small groups to observe the movement of the poi as one person twirls it. The poi dancer could then freeze with their arm in the position they would be in if moving the poi. Another student can extend the poi to the appropriate position, and a third student measures from the shoulder of the dancer.

Note that for question **3**, the students don't need to know the length of the string of a short poi. Standing an arm's length apart allows for the length of the short poi string.

As an extension, the students could watch a kapa haka performance and afterwards talk to the performers about how they space themselves out. For example, the students could ask the performers how they space themselves when they use rakau and taiaha. The students could then draw a floor plan to show the positions of the various performers.

Page 16: Rosetta's Room

Achievement Objective

- draw and interpret simple scale maps (Geometry, level 3)
- specify location, using bearings or grid references (Geometry, level 4)

Activity

This activity introduces the students to the level 4 objective of ordering pairs. Discuss with the students the importance of the way the co-ordinates are ordered. The first number in a pair of co-ordinates (x) indicates the distance along the x axis from the origin (0,0), and the second number (y) indicates the distance up the y axis from the point (x,0). This gives the co-ordinate (x,y). If the students aren't familiar with these concepts, you could talk through the co-ordinates of the solar heater with them. The students may have played games like Battleships, which use ordered pairs. (See also *Under the Sea*, Figure It Out, Levels 2–3, pages 6–7.)

As an extension, the students could imagine that they are robots. On grid paper, they could design their own room, put objects in it, and give their plan to a classmate to work out the grid co-ordinates for the different objects.

Page 17: Planet Centurion

Achievement Objectives

- read and interpret everyday statements involving time (Measurement, level 3)
- use their own language to talk about the distinctive features, such as outliers and clusters, in their own and others' data displays (Statistics, level 3)

Activity

This activity is about graphing data. The graphed data shows patterns in the data more clearly than data listed as numbers, and this makes the data easier to analyse.

When the students graph their data, make sure they plot the x co-ordinate correctly. Although the x axis of the graph is marked with regular 100 year intervals, the data is not given in regular intervals. For example, the difference between the first and second plaque is 100 years, but the difference between the second and third is 200 years.

The activity introduces the concept of an outlier, which is a piece of data that is outside the trend shown by the other data in a set. Discuss with the students how to recognise outliers in data displays. It is important for the students to investigate why outliers are sometimes present in data sets. Outliers are often the cause of a problem that researchers are trying to solve when they study data sets. Also, it is important to be aware of any outliers because they can affect the averages of data sets.

In question **3**, the students have to extrapolate the data to estimate the average age in 2200. To do this, they continue the line of the graph, excluding the outlier, until they are directly above 2200 on the x axis. They can then see what number on the y axis they are aligned with.

As an extension, you could discuss the concept of life expectancy with the students and ask them why they think it fluctuates (that is, what causes increases or decreases in life expectancy). The students could then investigate how much life expectancy has changed in New Zealand over the last 200 years. They could look in the *New Zealand Official Yearbook* or on the website of Statistics New Zealand (www.stats.govt.nz).

Note that life expectancies for men and women are different. You could discuss with the students why this could be.

You could link this activity to social studies with an investigation of life expectancies in countries around the world. The students could interpret events such as medical advances, economic prosperity, increased technology, and war as having a direct and graphic effect on life expectancy. Discuss with the students if these events would lead to outliers in their data displays or alter the life expectancy trend in any way.

Pages 18–19: South Pacific Journey

Achievement Objectives

- describe patterns in terms of reflection and rotational symmetry, and translations (Geometry, 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)

Activities

These activities investigate reflectional and translation symmetry. Students at this level should be very familiar with the ideas of reflectional and translation symmetry. Any students having difficulty identifying reflectional symmetry in **Activity One** may find it useful to put a mirror on the pattern and then move the mirror down the pattern until the reflection in the mirror is the same as the pattern behind the mirror. They continue moving down the pattern to identify any other lines of reflectional symmetry and then repeat this procedure with the mirror moving across the pattern.

It is important to point out to the students that while these examples of Pacific art appear symmetrical, the symmetry is not rigid. Most patterns from Pacific art are hand drawn and rigidly straight lines are rare. If the students draw the patterns for **Activities Two** and **Three** freehand rather than using a ruler or a compass, they will get a better likeness to the original designs. You may also need to point out that the dotted lines in **Activity Two** are lines of reflectional symmetry.

A langanga is the unit of measurement in a Tongan ngatu. While the length of a langanga (often based on the span of a hand) may vary between ngatu, the length will always be the same within each ngatu.

Page 13 of *Geometry*, Figure It Out, Levels 2–3 also looks at reflectional symmetry and asks students to complete patterns.

Pages 20–21: Epidemic!

Achievement Objectives

- use their own language to talk about the distinctive features, such as outliers and clusters, in their own and others' data displays (Statistics, level 3)
- read and interpret everyday statements involving time (Measurement, level 3)
- describe in words, rules for continuing number and spatial sequential patterns (Algebra, level 3)
- use graphs to represent number, or informal, relations (Algebra, level 3)

Activity One

The tables should help the students to recognise the pattern of deaths in each town. Students who have difficulty recognising the pattern need to concentrate on working out what has happened to the number of deaths from week 1 to week 2 and then extend this to week 2, week 3, and so on, until they are able to identify a definite pattern. They can then predict the results for weeks 5 and 6. For example:

Week 1	Week 2	Week 3	Week 4
1	2	4	8

+ 1 + 2 + 4
x 2 x 2 x 2

For this example, multiplying by 2 is the easiest pattern to use.

The patterns of deaths in the villages are examples of exponential growth, constant growth, and exponential decay. (In reality though, an epidemic wouldn't have a constant growth rate.) The graph for Munster, an increasingly steep curve, illustrates an exponential growth rate, which is the kind of growth often seen at the beginning of an epidemic. The deaths in Broningen are increasing at a constant rate of 5 per week, and the students should be very familiar with this number sequence. The graph of constant growth is a straight line. The deaths in Ratfree are halving each week. The graph for Ratfree, an increasingly shallow curve, is an example of exponential decay. This is typical of what would be observed at the end of an epidemic. There are many other examples of disease epidemics to be drawn from real life that could be discussed by the class: influenza, AIDs, and so on.

This activity may lead to discussion with more able students about exponential growth and decay. Because constant growth and exponential growth appear similar in the early days, it is difficult to know which pattern of growth is occurring with a disease or a noxious weed until the data set for such a study is quite large. You may like to point this out to the students and discuss with them how important it is not to rely too heavily on small data sets. (See also "The Chain Goes On", *Teachers' Notes: Connected 3 2001*, pages 24–27.)

Activity Two

In Activity Two, the students need to identify the number patterns in the table. The patterns are all quite straightforward, with the rats killed in Munster being a constant 50 each day (that is, 10 per villager), the rats killed in Broningen alternating between 90 and 110 (once again, 10 per villager), and the rats killed in Ratfree doubling each day. Remind students that the table shows the number of rats killed *each day*, so they will need to add up the daily totals to find the total number of rats killed for each village. There are just over 1 000 rats in each village, so once this target is met, there will be no more rats in that village. (The students may need to adjust the numbers in their table once this target is met.) The students then need to compare these totals with the target of 1 000 rats killed for each village to assess which villages are likely to survive.

Pages 22–23: Body Analyser

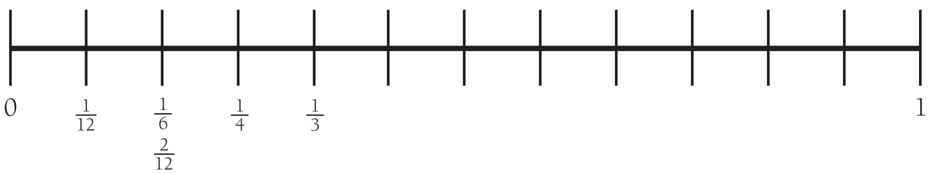
Achievement Objectives

- solve practical problems which require finding fractions of whole number and decimal amounts (Number, level 3)
- use their own language to talk about the distinctive features, such as outliers and clusters, in their own and others' data displays (Statistics, level 3)

Activity One

You may need to start this activity by discussing with the students the information they are able to obtain from the pie graph and how they can interpret it to make up statements. Afterwards, the students might like to discuss their three statements with a classmate.

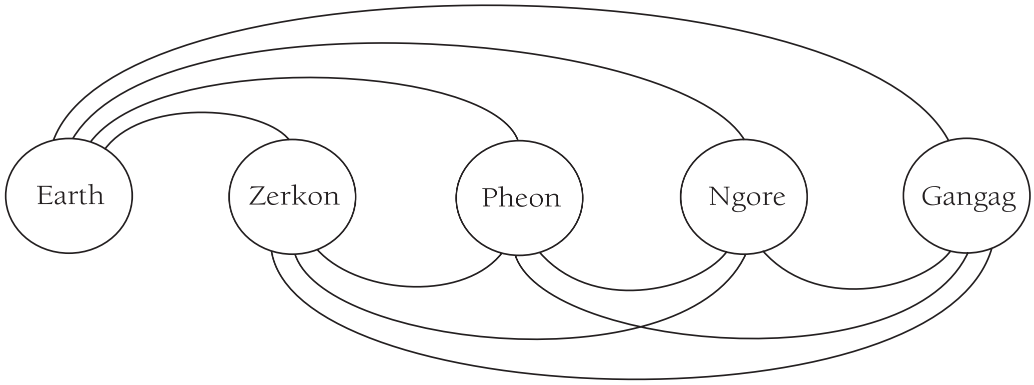
For question **2**, encourage the students to consider the strategies they could use to complete the pie graph for the Zerkonian. They may convert all of the fractions to twelfths, divide the pie graph into twelfths (like a clock face), and then complete the pie graph. Number lines may help with this task:



For your information, the exact make-up of elements in the human body is as follows: oxygen 65%, carbon 18.5%, hydrogen 9.5%, nitrogen 3.2%, calcium 1.5%, other elements 2.3%.

Activity Two

To help the students calculate the number of games in the first round of the rugby competition, draw a diagram like the one sketched below. Each line is a game. Count the number of lines to work out the number of games in each round.



Activity Three

The students' drawings here will need to be fairly simple and clear to allow their classmates to count the heads and limbs easily. Note that they don't need to draw the contestants from Earth and Zerkon because these are already shown in the illustrations.

In question **1**, the students interpret the data displays in order to draw the contestants. In question **2**, they swap pictures with classmates and record details about the contestants in data displays.

Page 24: Back to the Present

Achievement Objectives

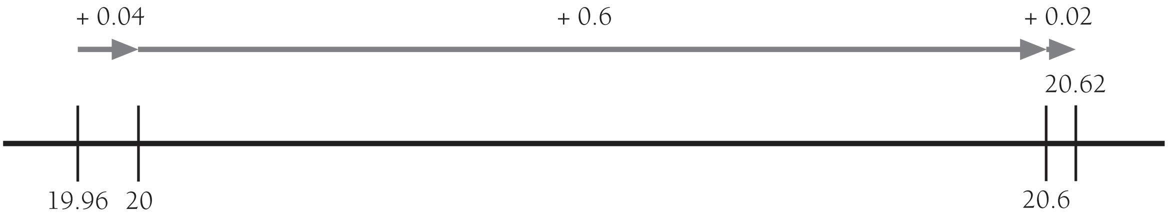
- write and solve problems which involve whole numbers and decimals and which require a choice of one or more of the four arithmetic operations (Number, level 3)
- read and interpret everyday statements involving time (Measurement, level 3)

Activity

This activity gives the students the opportunity to practise doubling numbers, dividing numbers by 10, and also adding whole numbers and decimals. (Parts of 100 years travelled will give decimal amounts for time points.) Because the students are working with large numbers, it is particularly important that they understand place value and that they add numbers in the correct columns (for example, adding ones to ones, tens to tens, hundreds to hundreds, and so on.) The students will need to be careful if they are using a calculator for this activity because most calculators display only eight digits, whereas the total time points has nine digits (seven before the decimal point and two after it). This means that just adding the time points on a standard calculator will give an incorrect answer (for example, 1 400 197.8). If the students are using a calculator, they will need to find a way to work out the correct total, for example, adding the whole numbers first and then the decimals and then adding those two totals together without using a calculator.

You could begin the activity by asking the students to estimate what they think the total time points will be.

A strategy the students may find useful when adding up their time points is to look for combinations of numbers that add up to 10, 100, and so on, or patterns such as doubles that they are able to calculate easily. If they find adding decimals quite difficult, using an empty number line may help them, for example:



The students will gain approximately 1 400 000 time points. (The number of time points will vary depending on the current date.) As explained in the answers, they may choose one of the rewards that need fewer than 1 400 000 time points or they may like to negotiate with a classmate to combine time points and get a mini space waka together.

As an extension, the students could draw a timeline and plot on it all the destinations that the *Space Waka* has visited. They could also include the year they were born and any significant dates they know.

III	IV	V	VIII	X			XVII	XIX	XLIX
	4		8		13	14			

III	IV	V	VIII	X			XVII	XIX	XLIX
	4		8		13	14			

III	IV	V	VIII	X			XVII	XIX	XLIX
	4		8		13	14			

III	IV	V	VIII	X			XVII	XIX	XLIX
	4		8		13	14			

III	IV	V	VIII	X			XVII	XIX	XLIX
	4		8		13	14			

III	IV	V	VIII	X			XVII	XIX	XLIX
	4		8		13	14			

III	IV	V	VIII	X			XVII	XIX	XLIX
	4		8		13	14			

III	IV	V	VIII	X			XVII	XIX	XLIX
	4		8		13	14			

Copymaster: Getting Heavy

Name	Weight on Earth	Estimated weight on Gargantor	Weight on Gargantor checked on calculator	Weight on Gargantor to 1 decimal place
Tūrei	525.57 N	2000 N	2102.28 N	2102.3 N
Monica	476.13 N			
Sam	423.92 N			
Natalie	392.49 N			

Name	Weight on Earth	Estimated weight on Gargantor	Weight on Gargantor checked on calculator	Weight on Gargantor to 1 decimal place
Tūrei	525.57 N	2000 N	2102.28 N	2102.3 N
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Monica	476.13 N			
Sam	423.92 N			
Natalie	392.49 N			

Scale: 1 centimetre : 1 day's travel

Name	Height (in cm)	Height (in laks)
Monica	144 cm	36 laks
Tūrei	152 cm	
Sam		35 laks
Natalie		34 laks
Your name		
Your classmate's name		

Name	Height (in cm)	Height (in laks)
Monica	144 cm	36 laks
Tūrei	152 cm	
Sam		35 laks
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Your name		
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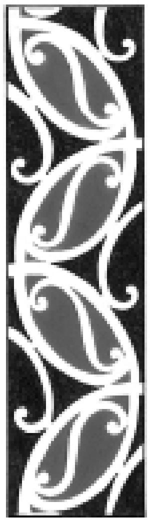
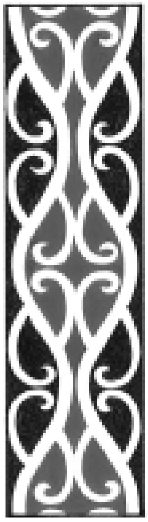
Your name		
Your classmate's name		

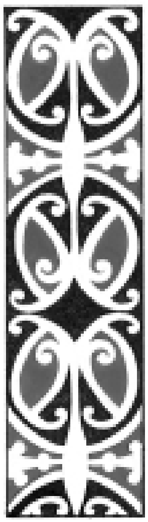
a.



b.

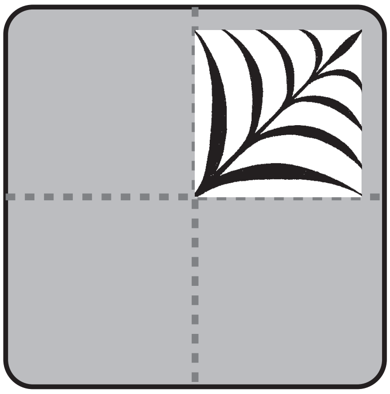


c.



d.

a.



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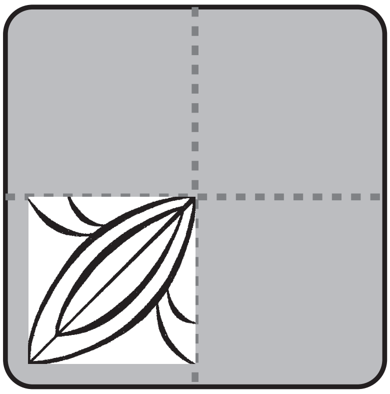
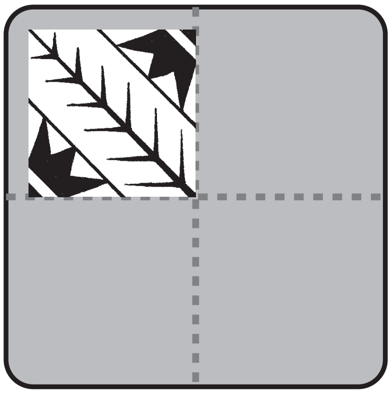
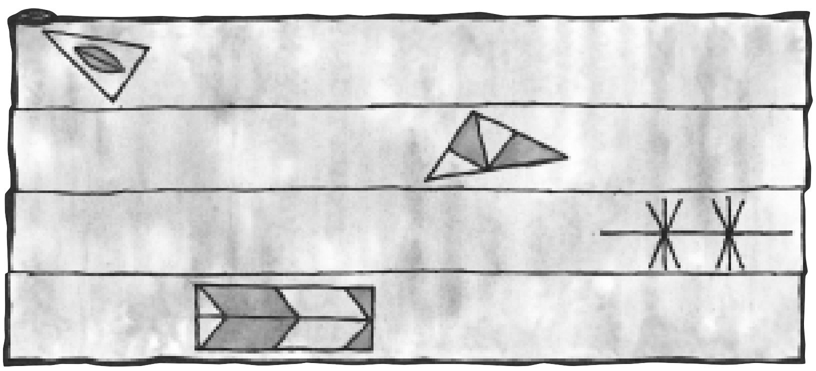


c.





Copymaster: Epidemic!

		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Munster	Villagers sent out	5	5	5	5						
	Rats killed	50	50	50	50						
Broningen	Villagers sent out	9	11	9	11						
	Rats killed	90	110	90	110						
Ratfree	Villagers sent out	whole village	0	0	0						
	Rats killed	10	20	40	80						

		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Munster	Villagers sent out	5	5	5	5						
	Rats killed	50	50	50	50						
Broningen	Villagers sent out	9	11	9	11						
	Rats killed	90	110	90	110						
Ratfree	Villagers sent out	whole village	0	0	0						
	Rats killed	10	20	40	80						

Copymaster: Back to the Present

Destination	Years back or forward	Total years travelled there and back	Time points
Ancient Rome	2 000	4 000	40
Delta Island		2 000	
Gargantor			
Hawaiki	1 000		
New Zealand dinosaurs			
New Zealand 1969			
New Zealand in 100 years			
Mayan civilisation	2 000		
Zigoura	500		
Aotearoa 1500			
Rosetta's year 3000			
Centurion 2300			
Pacific Islands	150		
Medieval Europe	650		
Zerkon			
		Total time points	

Destination	Years back or forward	Total years travelled there and back	Time points
Ancient Rome	2 000	4 000	40
Delta Island		2 000	
Gargantor			
Hawaiki	1 000		
New Zealand dinosaurs			
New Zealand 1969			
New Zealand in 100 years			
Mayan civilisation	2 000		
Zigoura	500		
Aotearoa 1500			
Rosetta's year 3000			
Centurion 2300			
Pacific Islands	150		
Medieval Europe	650		
Zerkon			
		Total time points	

Acknowledgments

Learning Media would like to thank Shelley Vaile for developing the teachers' notes and reviewing the answers. Thanks also to Ken Benn and Kathy Campbell for reviewing the answers and notes.

The illustrations and line art on the cover and on pages 1, 2, 3, and 10 are by Greg Broadmore; the map on pages 4 and 31 and the patterns on pages 7 and 33 are by Elspeth Alix Batt.

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Series Editor: Susan Roche
Series Designer: Esther Chua
Editor: Kirsty Farquharson
Designer: Meredith Biberstein

Published 2001 for the Ministry of Education by
Learning Media Limited, Box 3293, Wellington, New Zealand.
www.learningmedia.co.nz

Dewey number 510.76
ISBN 0 478 24705 2
Item number 24705
Students' book: item number 24604