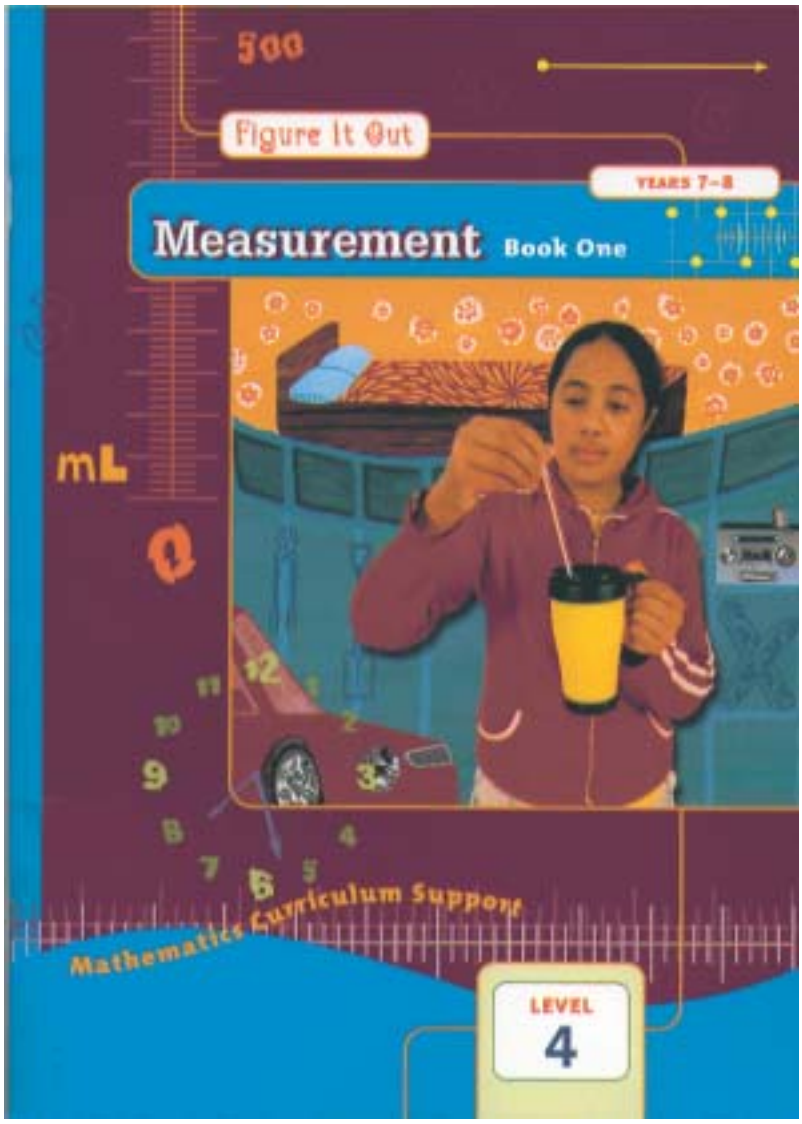
Answers and Teachers' Notes



MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

CONTENTS

The books for years 7–8 in the Figure It Out series are issued by the Ministry of Education to provide support material for use in New Zealand year 7–8 classrooms. The books have been developed and trialled by classroom teachers and mathematics educators and follow on from the successful series for levels 2–4 in primary schools.

Student books

The student books in the series are divided into three curriculum levels: levels 2–3 (linking material), level 4, and level 4+ (extension material). All the books are aimed at year 7–8 students in terms of context and presentation.

The following books are included in the series:
Number (two linking, three level 4, one level 4+, distributed in November 2002)
Number Sense (one linking, one level 4, distributed in April 2003)
Algebra (one linking, two level 4, one level 4+, distributed in August 2003)
Geometry (one level 4, one level 4+, distributed in term 1 2004)
Measurement (one level 4, one level 4+, distributed in term 1 2004)
Statistics (one level 4, one level 4+, distributed in term 1 2004)
Themes: *Disasters Strike!, Getting Around* (level 4, distributed in August 2003)

The activities in the student books are set in meaningful contexts, including real-life and imaginary scenarios. The books have been written for New Zealand students, and the contexts reflect their ethnic and cultural diversity and life experiences that are meaningful to students aged 11–13 years. The activities can be used as the focus for teacher-led lessons, as independent bookwork, or as the catalyst for problem solving in groups.

Answers and Teachers' Notes

The Answers section of the *Answers and Teachers' Notes* that accompany each of the student books includes full answers and explanatory notes. Students can use them for self-marking, or you can use them for teacher-directed marking. The teachers' notes for each activity, game, or investigation include relevant achievement objectives, comment on mathematical ideas, processes, and principles, and suggestions on teaching approaches. The *Answers and Teachers' Notes* are also available on Te Kete Ipurangi (TKI) at www.tki.org.nz/r/maths/curriculum/figure

Using Figure It Out in your classroom

Where applicable, each page starts with a list of equipment that the students will need to do the activities. Encourage the students 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. Encourage your students to write down as much as they can about how they did investigations or found solutions, including drawing diagrams. Discussion and oral presentation of answers is encouraged in many activities, and you 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. You should acknowledge successful ways of solving questions or problems, and where more effective or efficient processes can be used, encourage the students to consider other ways of solving a particular problem.

YEARS 7–8

Answers

Measurement: Book One

Page 1 Energy Crises

ACTIVITY

1. **a.** It is dropping while she is having breakfast and dinner respectively.

   b. Around 10.15 a.m., 12.30 p.m., and 3.45 p.m.

   c. Because food quickly satisfies hunger, but the feeling of hunger increases slowly over time.

2. Descriptions will vary. Ngahuia's energy levels are highest in the morning, peaking after breakfast and lunch, and boosted by morning tea. Dinner and supper give her energy small boosts, but these don't last long.

3. Her energy level increases immediately after eating and then decreases gradually as the next meal becomes due.

4. **a.** Graphs will vary.

   b. Graphs will vary. Your description should include where the peaks are and why. You may also discuss why some peaks are higher than others.

INVESTIGATION

Findings will vary.

Page 2 Icy Contents

INVESTIGATION

1. **a.–b.**

   Results will vary. Generally, ice takes up about one-third of the space in the container. This may be slightly less for small containers.

2. **a.** Unless you have bought and tested a number of drinks from the same outlet, you will not be able to be sure that other customers will have the same experience, and unless you buy drinks from a number of different outlets, you will not be able to be sure that what is true for one is true for all.

   b. Conducting this experiment "in the field" (buying drinks from real outlets) will be better than doing it in the classroom, and the more trials you do the better.

3. Letters will vary.

Page 3 Circle Links

ACTIVITY

1. **a.** Collections will vary.

   b. Measurements will vary.

   c. Answers will vary, but they should be close to 3.14.

   d. The circumference divided by the diameter should give a result of approximately 3.14. This is true for any circular object.

   e. Practical activity. Results should all be close to 3.14.

2. **a.** The symbol is called pi. You can find it on all scientific calculators. It appears in all formulae relating to circles.

   b. It is the value you get whenever you divide the circumference of a circle by its diameter.

Pages 4–5 Little Links

ACTIVITY ONE

1. 5.5 mm. (Each link is formed from a strip that is 15 mm long. The 2 ends of each rectangular link are each 2 mm wide, leaving $15 - 2 \times 2 = 11$ mm for the 2 sides. $11 \div 2 = 5.5$.)

2. $50 \times 4.5 = 225$ mm. (Although each link is 5.5 mm long, when the links are joined, there is an overlap of 1 mm, meaning that each additional link adds 4.5 mm to the total length.)

3. Answers will vary. 50 cm is a reasonable length. Dividing the length in millimetres by 4.5 (the additional length in millimetres added by each link) will give you the number of links needed.

ACTIVITY TWO

1. **a.** 10 mm. (When rolled into a circle, the length of each strip, 31.4 mm, becomes the circumference. Circumference = π x diameter; 31.4 = 3.14 x 10

   b. 181 mm. (Cutting this way, Jenna gets 20 strips from each rectangle. The first link contributes 10 mm to the length; all the other links add 9 mm because of the overlaps. 10 + 19 x 9 = 181 mm.)

2. **a.** 31 strips

   b. 6.37 mm. (20 ÷ π = 6.37)

   c. 167.47 mm, a chain that is slightly shorter. (The first link contributes 6.37 mm to the length; all the other links add just 5.37 mm because of the overlaps. 6.37 + 30 x 5.37 = 167.47 mm.)

Pages 6–7 Taking Off

ACTIVITY ONE

1. 13 192 kg in total. This is made up of 136 x 82 = 11 152 kg (passengers and hand baggage) and 136 x 15 = 2 040 kg (baggage for the hold).

2. **a.** 7.48 m^3. (136 x 0.05 x 1.1 = 7.48 m^3. Note: 110% = $\frac{110}{100}$ = 1.1)

   b. 12.52 m^3. (20 – 7.48 = 12.52 m^3)

   c. 908 kg. (Mass of aircraft, food, crew, passengers, and baggage = 32 000 + 400 + 500 + 11 152 + 2 040 = 46 092 kg. Maximum mass before fuel is 47 000 kg, leaving 47 000 – 46 092 = 908 kg for cargo.)

ACTIVITY TWO

1. 7 kg (effectively none!)
   (19 passengers at 82 kg = 1 558 kg. 20 kg baggage for 19 passengers = 380 kg. Plane + crew + passengers + baggage = 6 878 kg.
   Limit before fuel = 6 885 kg.)

2. **a.** 1 053 kg

   b. 473 kg, or nearly half a tonne.
   (Plane + crew + passengers + baggage = 6 412 kg, which is 473 kg less than the 6 885 kg limit before fuel.)

Pages 8–9 Castle Construction

ACTIVITY

1. Practical activity

2. **a.** 25 cm^2. (5 x 5 cm^2)

   b. 72 cm^2. (12 x 6 cm^2)

   c. 6.37 cm. (circumference = π x diameter
   20 = 3.14 x diameter
   diameter = 20 ÷ 3.14
   = 6.37 cm)

   d. 31.8 cm^2. (area = πr^2
   = π x 3.185 x 3.185
   = 31.8 cm^2)

   e. 28.3 cm. ($\frac{1}{2}$π x diameter = $\frac{1}{2}$ x 3.14 x 16.4
   = 25.7 cm)

3. Practical activity

4. Practical activity

5. **a.** Practical activity. Answers will vary. (The model illustrated in the student book had an area of close to 1 600 cm^2.)

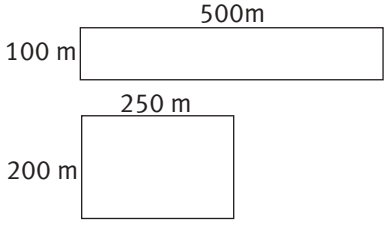
   b. 1 cm could represent 1 m. Anything less than this would make the Great Room too small to be "great".

Pages 10–11 Divide and Prosper

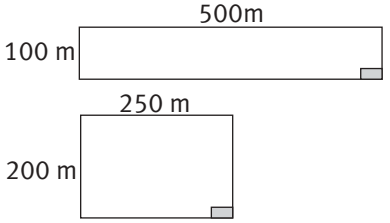
ACTIVITY ONE

1. 50 000 m^2. (5 x 10 000 m^2)

2. **a.** Rectangles may vary. Two possibilities are illustrated here, but with the size reduced:



   b. The section should be 2 cm by 1 cm. (On these diagrams, it is shown as a small grey rectangle.)



   c. 62.5 times. (50 000 ÷ 800 = 62.5)

3. Answers will vary. Residential sections are commonly in the range 500 to 1 000 m^2.

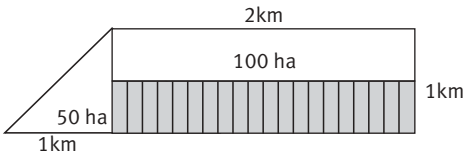
4a.–b. Answers will vary.

5. A full-sized field is about 100 x 50 = 5 000 m^2, which is half a hectare.

ACTIVITY TWO

1. 250 ha. (The area can be divided into a triangle with a base of 1 km and a height of 1 km and a rectangle with a base of 2 km and a height of 1 km. Total area = $(\frac{1}{2}$ x 1 x 1) + (2 x 1) = 2.5 km^2. As 1 km^2 = 100 ha, the area = 2.5 x 100 = 250 ha.)

2. There are different ways of dividing the property, but this is probably the simplest:



3. Answers will vary.

INVESTIGATION

Costs will include paying surveyors, contractors, legal fees, council approval costs, and so on.

Pages 12–13 Weighty Water

ACTIVITY

1. Answers will vary, taking into account the shape of the bath. A reasonable estimate for a standard bath, filled 3 times, is 700–800 L.

   The internal volume of the bath in cubic metres can be estimated by multiplying average length, breadth, and depth. The following measurements are typical for a standard bath: 0.585 x 1.4 x 0.32 = 0.26 m^3 (approximately $\frac{1}{4}$ m^3).

   There are 1 000 litres in 1 cubic metre, so 0.26 m^3 = 260 L. 3 x 260 = 780 L

2. **a.** Answers will depend on the answer given to question **1**.

   1 litre of water has a mass of 1 kg. 780 L has a mass of 780 kg. That is 0.78 tonne (just over $\frac{3}{4}$ tonne).

   b. 0.78 tonne is similar to the mass of a small car (or a large bull or 20 bags of cement).

3. **a.** 8 x 20 x 1.2 = 192 m^3

   b. The mass of the water is 192 tonnes.

   c. If the pool were to burst, the force of the water could cause serious damage to the property below. Even if this did not happen, the seepage of so much water could undermine the foundations of the neighbours' house.

4. **a.** 1 280 L. (0.8 x 800 x 2 000 ÷ 1 000. The water is falling 0.8 cm per day. The dimensions of the pool have been converted to centimetres.)

   b. 112 days (rounded up). (89 ÷ 0.8 = 111.25)

   c. Answers will vary.

   Possible reasons for increased time include:

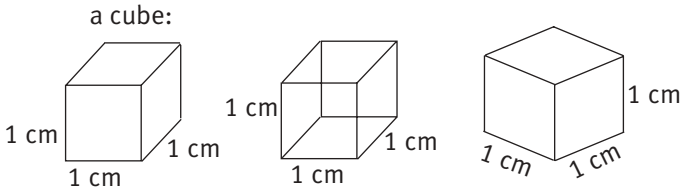
   - Water pressure will reduce as the pool empties, leading to a reduced rate of flow.
   - Rainfall will add to the amount of water to be emptied.

   A possible reason for decreased time is that the crack in the pool may get bigger, leading to a greater rate of flow.

Page 14 Petrol Power

ACTIVITY

1. **a.** Practical activity. Here are three ways of drawing a cube:



   b. 1 000 cm^3. (10 x 10 x 10)

   c. 1 L.

2. They are both the same. 1 800 cm^3 (or 1 800 cc) is another way of saying 1 800 mL, which is the same as 1.8 L.

3. **a.** 1 300 cc, 1.5 L, 1.6 L, 2 000 cc, 3 000 cc, 3.2 L

   b.

Name	Centimetres cubed (cc)	L
William	1 300	1.3
Emma	2 800	2.8
Rāwiri	1 600	1.6
Sonia	3 200	3.2
Jane	5 400	5.4
Jonah	1 100	1.1

INVESTIGATION

Results will vary.

Page 15 Books in Boxes

ACTIVITY

1. **a.** The maximum is probably 23 books (18 stacked on edge with 2 more fitted down the side and 3 flat on top).

   b. 36.6 kg. (23 x 1.49 + 2.3 kg)

   c. 11 books. (20 – 2.3 = 17.7 kg available for books. 17.7 ÷ 1.49 = 11.9, which needs to be rounded down to 11, because 12 books would exceed the limit on mass.)

   d. (11 x 29 x 22 x 1.8) ÷ (33 x 33 x 28) = 0.41 or 41% (rounded to the nearest whole number)

2. **a.** The maximum is probably 26 books. (2 rows of 8 books stacked on their long edge, 1 row on top of the other, 1 row of 8 books stacked on their bottom edge, and 2 books lying flat in the space on top)

   b. 15.6 kg. (26 x 0.510 + 2.3 kg)

   c. All 26 will fit because they do not exceed the 20 kg limit on mass.

   d. (26 x 19.5 x 13 x 3.8) ÷ (33 x 33 x 28) = 0.82 or 82% (rounded to the nearest whole number)

3. **a.** 150 books.
   (Each weighs 118 g. 17.7 ÷ 0.118 = 150)

   b. Answers will vary but should be in the range 32 500–33 000 cm^3.

   (One book is 29.7 x 21 cm, and a stack of 10 books is about 3.5 cm high. Based on these dimensions, the volume of 150 books will be 15 x 29.7 x 21 x 3.5 = 32 744 cm^3 [rounded to the nearest whole number].)

   c. Answers will vary, but based on the dimensions in **b**, the answer would be 107%.
   (15 x 29.7 x 21 x 3.5) ÷ (33 x 33 x 28) = 1.07 or 107% [rounded to the nearest whole number]. As 100% means the box is totally full, 107% means that the volume of 150 books exceeds the volume of the box.

Pages 16–17 Cellphone Confusion

ACTIVITY

1. **a.** **i.** $63.90
   Peak calls: 20 min x 0.99 = $19.80
   Extra off-peak calls at standard rates:
   90 min x 0.49 = $44.10

   ii. Text messages: 105 x 0.20 = $21.00

   iii. $109.90. (25.00 + 63.90 + 21.00)

   b. $1,318.80. (12 x 109.90)

2. **a.** $45.80
   Peak calls: 20 x 0.99 = $19.80
   Extra off-peak calls at standard rates:
   40 min x 0.65 = $26.00

   b. $16.50. (110 x 0.15 = $16.50)

3. **a.** $62.30

   b. $1,017.60.
   (3 months x 62.30 a month = $186.90;
   9 months x 92.30 = $830.70;
   total for the first 12 months is
   186.90 + 830.70 = $1,017.60.)

4. **a.** Busy Lines

   b. Yes. (After 24 months at this rate of usage, the charge from YY would be $2,637.60 and the charge from BL would be $2,125.20.)

5. Busy Lines is cheaper in each case.
   (12 months: YY = $1,418.80;
   BL = $1,217.60;
   24 months: YY = $2,737.60;
   BL = $2,325.20)

6. Results will vary.

Pages 18–19 Scale of Events

ACTIVITY ONE

1. **a.** Answers will vary.

   b. Explanations will vary. Factors you might take into account include:
   - number of human deaths
   - how recent the event was
   - where the event occurred
   - how it affects you personally.

2. Discussion may include these points:

   - People rank the events according to their feelings, and feelings are not usually a very reliable guide as to importance.
   - A large range of events may fall under the same label (descriptive category).
   - Different people may not share the same idea of what is meant by each description.

ACTIVITY TWO

1.–3. Results will vary.

Pages 20–21 Ways to Go

ACTIVITY ONE

1. **a.** 6.40 a.m.

   b. 7.05 a.m.

   c. 19 min

   d. 47 min

2. **a.** 8.30 a.m.

   b. 9.35 a.m.

   c. 1 hr 5 min

ACTIVITY TWO

1. He can on Tuesdays and Thursdays. He can't on Mondays, Wednesdays, or Fridays because the train doesn't stop at Linden.

2. **a.** 6:48 (6.48 a.m.)

   b. Yes. This is the same train that leaves Porirua Station at 6:44 (6.44 a.m.), and as it is not an express, it stops at Linden, where Jack gets on.

3. **a.** The 16:36 (4.36 p.m.) train

   b. 5.00 p.m.

   c. No. It's an express train and doesn't stop at Linden.

4. **a.** The 17:04 (5.04 p.m.) train

   b. Yes, but if she catches this train, she will have a wait of 13 minutes for the next bus and will get to her stop at 6.05 p.m.

5. The 16:20 (4.20 p.m.) train

Pages 22–23 Great Gardens

ACTIVITY ONE

1. 3.22 m^2. (4.6 x 0.7)

2. 6 m. (0.7 + 4.6 + 0.7)

3. 16 cm or between 15 and 16 cm (rounded from 15.53 cm). (Using centimetres, the volume of soil is 0.5 x 100 x 100 x 100 = 500 000 cm^3, and the area of the garden is 460 x 70 = 32 200 cm^3. The depth is the volume of soil divided by the area it has to cover: 500 000 ÷ 32 200 = 15.53 cm.)

4. **a.** 0.05 m^3

   b. 4 bags.
   (The volume required to cover the garden to a depth of 5 cm is found by multiplying the area of the garden by 5: 32 200 x 5 = 161 000 cm^3. Because 1 000 cm^3 = 1 L, 161 000 cm^3 = 161 L. 3 bags hold only 150 L, so 4 bags are needed.)

   c. 3 cm.
   (Two 50 L bags contain 100 L of bark. This is 100 000 cm^3. Spread over an area of 32 200 cm^2, this gives a depth of 100 000 ÷ 32 200 = 3.11 cm.)

ACTIVITY TWO

1. 32.73 m^2.
   (5 x 4.5 + 3.1 x 2.5 + 0.5 x 3.1 x 1.6)

2. 4.91 m^3.
   (The volume needed is found by multiplying the area of the garden by the depth of soil. Working in metres because of the larger area, 32.73 x 0.15 = 4.91m^3, rounded to 3 significant figures.)

3. **a.** 1.64 m^3.
   (Volume = 32.73 x 0.05 = 1.64 m^3, rounded to 3 significant figures.)

   b. 33.
   (Number of bags = 1.64 ÷ 0.05 = 32.8)

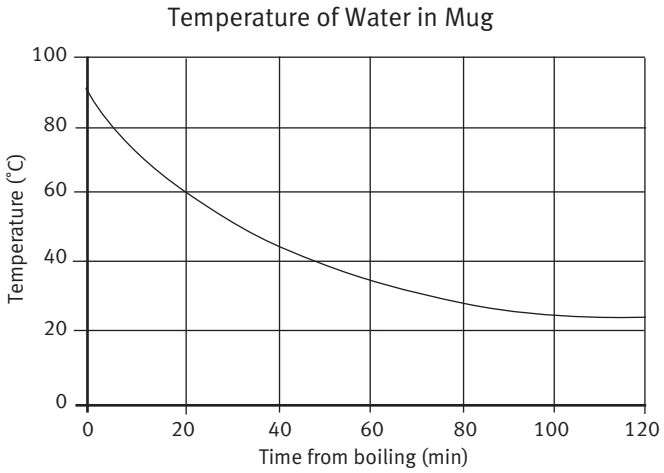
4. 27.2 m

Page 24 Hot Stuff

ACTIVITY

1. Practical activity

2. Graphs will vary but should show a tailing off as the liquid approaches room temperature.



3. **a.** The rate at which the water cools decreases as time goes by.

   b. No, unless the room temperature is less than 0°C. It is the surrounding air that does the cooling, so the water can't get colder than the air.

4. Practical activity. Results will vary, but the results and graph should show that the temperature of the liquid goes down rather more slowly. (If not, either the experiment has not been conducted appropriately or the insulation on the mug is ineffective.)

YEARS 7–8

Teachers' Notes

Overview — Measurement: Book One

Title	Content	Page in students' book	Page in teachers' book
Energy Crises	Measuring and interpreting qualitative data	1	10
Icy Contents	Measuring and comparing volumes	2	11
Circle Links	Finding an approximate value of π from measurements	3	12
Little Links	Working with millimetres and applying circle formulae	4–5	13
Taking Off	Solving problems with mass and volume	6–7	14
Castle Construction	Measuring length and area and constructing a scale model	8–9	15
Divide and Prosper	Drawing scale diagrams; working with large areas	10–11	16
Weighty Water	Solving problems with mass and volume	12–13	17
Petrol Power	Understanding the equivalence of units	14	18
Books in Boxes	Solving problems with mass and volume	15	19
Cellphone Confusion	Working with rates and making comparisons	16–17	20
Scale of Events	Designing and using simple scales to measure qualitative data	18–19	22
Ways to Go	Interpreting and using timetables	20–21	23
Great Gardens	Exploring area, perimeter, and volume	22–23	23
Hot Stuff	Measuring change against time	24	24

Page 1

Energy Crises

Achievement Objectives

- design and use a simple scale to measure qualitative data (Measurement, level 4)
- interpret and use information about rates presented in a variety of ways, for example, graphically, numerically, or in tables (Measurement, level 5)
- sketch and interpret graphs which represent everyday situations (Algebra, level 5)

ACTIVITY

This activity focuses on measuring and interpreting qualitative data, using energy and hunger levels as the subject.

Discuss with the students the important distinction between *qualitative* measurements (as used in this activity), which require *subjective* judgments, and *quantitative* measurements, which can be made *objectively* using devices or instruments (such as a ruler, watch, multimeter, scales, anemometer, graduated jug, or thermometer). You could ask the students to list as many examples as they can of measuring instruments and as many examples as they can of both kinds of measurements. They may also like to explore the distinction between *counting* and *measuring*.

The two graphs are time-series graphs, and every peak, trough, and slope tells its own bit of a story. The challenge is to read the story. Key concepts are positive and negative slope (uphill and downhill as you read from left to right) and maximums and minimums (peaks and troughs).

Both hunger and energy rise and fall through the day, and because the same food that reduces hunger increases energy, there is a relationship between the highs and the lows in the two graphs. One way of demonstrating the relationship would be to make an OHT of the two graphs and then superimpose them. It should be clear that as hunger levels drop, energy levels increase (though there is a short delay in this happening). The students could see the same connections by using tracing paper to take a copy of one of the graphs and then moving it onto the other.

When doing question **4**, the students will need to use a suitable scale (perhaps one marked 1–10) against which to record their levels during the day. They should measure the level (of hunger, happiness, or whatever) every half hour. This will keep them alert to changes. Someone with a watch that can be set to beep every 30 minutes could be assigned as timekeeper.

INVESTIGATION

This task gives the students the opportunity to explore good nutrition and to compare this with the "quick shot" energy boosting that is heavily promoted in advertising campaigns. The Internet, nutritionists, the Heart Foundation, and technology and health teachers are all possible sources of information.

A flow diagram or checklist may help the students to plan their investigation:

- Write down the topic or question to be investigated.
- Work out what questions to ask.
- Find out where to look for answers.
- Check with the teacher for appropriateness and safety.
- Collect the information you need.
- Sort and analyse your information.
- Prepare a sketch of your poster.
- Make your poster.
- Explain your poster to the class and have a question for your classmates to discuss, using the information given.

CROSS-CURRICULAR LINKS

Health and Physical Education

This activity could form part of a unit on healthy eating. As part of this, the students could investigate the effects of advertising on our diets. They could also investigate the major illnesses (for example, heart, diabetes, and cancer) that correlate strongly with poor dietary choices. (See also the activity Fat in Foods in *Measurement: Book 2*, Figure It Out, Years 7–8) The two books, *Choice Food!* and *Healthy People Eat Healthy Food* from the Curriculum in Action series (Ministry of Education, 1999) are useful resource books.

Achievement Objectives

- identify factors that affect personal, physical, social, and emotional growth and develop skills to manage changes (Personal Health and Physical Development, level 3)
- investigate and describe lifestyle factors and media influences that contribute to common health problems across the lifespan of people in New Zealand (Healthy Communities and Environments, level 4)

Page 2 Icy Contents

Achievement Objectives

- carry out measuring tasks involving reading scales to the nearest gradation (Measurement, level 4)
- plan a statistical investigation arising from the consideration of an issue or an experiment of interest (Statistics, level 4)
- effectively plan mathematical exploration (Mathematical Processes, problem solving, level 4)
- record information in ways that are helpful for drawing conclusions and making generalisations (Mathematical processes, communicating mathematical ideas, level 4)
- report the results of mathematical explorations concisely and coherently (Mathematical processes, communicating mathematical ideas, level 4)

INVESTIGATION

In this activity, the students investigate a familiar purchase (drinks at fast food restaurants or movie theatres) in order to make a decision about value for money.

Question **1** asks the students to set up what is, in effect, a science experiment as well as a maths investigation. They should be responsible for devising a process that will lead to a valid conclusion and setting it out on paper. There will be a number of different ways of doing this. Once they have sorted out the various steps, they should discuss their method with you so that you have the opportunity to identify possible pitfalls or errors. This planning would be a suitable small-group task.

A trial experiment could be carried out at school or at home. This would clarify the process, identify problems, and may suggest an answer to the original question, but it would not lead to a valid conclusion about what goes on in a real theatre or restaurant. You will need to discuss the concept of validity with your students.

If the activity is to be done in local picture theatres or restaurants, the students will have to work out how to carry it out discreetly and without making a mess. One possible idea would be for them to take two thermos flasks with them in a small bag. They could then transfer the drinks (minus the ice) to the flasks. The actual measuring could then be done at home, and the drink kept cold for later enjoyment!

Question **2** asks the students to evaluate the generality of their findings. They need to realise that there are very big variables (things that change) in their investigation. This means that if they repeated the experiment, they could get quite different results. They should consider how to improve the validity of their conclusions. Hopefully, they will realise that the more times an experiment is repeated and the more places that are sampled, the more general are the conclusions that are reached.

CROSS-CURRICULAR LINKS

Science

This activity is centred around an hypothesis and investigation that could readily be related to the students' science programme.

Achievement Objective

- plan and carry out a "fair test" and make decisions about whether the conclusions drawn from an investigation are soundly based (Making Sense of the Nature of Science and its Relationship to Technology, level 4)

English

Question **3** asks for a formal letter that could be sent to *Consumer*. This could link to work being done in transactional writing.

Achievement Objective

- write instructions, explanations, and factual accounts, and express and explain a point of view, in a range of authentic contexts, organising and linking ideas logically and making language choices appropriate to the audience (Written Language: transactional writing, level 4)

Page 3 Circle Links

Achievement Objectives

- express a fraction as a decimal, and vice versa (Number, level 4)
- carry out measuring tasks involving reading scales to the nearest gradation (Measurement, level 4)
- calculate perimeters of circles, rectangles, and triangles, areas of rectangles, and volumes of cuboids from measurements of length (Measurement, level 4)

ACTIVITY

This activity is designed to help students find the relationship between the circumference and the diameter of a circle. This relationship, a constant (the same for all circles, regardless of size), is known as π (pi), a letter of the Greek alphabet.

By measuring a number of different-sized circular objects and using a calculator to divide the circumference of each by its diameter, the students should discover that each time they get a value of 3.14 or closer. 3.14 is the standard approximation (3 significant figures) for π.

What students will not realise without help is that π is an irrational number. Indeed, most will not know that there are such things as irrational numbers. It is worth getting your students to spend some time exploring this new idea. Some facts:

- The exact value of an irrational number can never be written down.
- An irrational number cannot be written as a fraction (such as $\frac{3}{4}$ or $\frac{5}{11}$).
- When written as a decimal, an irrational number is never complete.
- When an irrational number is written as a decimal, there is no pattern to the sequence of the digits.
- The number of irrational numbers is unlimited. The set of irrational numbers includes $\sqrt{2}$, $\sqrt{3}$, and the square root of every other prime number, most roots, the special constants *e* and φ, and so on.)

Your students can easily demonstrate, using a calculator, that any fraction they choose is *not* an irrational number. Here are some examples, using a calculator with a 10-digit display:

- $\frac{2}{3}$ = 0.333333333 (The sequence of the digits follows a pattern.)
- $\frac{7}{8}$ = 0.875 (The sequence of digits is complete, finite.)
- $\frac{6}{11}$ = 0.545454545 (The sequence of the digits follows a pattern.)
- $\frac{5}{12}$ = 0.416666666 (The sequence of the digits follows a pattern.)

Where the bottom value (denominator) of a fraction is a larger number, the repeating sequence will not necessarily become apparent within the 10-digit frame. For example: $\frac{5}{23} = 0.217391304$. In such cases, the students could use a calculator with a larger display, or a computer.

The discovery of irrational numbers (credited to Pythagoras) split the Greek mathematical community of the day. It challenged their belief in the absolute orderliness of mathematics. Interested students could investigate this further using the Internet. There are also sites devoted to the wonders of π itself.

Pages 4–5 Little Links

Achievement Objectives

- calculate perimeters of circles, rectangles, and triangles, areas of rectangles, and volumes of cuboids from measurements of length (Measurement, level 4)
- devise and use problem-solving strategies to explore situations mathematically (Mathematical Processes, problem solving, level 4)
- record and talk about the results of mathematical exploration (Mathematical Processes, communicating mathematical ideas, level 4)

To do this activity, the students need to:

- be able to work in millimetres and fractions of millimetres
- understand what π is and how to use the π key on a calculator
- know how to find the diameter of a circle, given the circumference.

ACTIVITY

Jenna makes gold and silver chains, cutting narrow strips for the links from small rectangles of metal. The students have to work from the dimensions of the rectangle to calculate the size of the links and the length of the chain that can be made when they are joined. All measurements are given in millimetres.

The students should have completed the Circle Links activity (page 3) before beginning this one. This will ensure that they understand the π relationship between circumference and diameter.

Some students may have trouble visualising this task, and for them it could be useful to model it using plastic putty. This would help them to see the way in which the overlap reduces the contribution each additional link makes to the overall length of the chain. If you have good drawing skills, you could illustrate the effect of the overlaps, using a sketch on the whiteboard.

The students are asked to explain how they arrive at their answers. They could do this initially in discussion with other students and then as a written record for sharing and display. This sharing of process is an important skill in mathematics and a requirement of the Mathematical Processes strand of the curriculum.

Pages 6–7 Taking Off

Achievement Objectives

- calculate perimeters of circles, rectangles, and triangles, areas of rectangles, and volumes of cuboids from measurements of length (Measurement, level 4)
- 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)
- make sensible estimates and check the reasonableness of answers (Number, level 4)
- interpret information and results in context (Mathematical Processes, developing logic and reasoning, level 4)

ACTIVITY ONE

Both activities are based on the fact that a plane can't take off if its mass exceeds a carefully calculated limit.

The students may find that the reading and interpretation involved in this task is just as much a challenge as the maths. The information they need is all there in the panel, but it may not be immediately obvious to them what they should do with it.

Question **1** asks the students to make an accurate calculation using specific figures and to come up with a specific answer (13 192 kilograms). But because their accurate calculation is based on a figure that is an estimate (the average mass of a passenger and their hand baggage = 82 kilograms), their answer is also an estimate.

Some educational suppliers now sell kits of 12 metre-long sticks and 8 corner joints, from which you can construct a wire-frame "cubic metre". One of these could help the class to visualise what sort of space 20 cubic metres is. Also, if they work out the volume of their classroom, or their bedroom, they will be able to relate the size of the 737's holds to this known space.

The students may need some help with the 10 percent wastage referred to in question **2a**. The answers incorporate the 10 percent into the calculation, using the multiplier 1.1 ($\frac{110}{100}$ = 110%). An alternative is to find 10 percent of the volume and add this to the total.

For **2b**, the students need to note that there are *two* holds, each with a capacity of 10 cubic metres (this is explained at the start of the question but may get overlooked).

When answering question **2c**, the students need to go back to the "before fuel" limit of the plane (found in the panel) and subtract from this the mass of the empty aircraft, crew, pantry, and passengers (which was calculated in question **1**). What is left is the mass of cargo that can be carried.

ACTIVITY TWO

This activity gives the individual masses of passengers and their hand baggage. In practice, operators do not weigh individuals, but they do make allowances if their human cargo is atypical (for example, members of an adult male sports team are assigned a weight of 93 kilograms instead of the usual 82 kilograms). In this case, the fact that the mean weight of the passengers is well below the standard 82 kilograms means that the plane could safely carry more cargo, whether or not the operator chooses to do so.

Note

Although the maths and procedures have been simplified, these activities are modelled closely on the weights and allowances used for the Boeing 737 and the Beech 1900D. Nervous students can be assured that the weight limits leave a sizeable safety margin, so their lives will not be in danger if someone puts one too many books in their hand baggage!

For full details on Air New Zealand's baggage rules, see:
www.airnz.co.nz/travelinfo/ontheplane/baggageinformation/default.htm

Pages 8–9 Castle Construction

Achievement Objectives

- perform measuring tasks, using a range of units and scales (Measurement, level 3)
- design the net and make a simple polyhedron to specified dimensions (Geometry, level 4)
- make a model of a solid object from diagrams which show views from the top, front, side, and back (Geometry, level 4)
- calculate perimeters of circles, rectangles, and triangles, areas of rectangles, and volumes of cuboids from measurements of length (Measurement, level 4)
- find perimeters, areas, and volumes of everyday objects (including irregular and composite shapes), and state the precision (limits) of the answer (Measurement, level 5)

ACTIVITY

The students are given diagrams (not templates) of the various parts of a model castle and then have to make the castle using card. After the model has been made, the students work out the areas of the various shapes. From an organisational point of view, the task is a complex one (you need to ensure that there are enough materials and equipment to go around), particularly if the whole class is working on the activity at the same time.

The students could create a table for their measurements and calculations:

Part	Dimensions	Formula	Area	Number	Total Area
Square tower	Side = 5 cm	A = s x s	5 x 5 = 25	2	25 x 2 = 50 cm^2

Finding the area of a circle is listed in level 5 of the curriculum, and if the students have not done this before, the formula (included on the page in the student book) needs to be carefully introduced at this point. As an alternative, or as an introduction to the formula, you may wish to have the students estimate the area by drawing the circle on squared paper and counting the squares.

To estimate the area of the castle's inner space (question **5a**), have the students place the completed castle on paper drawn up with a grid of 1 centimetre squares and trace around its outline. They then count the number of full squares within the outline and add to this their estimate of the number of full squares that could be made from the part squares. This is the estimated area in centimetres squared.

In question **5b**, the students are asked to suggest what size the scale length of 1 centimetre might represent. Some may have difficulty with this because they cannot visualise everyday places and spaces in terms of metres. A useful starting point would be to investigate the plausibility of a scale of 1 centimetre to 1 metre. This would make the wall 8 metres high. Relate this to the height of a standard New Zealand ceiling (about 2.5 metres) and they will see that the wall would be about three times this – enough height for a very impressive wall! They could also measure out the dimensions of the Great Room on the school courts, using this scale, and try others if they wish.

CROSS-CURRICULAR LINKS

Social Studies

This activity could be part of a unit on the Middle Ages, looking at the design of medieval castles, the technology used to build them, and the social life of the day. Comparisons could be made with Māori pā. (A model of a pā could also be constructed.)

Achievement Objectives

Demonstrate knowledge and understandings of:

- the impact of the spread of new technology and ideas on culture and heritage (Culture and Heritage, level 4)
- how places reflect past interactions of people with the environment (Place and Environment, level 4)

Pages 10–11 Divide and Prosper

Achievement Objectives

- carry out measuring tasks involving reading scales to the nearest gradation (Measurement, level 4)
- calculate perimeters of circles, rectangles, and triangles, areas of rectangles, and volumes of cuboids from measurements of length (Measurement, level 4)
- record information in ways that are helpful for drawing conclusions and making generalisations (Mathematical Processes, communicating mathematical ideas, level 4)
- report the results of mathematical explorations concisely and coherently (Mathematical Processes, communicating mathematical ideas, level 4)

ACTIVITY ONE

The hectare is the basic unit of land area for all but very large areas (in which case, the units used are square kilometres). This activity is designed to help students visualise and use hectares.

The key fact is that 1 hectare = 10 000 square metres. Although a hectare can have any shape whatsoever, it is helpful to think of it as a square measuring 100 metres x 100 metres. As the students will learn when they do the activity, a full-sized rugby field is around 100 metres x 50 metres, or half a hectare. It is worth revisiting this comparison repeatedly until everyone in the class remembers it for life!

In question **2**, students are asked to draw 2 rectangles to scale, one inside the other. Those who have difficulty getting underway with this can draw lengths such as 1 centimetre, 2 centimetres, and 5 centimetres, then label them in metre equivalents using the scale 1 centimetre to 20 metres.

When doing question **3**, those who live in their own homes can ask their parents the size of their section. They will either have this piece of information in their head or will be able to find it on the title deed. Those living in rented properties are unlikely to have ready access to this information, but they could find it out through the local council. Some cities have property data such as section size and rateable value freely available on their websites. Alternatively, the students could estimate the size of their section by pacing it out.

Question **4** asks students to investigate real estate advertising in local newspapers, with the students comparing the sizes of different types of properties. Some students may wish to visit real estate web pages for this information. Others may be interested in asking an agent what makes a piece of land a "lifestyle block".

ACTIVITY TWO

In this activity, the students need to be able to break up a shape into smaller shapes (a rectangle and triangle) so that they can work out the area. They also need to understand the relationship between kilometres and metres.

In question **2**, the scale suggested is tight for an A4 page. An alternative would be to use a scale of 1 centimetre to 200 metres or to use A3 paper.

Question **3** is another investigation of real estate. This time, the object is to find the current cost of lifestyle blocks in your area. If your school gets bundles of newspapers, they will come in handy for this exercise.

INVESTIGATION

The local council or a land surveyor would be able to explain what is required when subdividing land. The students may be surprised to learn that there are many requirements to be met and major costs involved. This is true even when dividing a residential section in two. If you live in an area where a major piece of land is being developed for housing, the process may be a suitable project for a pair of interested students, who could then report their findings to the class.

CROSS-CURRICULAR LINKS

Social Studies

This activity could be part of an investigation into local history, looking at the way land use has changed and how a town or city has grown as big blocks of land have been progressively subdivided over time. Such a study could include historic Māori use, old farmlands or orchards, present-day lifestyle blocks, and infill housing.

Achievement Objective

Demonstrate knowledge and understandings of:

- how places reflect past interactions of people with the environment (Place and Environment, level 4)

Pages 12–13 Weighty Water

Achievement Objectives

- make sensible estimates and check the reasonableness of answers (Number, level 4)
- write and solve problems involving decimal multiplication and division (Number, level 4)
- carry out measuring tasks involving reading scales to the nearest gradation (Measurement, level 4)
- find perimeters, areas, and volumes of everyday objects (including irregular and composite shapes), and state the precision (limits) of the answer (Measurement, level 5)
- design and use models to solve measuring problems in practical contexts (Measurement, level 5)

ACTIVITY

The previous activity was designed to help students gain a sense of area, measured in hectares. This activity is designed to give them a feel for volumes and the mass of water. It also reinforces the processes for calculating volume and mass.

The students need to be given time to find out the volume of a (standard) bath. This could be done as a home activity the night before. Given that any bath has a sculpted shape, this involves rather more than simply finding the bath's external dimensions. The students could be challenged to come up with a method and asked to report back next day on both the volume and the method used to estimate it. Clarify the fact that in this case, we are using the bath simply as a unit of measurement, so they are to imagine it filled to the rim. Students who come from homes where the bath is a corner bath or a spa bath can still find its volume, but when they do question **1,** they should use the approximate volume of a standard bath, as worked out by their classmates.

Two ways of estimating the volume of a bath are:

- Regard the shape as more or less a cuboid. Use a tape measure to measure the length and breadth at about halfway up the sides (to find an approximation for the median length and breadth) and the depth at a point about halfway along the bath (to find an approximation for the median depth). Multiplying the median length, breadth, and depth gives a satisfactory estimate for the volume.
- Fill the bath from the cold tap, using a 10 litre bucket. Mark the number of full buckets off on a tally chart. (Any students who want to try this should make sure they get their parents' permission first.)

The vital connections here should be learned by heart and never forgotten:

- 1 000 cubic centimetres = 1 litre
- 1 litre of water weighs 1 kilogram.

These relationships are so precise and convenient because the metric system was designed to be simple and sensible.

Question **2** asks the students to make a comparison between the mass of the water in the waterbed and the mass of a car. It is surprisingly difficult to find the mass of cars, but the Internet is a useful resource. Question **3** applies the same principles of volume and mass to a larger situation.

Question **4** is a more complex scenario, involving rates, and you should work through it before giving it to your students so that you are familiar with the issues. One approach to part **a** is as follows:

- The depth has gone down 4 centimetres in 5 days. At this rate, it would go down 8 centimetres in 10 days or 0.8 of a centimetre in one day.
- This means that every day, the pool is losing the equivalent of a layer of water 8 metres by 20 metres by 0.8 centimetres. Converting all units to centimetres, 800 x 2 000 x 0.8 = 1 280 000 centimetres cubed.
- 1 000 centimetres cubed is equivalent to 1 litre. So, to convert the volume from centimetres cubed to litres, divide by 1 000 to get 1 280 litres.

CROSS-CURRICULAR LINKS

Social Studies

Students could investigate the legal and moral responsibilities of the owner of the leaky pool, along with a consideration of good neighbour protocols. Newspapers and consumer advocate television programmes often have stories about such issues involving neighbours.

Achievement Objective

Demonstrate knowledge and understandings of:

- how and why people exercise their rights and meet their responsibilities (Social Organisation, level 4)

Page 14 Petrol Power

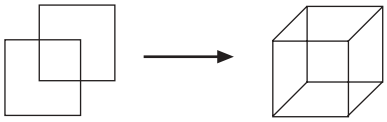
Achievement Objectives

- demonstrate knowledge of the basic units of length, mass, area, volume (capacity), and temperature by making reasonable estimates (Measurement, level 3)

ACTIVITY

This page is about engine capacity and the relationship between the different units used to measure it. The activity reinforces the relationships emphasised on the two previous pages.

Students are asked to use modelling clay to accurately make a cube with sides of 1 centimetre or, as a less satisfactory alternative, to accurately draw a cube of this size. If modelling clay is not available, the cube could be made from carrot or potato. A simple way to draw a cube is to draw a square and then draw a second square to the right and up. Connect the vertices with straight lines:



After making or drawing the cube, the students are asked to compare its volume with a cube that has sides of 10 centimetres. The small and large cubes from base 10 place value blocks could be used for this purpose. The students are then asked to order engines of various capacities and complete a table using both cubic centimetres and litres.

INVESTIGATION

This could be carried out in small groups, with the students finding out how an internal combustion engine works. They are asked to make scale models of cylinders of different sizes. These could be cardboard tubes. The students may need help with the mathematics here because they may not have yet met the volume of a cylinder ($V= \pi r^2 h$). When they have completed their investigation, they are likely to be surprised at how small the cylinders of a car engine actually are.

CROSS-CURRICULAR LINKS

Science

Achievement Objective

- investigate and offer explanations of how selected items of technology function and enhance everyday activities of people (Making Sense of the Physical World, level 4)

Page 15 Books in Boxes

Achievement Objectives

- make sensible estimates and check the reasonableness of answers (Number, level 4)
- find a given fraction or percentage of a quantity (Number, level 4)
- carry out measuring tasks involving reading scales to the nearest gradation (Measurement, level 4)
- calculate perimeters of circles, rectangles, and triangles, areas of rectangles, and volumes of cuboids from measurements of length (Measurement, level 4)

ACTIVITY

Make sure there is a set of maths books, dictionaries, or similar and a plastic box (the dimensions given in the activity are those of a standard "cube" crate) in the classroom. The students can then explore ways of stacking the books. They will be able to see and feel what 20 kilograms is like.

If there is a crate and a set of books similar in size to the box and atlases in question **1a**, it will be easy for the students to experiment until they find the most economical way of stacking the books. If these are not available, they should be able to sketch the different possibilities and use a calculator to help them work out the dimensions of the various stacks.

When working out mass in questions **1b** and **1c**, the students need to remember to take the mass of the plastic box (2.3 kilograms) into account.

Question **1c** asks the students to work out how many atlases could fit in the box without exceeding the 20 kilogram limit. They should estimate the answer before they calculate it. Question **1d** is a 3-part problem:

- calculate the volume of the atlases
- calculate the volume of the box
- calculate the percentage of the volume of the box that is occupied by the atlases.

Encourage your students to explain how they got the percentage. Many push the percentage key without having any idea about what the calculator is doing. (It may be a good idea to tell them not to use the percentage key at all.)

Question **2** repeats the same questions but uses books with different dimensions and mass. This time, the books will fill the crate without going over the 20 kilogram limit. Your students can think about why this is and should conclude that some books are heavier than others (that is, they have a greater density), which they knew all along.

Question **3** involves Figure It Out books. The school office may have a set of digital scales for measuring the mass of parcels, in which case, the students will be able to find the mass of a single book. If this is not possible, they can put a stack of 10 or 20 books on whatever scales are available, find the total mass, then divide by 10 or 20 to get a fairly accurate mass for 1 book. A similar principle can be used to find the thickness of 1 book: find the thickness of a stack of books and then divide by the number of books in the stack.

In **3c**, the answer turns out to be a percentage that exceeds 100. Let the students work out what this means.

CROSS-CURRICULAR LINKS

Health and Physical Education

The principal puts a weight limit on the boxes because he doesn't want the students or staff to strain their backs when lifting them. Your students should investigate whether this is a suitable limit.

This activity could lead into a discussion concerning the importance of looking after one's back, an investigation of the incidence or causes of back injury, and/or research into safe lifting techniques. The ACC has relevant information in pamphlet form. Findings could be worked into a poster or a computer presentation. The students could find out about the use of devices such as trolleys and hand trucks for shifting large loads and the hoists used in hospitals for lifting patients into bed. They could also find out how piano shifters manage. Often there are only 2 people to shift a heavy piano up and down flights of steps.

Achievement Objective

- access and use information to make and action safe choices in a range of contexts (Personal Health and Physical Development, level 4)

Pages 16–17 Cellphone Confusion

Achievement Objectives

- perform calculations with time, including 24-hour clock times (Measurement, level 4)
- make sensible estimates and check the reasonableness of answers (Number, level 4)
- interpret and use information about rates presented in a variety of ways, for example, graphically, numerically, or in tables (Measurement, level 5)
- devise and use problem-solving strategies to explore situations mathematically (Mathematical Processes, problem solving, level 4)
- record information in ways that are helpful for drawing conclusions and making generalisations (Mathematical Processes, communicating mathematical ideas, level 4)

ACTIVITY

This activity loosely mirrors the complex deals being offered by cellphone companies. The maths in the activity is quite intricate, and the students will need to read the information with care so that they take all factors into account.

The facts can be collated in a spreadsheet or a table. This will help the students to sort out the information as they answer the questions.

	Monthly fee	Off peak (month)	Daytime calls (min)	Texts	Total cost (excluding cost of phone)	Add cost of phone
Yackety Yack	$25	100 mins free, then 49 cents	99 cents	15 free, then 20 cents		$100
1 month	25	90 x 0.49	20 x 0.99	105 x 0.20	25 + 44.10 + 19.80 + 21 = $109.90	
12 months					109.90 x 12 = $1,318.80	$1,418.80
24 months					$2,637.60	$2,737.60
Busy Lines	3 months free, then $30 a month	150 mins free, then 65 cents	99 cents	10 free, then 15 cents		$200
1 month	0	40 x 0.65	20 x 0.99	110 x 0.15	26 + 19.80 + 16.50 = $62.30	
3 months	0				62.30 x 3 = $186.90	
12 months	9 x 30				62.30 x 12 + 9 x 30 = $1,017.60	$1,217.60
24 months	21 x 30				62.30 x 24 + 21 x 30 = $2,125.20	$2,325.20

Cellphone companies have their rates posted on the web, so this is where the students should go when answering question **6**. A proportion of the class will already be regular cellphone users and will be able to establish a "profile" for themselves against which to check the different plans available.

As an extension activity, your students could create a survey to find out:

- the proportion of students who have phones
- who pays for student phones and their use
- how much students are spending on cellphones.

This information could be collated and presented using charts or a computer.

CROSS-CURRICULAR LINKS

As cellphones become more sophisticated, the social implications of their use become greater and more widespread. This activity could be part of a cross-curricular unit using achievement objectives from the science, social studies, and technology curricula. As part of this, students could:

- find out how cellphones work
- investigate the history and evolution of the telephone
- investigate the social changes occurring as a result of this technology
- consider cellphone etiquette and safety issues
- debate the proposition that their use should be banned during the school day
- predict what further changes in phone technology might be in store and what the effects of such changes might be. They could consider what might be lost as well as what might be gained from such developments.

Achievement Objectives

Science

- investigate and describe how selected items of everyday technology work and affect our lives (Making Sense of the Physical World, level 3)
- investigate and offer explanations of how selected items of technology function and enhance everyday activities of people (Making Sense of the Physical World, level 4)

Social Studies

Demonstrate knowledge and understandings of:

- the impact of the spread of new technology and ideas on culture and heritage (Culture and Heritage, level 4)

Technology

- explore and discuss the impacts over time on the local and wider environments and society of some specific technology, as in the dairy industry; the introduction of wide-bodied jets (Technology and Society, level 4)

Pages 18–19 Scale of Events

Achievement Objectives

- design and use a simple scale to measure qualitative data (Measurement, level 4)

ACTIVITY ONE

In this activity, the students are asked to place various events on a 5-point scale measuring their seriousness. The activity could be introduced with a discussion about what constitutes a disaster and what doesn't, or the students could be given the chance to get right into the task and discover the issues for themselves, with the class discussion coming later.

Whether we view an event as a disaster or not depends on a personal assessment that is itself based on a complex mix of factors including:

- our own values
- how the event impacted directly on our own lives
- where the event occurred
- the cause of the event
- how long ago the event occurred
- how many were killed or affected in the event
- who was involved
- how much we know about the event.

Students need to be accepting of the fact that others may view a particular event very differently for reasons that are valid for them.

Activity One and **Activity Two** both involve *qualitative* scales as distinct from *quantitative* scales. The notes for Energy Crises (page 1) explain the difference between these two kinds of scale. The students need to clearly understand the distinction.

The questions in **Activity Two** ask the students to explore placing the same data set on different qualitative scales and then to evaluate the scales. Answers will vary, but they are likely to find that:

- the fewer the points on the scale, the quicker it is to categorise the data
- it takes longer to sort data on a continuum, but once this has been done, the scale reveals more.

Discipline Dilemmas (*Statistics: Book One*, Figure It Out, Years 7–8), explores the way in which the scale used can affect the conclusions drawn.

CROSS-CURRICULAR LINKS

Social Studies

This activity could be used as part of a unit on disasters.

Achievement Objectives

Demonstrate knowledge and understandings of:

- causes and effects of events that have shaped the lives of a group of people (Time, Continuity, and Change, level 4)
- how and why people experience events in different ways (Time, Continuity, and Change, level 4)

Pages 20–21 Ways to Go

Achievement Objectives

- read and construct a variety of scales, timetables, and charts (Measurement, level 4)
- perform calculations with time, including 24-hour clock times (Measurement, level 4)

ACTIVITY

This activity is about reading and interpreting timetables. The bus timetable uses 12-hour time, and the train timetable uses 24-hour time. Make sure that everyone knows how to interpret 24-hour time and why it is needed (especially to avoid confusion where international communications or travel are involved). Students are used to seeing both formats on digital watches, clocks, VCRs, microwaves, ovens, dishwashers, and so on. The bus timetable uses a dot to separate hours and minutes; the train timetable uses a colon. Again, students meet both in everyday life: the colon separator is used on most digital devices, but the dot is normally used in print. They need to be able to understand and use time in both formats.

If you know that your class is likely to have trouble with timetables, prepare them with a class or group discussion. There are plenty of questions that can be asked while leaving the questions in the activity to be done by the students themselves, for example, "When is the earliest Savannah could get to university if she caught the 9.00 a.m. bus from Richard Street?" or "What would be the latest time she could leave home if her first lecture was at 10.00 a.m.?" or "Which bus would she need to catch from Richard Street if she wanted to get the 7.25 a.m. train from Porirua Station?"

As an extension activity, some students may like to investigate how it is that time is based on numbers such as 60, 24, and 7 when we measure everything else (except angle!) in tens. This could extend to an investigation of the numerous imperial measuring systems that were replaced by the metric system. They might investigate why it is that the US still uses imperial units for most of their measurements.

Pages 22–23 Great Gardens

Achievement Objectives

- make sensible estimates and check the reasonableness of answers (Number, level 4)
- write and solve problems involving decimal multiplication and division (Number, level 4)
- calculate perimeters of circles, rectangles, and triangles, areas of rectangles, and volumes of cuboids from measurements of length (Measurement, level 4)

ACTIVITY ONE

The students should not have much trouble with the questions involving area and perimeter, though they may need help with those that involve depth. They do, however, need to note that measurements are given in centimetres and metres. In this context, metres are the most suitable units for length and square metres the most suitable units for area, but centimetres are fine for depth. Working between the different units will test their understanding of place value. Remind them that they must check their answers for reasonableness.

When doing question **3**, the students could ask themselves how deep a cubic metre of soil would be when spread over 1 square metre, 2 square metres, or 3 square metres. They could then repeat the task, starting with half a cubic metre of soil. This should enable them to see the inverse relationship between area and depth (as area increases, depth decreases).

Question **4** requires students to convert litres into cubic metres. You may need to remind them that a cubic metre is the same as 1 000 litres.

ACTIVITY TWO

This activity draws on similar maths, with the added complexity of a composite shape for area.

When doing question **4**, the students will find that no length is given for the slant side of the garden. Instead of telling them how to deal with this, give them the chance to use the maths they know. It is not expected that they will use Pythagoras' theorem; this is found in level 5 of the curriculum. Although it is not made explicit, the diagram of the garden has been drawn to scale. The students should be able to discover this fact for themselves and to use the scale to find the length of the slant side accurate to the nearest 0.1 of a metre. If the diagram had not been drawn to scale, they could still have found the missing length to a sufficient level of accuracy by drawing it to scale themselves.

CROSS-CURRICULAR LINKS

Science

This activity could be linked to a science unit on horticulture. The students could investigate what mulches are, how they benefit the garden and the gardener, and what different kinds of mulch there are.

Achievement Objective

- investigate the positive and negative effects of substances on people and on the environment (Making Sense of the Material World, level 4)

Page 24 Hot Stuff

Achievement Objectives

- read and construct a variety of scales, timetables, and charts (Measurement, level 4)
- carry out measuring tasks involving reading scales to the nearest gradation (Measurement, level 4)
- record information in ways that are helpful for drawing conclusions and making generalisations (Mathematical Processes, communicating mathematical ideas, level 4)

ACTIVITY

This maths task is also a science experiment, and students need to treat it as they would an experiment. They should be allowed to work out the details themselves, following a clear and serious warning that *their method must not put them at risk of scalding*.

These headings will provide a structure for the task, from beginning to end:

- focusing
- planning
- information gathering
- processing
- interpreting
- reporting.

This experiment is simple to set up, with the only specialist item required being a thermometer capable of being immersed in liquids at boiling point (a glass spirit thermometer or a digital probe thermometer are both suitable and fairly inexpensive).

The students should take the temperature of the water immediately it is put into the mug, then every 2 minutes for the first 10 minutes because this is when it is falling most rapidly. After this, they can extend the interval between observations. If possible, measurements should continue to be taken for at least 2 hours, by which time the liquid should be down to within 4 degrees of room temperature.

When comparing the thermal qualities of different mugs in question **4**, the students need to realise that they must use the same amount of water in each case. This is because large volumes of liquid lose temperature more slowly than small volumes. Using just one thermometer, it should be possible to monitor the temperature of liquids in several different mugs.

When temperatures are plotted, a time-series graph results, with a curve that slopes away to the right. It is unlikely that the first reading will record a result of 100° because the temperature drops extremely quickly as the water comes in contact with the air and the cold cup. The graph will fall away very steeply at first and then gradually become closer to the horizontal as a stable temperature is reached.

The students could experiment with pre-heating a coffee mug and seeing what difference this makes to the initial drop-off in temperature. They would do this by first filling the mug with boiling water, letting it stand for a minute or two, then emptying it and refilling it with boiling water. They would then start recording the temperature.

CROSS-CURRICULAR LINKS

Science

This particular type of time-series graph is similar to a decay graph. Such graphs model the decay of radioactive isotopes and demonstrate how it is that they can remain dangerous for exceedingly long periods of time (zero danger being represented by the horizontal axis). The decay of carbon isotopes is similarly modelled, and it is this process that lies behind the carbon dating of prehistoric objects. Students who are scientifically curious could investigate these processes and the related concept of "half-life", reporting their findings back to the class.

Achievement Objectives

- investigate and describe their ideas about some commonly experienced physical phenomena to develop their understanding of those phenomena (Making Sense of the Physical World, level 3)
- process and interpret information to describe or confirm trends and relationships in observable physical phenomena (Making Sense of the Physical World, level 4)

ACKNOWLEDGMENTS

Learning Media and the Ministry of Education would like to thank Len Cooper, mathematics consultant, Auckland, for developing these teachers' notes.

The photograph on the cover is by Mark Coote and Adrian Heke. The illustration on the cover is by Kirsty Lillico. The photographs in the side strips on the contents page and page 2 are by Meredith Biberstein.

The photograph in the side strip on page 9 is by used with the permission of the Alexander Turnbull Library, Wellington.

Series Editor: Susan Roche
Editor: Ian Reid
Series Designer: Bunkhouse graphic design
Designer: Nicole Wright

Published 2004 for the Ministry of Education by
Learning Media Limited, Box 3293, Wellington, New Zealand.
www.learningmedia.co.nz

Dewey number 530.8
ISBN 0 7903 0161 X
Item number 30161
Students' book: item number 30155