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Waste Less

Mathematics (Standard) Years 9—10

A teaching and learning theme on Mathematics of our Environment

EPA NSW

NEW SOUTH WALES DEPARTMENT OF SCHOOL EDUCATION

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FOREWORD

In 1996 a staff interchange was arranged between the NSW Department of School Education and the Environment Protection Authority. The aims of the interchange were to promote professional development for the participants and to produce a curriculum support document. Ross Tanswell from Kanahooka High School worked with Debbie Maddison from the South Coast, Environment Protection Authority, gathering data and analysing material which could support the new Board Mathematics syllabus. The new syllabus in Mathematics (Standard) Years 9 and 10 devotes a whole teaching and learning theme to Mathematics of our Environment. *The interchange participants trialled the material with Years 9 and 10 students at Kanahooka High School.*

With the support of other mathematics teachers, the Mathematics Consultant from the Wollongong District Office and a number of other educationists and EPA officers, this document was then developed to assist teachers statewide.

While the activities and information were developed with the Mathematics Years 9 and 10 Syllabus in mind much of the material would be appropriate or adaptable to other mathematics syllabuses.

This joint publication of the Environment Protection Authority and the Curriculum Directorate of the NSW Department of School Education has been developed to assist in the teaching of mathematics and to support the integration of environmental education across the curriculum.

At a time when numeracy is an educational priority and care for the environment has high public support, it is anticipated that the material in this document will be of great value to schools.

Lindsay Wasson
Director of Curriculum
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INTRODUCTION

Rationale

The new Mathematics 9-10 Syllabus will be introduced in 1997 for assessment in the School Certificate, 1998. One of the focus areas of this syllabus is *"Mathematics of our Environment"*. To support this, and to assist teachers with the implementation, this unit has been produced as a guide to integrate environmental and mathematical concepts. The thematic content for the mathematical syllabus looks at populations, the school environment and the general environment. The unit aims to raise awareness of environmental issues and the need to take care of the environment by developing mathematical skills in the context of environmental investigations. The examples and activities in this publication should also stimulate ideas for integrating environmental education and mathematics concepts in a number of other mathematics syllabuses 7-10.

Who is the unit for?

The curriculum support material in this document is mainly intended for the environmental theme within the Mathematics (Standard) 9-10 Syllabus. This syllabus may be a useful resource for other teaching and learning units with an environmental focus which will ensure students receive a balanced, thoughtful and problem-solving approach to contemporary environmental issues and their inherent complexities.

Aim of the unit

An understanding of the new Mathematics Syllabus and the Environmental Education Curriculum Statement (1989) will ensure the relevance and appropriateness of the resources. The objectives of these resources are to provide:

- an environmental perspective to Mathematics (Standard) Years 9-10 and, to some extent, a perspective for other mathematics syllabuses
- a stimulus for teacher and student interest in exploring the environment as a practical context for the development of mathematical skills
- an accessible and relevant teaching and learning resource
- a focus for the in-service education for professional development of teachers linking maths and the environment
- opportunities for the development of knowledge, skills, attitudes and behaviours which promote a conservation ethic.

Outcomes

This unit should encourage students to think about aspects of their environment that they value, helping them to develop skills in environmental management through involvement in determining the quality of their local environment. Students will develop the mathematical skills necessary to collect data on aspects of the environment, analyse such data, and make inferences from such analysis and, in turn, develop an understanding of suitable waste minimisation practices which can be undertaken at home and at school.

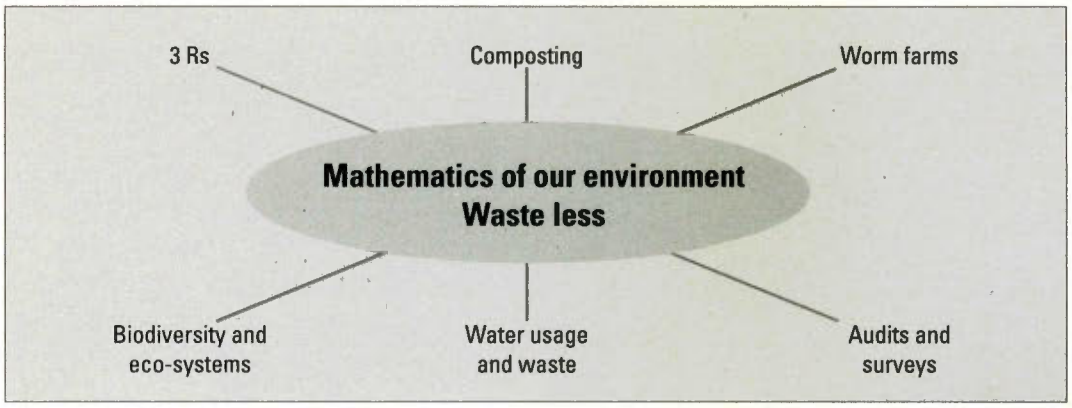
How to use the unit

Each topic has a number of activities and exercises which can be carried out by students independently, in small groups, or by the whole class. The ideas presented can be applied to a wide variety of teaching styles, situations and stages of student development, and teachers may select activities accordingly.

Time required

Each topic is designed to take one week for the average student group but it can be varied to suit each teacher's requirements.

UNIT OVERVIEW – showing issues to be covered within the theme



Learning Experiences

Through the theme, *Mathematics of our Environment*, students should develop an understanding of the three major themes in the new syllabus, that is:

Populations

Learning experiences should provide the opportunity for students to:

- use sampling techniques to estimate large numbers, e.g. crowd size
- set up number sequences reflecting population growth, given certain assumptions (e.g. every minute, a bacterium divides into 2), and extend the patterns
- follow and construct rules for describing patterns and sequences using natural language
- describe simple patterns using natural language and algebra
- interpret data from tables and graphs on animal or human populations
- represent data on animal or human populations, using tables and graphs, and make predictions for their future
- use simple rates to compare growth and decline of populations.

The school environment

Learning experiences should provide the opportunity for students to:

- make reasonable estimates of lengths and perimeters in the school environment and use measuring tools to find actual lengths and perimeters
- make a square metre and use it to estimate and subsequently calculate the number of square metres of floor space in the classroom
- measure lengths accurately and work out floor areas of different rooms or parts in the school
- make a cubic metre and use it to estimate and subsequently calculate the volume of the classroom
- compare the volume of different classrooms
- create simple scale models of school buildings
- draw different views of buildings (e.g. side, top, front, back views).

The general environment

Learning experiences should provide the opportunity for students to:

- recognise the Fibonacci sequence and relate it to similar arrangements in nature
- extend the Fibonacci sequence and describe the rule in words
- use a calculator and tabulation to work out the ratio of pairs of successive terms in the Fibonacci sequence
- determine an approximation for π from the circumference and diameter of objects with a circular cross-section
- use the formula $(C=\pi d)$ to find the circumference of circular objects, e.g. the girth of a tree after estimating its diameter
- use the formula $(C=\pi d)$ to find the diameter of circular objects after measuring the circumference, e.g. find the diameter of trees or power poles after measuring the girth (the girth of a tree is usually measured 1.3m up from the base)
- substitute into formulae related to aspects of the environment and solve any resulting equation
- estimate and find heights of objects within the environment, e.g. trees, flagpoles etc (using a shadow stick and similar triangles, or a clinometer)
- interpret data on an aspect of the environment, e.g. management of forests or use of trees for paper or furniture, identify any misleading statistics, display information and present a brief report on the aspect investigated.

STUDENT OUTCOMES

This guide gives a quick overview of the student outcomes covered in each Topic through the Theme *Maths in our Environment*.

		3 R's	Composting	Worm farming	Bio-diversity	Water usage	Audits
Working mathematically		X	X	X	X	X	X
Geometry	Drawing figures and making models	X	X	X			
	Arrangements and locations	X					
Number	Number skills		X			X	X
	Ratio and rate	X	X		X	X	X
Measurement	Choosing units	X		X	X	X	X
	Measuring	X	X	X	X	X	X
	Estimating	X		X		X	
	Perimeter	X		X		X	X
	Area	X		X	X	X	
	Volume and Capacity		X	X	X		X
Chance and data	Displaying, summarising and interpreting data	X	X	X	X	X	X
Algebra	Patterns	X		X	X		
	Graphs	X		X	X	X	
	Formulae	X		X		X	

BACKGROUND

In 1995 the people in the Sydney metropolitan region sent to landfill 2.96 million tonnes of waste, over 850kg per person. Waste has become a part of our daily lives, but it is having adverse effects on the environment. Governments are acting to reduce waste and conserve resources; the NSW Government has adopted a target of 60% reduction in waste sent for disposal by the year 2000.

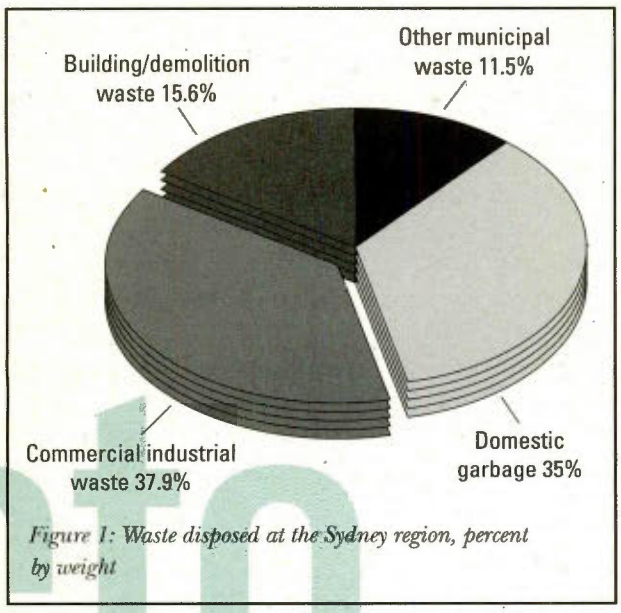


Figure 1: Waste disposed at the Sydney region, percent by weight

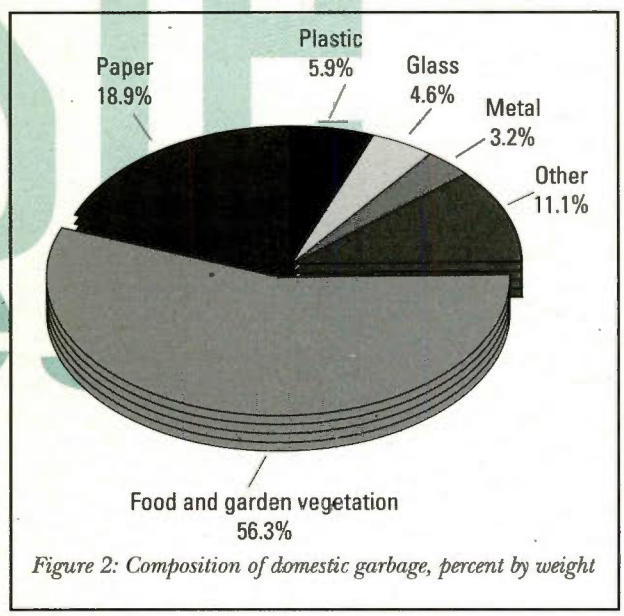


Figure 2: Composition of domestic garbage, percent by weight

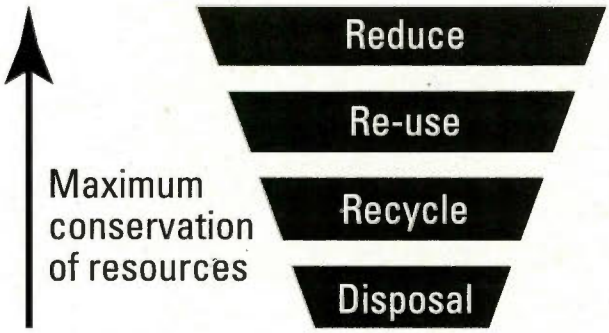
Figure 1 gives an indication of how much waste is being generated, in total, to landfill with Figure 2 breaking down the makeup of domestic waste.

The approach to waste management is based on the philosophy that sustainability of resources can be achieved only through reduced generation of waste and avoidance of unnecessary consumption. The government has adopted a waste management hierarchy which stresses the importance of waste reduction above even re-use and recycling, with waste disposal to be used only as a last resort.

Each one of us contributes, to some extent, to our waste problems. So, it is up to each one of us to do our best to reduce waste and not expect that someone else will do it all for us. Waste reduction starts with the actions and decisions we each make in our everyday lives.

We can Reduce, Re-use and Recycle. Each of these helps to decrease waste, but they are placed in order of their effectiveness. Reducing waste is the most important means of decreasing waste and its impacts. Re-using products in their original form is better than recycling their materials. This order highlights the wider environmental issues, such as the burning of fossil fuels, pollution of air, land and water, and land degradation resulting from resource extraction.

Reducing waste means avoiding waste: buying only what you really need and choosing things that result in minimal amounts of waste. More and more people today are questioning consumerism. They are asking themselves: "Do I really need this?"



Waste management hierarchy

TOPIC 1: 3 R's (Reduce, Re-use, Recycle)

Rationale

This topic enables students to use **geometry, measurement** and **chance and data** skills whilst investigating the status of waste management in their own council area and comparing the quality, cost efficiency and effective customer-focused service in waste management and waste minimisation.

You will need

Activity 1.1: Handout 1.1, *Litter mapping*
Tape measure or trundle wheel for measuring sections
4 x 1 metre rules (to demonstrate a square metre)

Activity 1.2: Handout 1.2, *How much litter?*
One or more examples of each listed type of packaging (aluminium cans, milk carton etc). This could be kept from previous activity
Set of scales for measuring mass (weight)

Activity 1.3: Handout 1.3, *Waste minimisation, Kiama Municipal Council*
Geometry set

Activity 1.4: Handout 1.4, *What's in your garbage?*
Graph paper

Teachers' notes on activities

Activity 1.1: Litter mapping (3 hours overall)

This activity is designed for the students to develop their knowledge, understanding and skills by:

- using geometric techniques and tools to construct lines and 2D figures;
- using a variety of techniques and tools to measure and compare quantities, including angles;
- displaying data in different forms;
- investigating a problem by posing suitable questions and planning data collection;
- planning, carrying out and reporting on a statistical investigation with guidance;
- interpreting and using ratios and rates to solve simple problems; and
- developing an appreciation of mathematics as an essential and relevant part of life.

Activity 1.2: How much litter (40 to 90 minutes overall)

This activity is designed for the students to develop knowledge, understanding and skills by:

- making estimates of mass and checking by measuring;
- recognising and using conventions to manipulate simple algebraic expressions; and
- interpreting and using mathematical information presented in a variety of forms.

Activity 1.3: Waste minimisation, Kiama Municipal Council (40 to 90 minutes overall)

This activity is designed for the students to develop knowledge, understanding and skills by:

- having an appreciation of mathematics as an essential and relevant part of life;
- selecting and using appropriate mental, written or calculator techniques to perform a variety of operations involving fractions, decimals, percentages and positive integers;
- rounding numbers appropriately to a desired degree of accuracy;
- organising and displaying collected data in a variety of ways; and
- interpreting data represented in tables and graphs.

Activity 1.4: What's in your garbage? (40 minutes)

This activity is designed for the students to develop knowledge, understanding and skills by:

- making scale drawings and using them to solve problems;
- reading and interpreting information represented in tables;
- making reasonable sketches of simple solids and their cross sections.

Alternative activities

- Audit of lunch bin: Compare each student's lunch in terms of the amount of waste generated (mass of waste; types of waste; if reusable; possible to recycle).
- No-waste lunch: Class challenge to come up with the "best" lunch with the least waste. Compare weights or volumes; estimate how long it would take to fill a bin, a cubic metre, the classroom. Compare the differences between "audit of lunch bin" and "no-waste lunch".
- Measure characteristics of an aluminium can ie: length, mass, circumference. How many cans make up a tonne: how many cans are needed end-to-end to cover various distances e.g.: your school to Sydney? The circumference of the earth would need how many cans? How much are they worth per can, per kilo, per tonne?
- Re-use of packaging: Discover how many ways items can be re-used: plant containers, pencil containers. In terms of weight, volume, how much waste is re-used? Could these items be re-sold through the school? How much could the school make in a month, a year?
- Costs of recycled material versus new material.
  Using the table below, compare costs as fractions, %; graph the two costs.

Recycling competes with cost of raw materials and price of disposal

	Costs of collecting, sorting, transport (per tonn(e)	Revenue from sale, rebates, avoiding tip (per tonne)
PET	$1 203	$600
HDPE	$1 293	$450
PVC	$685	$350
Cartons	$692	$200
Steel	$273	$40
Cans	$910	$830
Glass	$115	$100
Paper	$90	$50
As the costs and revenues of recycling are constantly changing, the figures are a guide only.		

Extension

School awareness: How can your school improve waste minimisation (3Rs)
(Hint: Using both sides of the paper, reusing packaging, looking at purchasing practices kerbside collections; recycling at school). What savings or costs would there be to the school? Cost benefit analysis.

Handout

1.1: LITTER MAPPING

1. **Working in groups divide up your school grounds into rectangular sections and estimate the approximate perimeter of each section. Use a measuring tool to find actual lengths and perimeters.**
2. **Draw a scaled outline of your section, showing the dimensions and purpose of that section (building A, canteen, sports field etc). Show all important features such as paths, gardens, large trees, garbage and recycling bins, etc. on your outline.**

HINT: Do not pick up sharp objects. If you find dangerous materials, such as needles, note where they are and tell your teacher immediately. Always wear gloves and use tomngs.

3. **Note on each outline where litter is located within each section. Use coloured pencils to show the type of litter you find; agree on the same colours for everyone, e.g.: green = putrescibles** (food waste) etc. Make one coloured mark for each piece of litter found. You might want to have a special symbol for each type of waste as well.
4. Complete the following table, using your section litter map.

	TYPE OF ITEM						
	Putrescible	**Paper**	**Glass**	**Metal**	**Plastic**	**Other**	**Bin**
Colour and Symbol							
Tally							

4.1 How many pieces of litter in total did your group find? .....

4.2 Graph your results

4.3 How many would there be in one week, if this represents:

(a) one day .....

(b) one month? .....

(c) one year? .....

5. Work out total area for your section (square metre) by using the following information: .....

5.1 On your section map, draw a grid representing five metre x five metre squares (i.e. each square = 25 square metres)

5.2 Count total squares to give total area in square metres (check answer by using formula length x breadt(h)

5.3 How many pieces of litter, on average, were found in each square metre? .....
(rate of litter = total number of pieces of litter found **divided** by total square metres)

6. Combine all data (make a class map, showing all litter found)

   6.1 Display the data

   6.2 How many pieces of litter were found in total? .....

   6.3 How many pieces of litter are found in each square metre? Show working

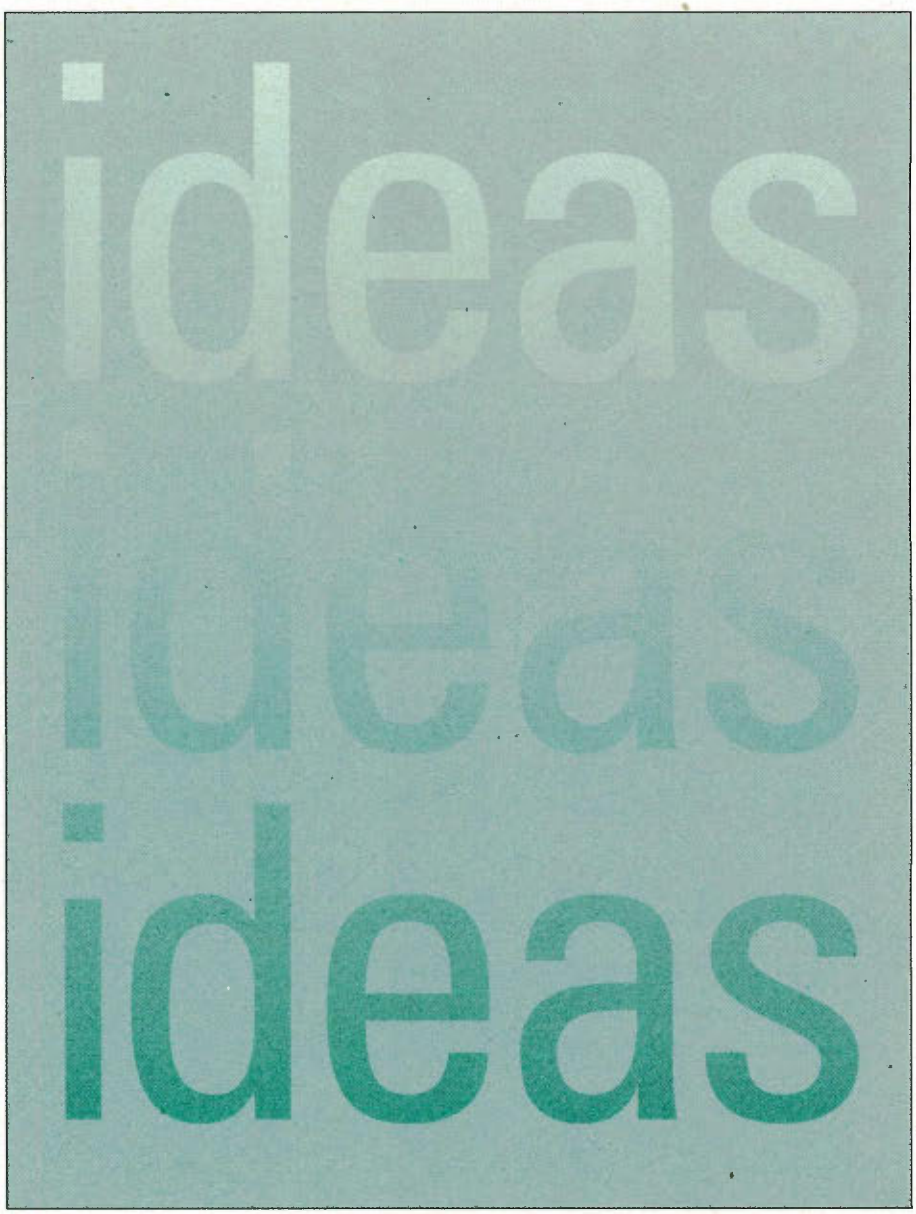
7. In which section was the most litter found? (Compare rate of litter) .....

   7.1 What was the most common type of litter found, and where did you find it? .....

   7.2 On your grid (5.1), draw up a number plane. Use co-ordinates to give locations on your litter map.

8. Draw up consequence charts to show the amount of litter that could be accumulated in future and display your charts around the school.

9. **What can you do about the litter in your school? Suggest action plans and ideas.**



Handout

1.2: HOW MUCH RUBBISH?

The sight of a marine animal choking on a plastic bag clearly highlights that litter creates a problem. Broken glass, plastics and bits of metal on our streets and in our parks and waterways are real hazards to people and animals. And then there's the cost of cleaning up the mess!

Did you know? At least 80 of the world's 280 species of seabirds are known to ingest small pieces of floating plastic, mistaking these for foods.

How good are you at estimating the weight of packaging?

1. Using collected examples, complete the following table for common household packaging:

   Step 1: By holding the package in one hand, estimate the approximate weight and fill in column B

   Step 2: Weigh, using scales, one of each item and record in column C

   Step 3: Calculate the number of each item needed to make up one kilogram and record in column D

Packaging A	Estimate number of packages required to make one kilogram B	Actual measured weight of each item C	Actual number of packages required per kilogram D
Aluminium cans			
Milk cartons (1L)			
Supermarket bags			
Toothpaste packets			
Cereal packets (550(g)			
PET soft drink bottles (2L)			
Coffee Jars (150(g)			

HINT: To work the answers to column D use the following example:
If 1 toothpaste packet weighs 8g, how many does it take to make one kilogram? $\frac{1\,000}{8} = 125$ pkt (1kg = 1 000 g)

2. What can be done to reduce this rubbish?

Handout

1.3: WASTE MINIMISATION - KIAMA MUNICIPAL COUNCIL

Kiama Municipal Council was awarded the 1995 Management Innovation Award acknowledging that in just 18 months they had completely transformed their waste management and recycling service to one which is fast becoming recognised as innovative and the most environmentally, economically sustainable system in Australia. The service when introduced cost council and residents $1 to establish a legal contract but will result in an estimated saving of up to $1.3 million over a five year period and an increase in waste depot and recycling income from $83 000 to $200 000 per annum.

During 1995 residents of Kiama Municipal Council recycled:

- 35 941 tonnes of recyclable material through Minnamurra and Gerroa Tip Revolve Centres,
- 2 047.1 tonnes combined of total green waste,
- 1 131.04 tonnes of recyclables through the "all-in-one" Kerbside Recycling Service.

This totals **39 119.14** tonnes of recyclable materials collected. This total is equivalent to approximately **7 530** garbage trucks.

Table 1.3a: Combined recycling with garbage reduction and reuse (Kiama Municipal Council)

Materials	**Tonnes material collected**	**Facts Savings and possible new products**
Paper/cardboard	12 052	Saves 150 650 trees
Steel cans	56	67.2 cars
Aluminium cans	10.4	• Saves 52 tonnes of bauxite • Saves 95% energy
Glass	10 400	Enough to make 62 600 000 (375mL) bottles
PET (Plastic bottles)	707	14 000 000 non-food container bottles
HDPE (Plastic milk carton)	398	8 000 000 non-food containers (e.g. detergent)
Cardboard milk cartons	5	666 000 sheets of photocopy paper
Plastic bottles (detergent)	3	60 000 non-food container bottles
In addition to the above materials 3 010 tonnes of firewood; 9 381 tonnes of scrap metal; 11 324 tonnes mulch and $16 972 of secondhand material sold during 1995		

Handout

1.3: WASTE MINIMISATION - KIAMA MUNICIPAL COUNCIL (CONT.)

1. Using Table 1.3a complete the following table

Table 1.3b

Materials	Tonnes	%	Angle (sector graph)*
Paper/cardboard	12 052	51	183.6°
TOTAL	23 631.4	100%	360°

To find the angle

% as fraction out of 100 times 360 (360° in a circle)

e.g. $\frac{51}{100} \times 360 = 183.6°$

2. Draw a sector graph to show the differing amounts of recycled materials.

3. **How many trees go to make up**

   (a) One tonne of paper? .....

   (b) One kilogram of paper? .....

4. **How much waste paper, recycled, saves one tree?** .....

5. **Compare the initiatives of your own Council to those of Kiama. Can you improve waste management in your area? If so, how?**

Handout

1.4: WHAT'S IN YOUR GARBAGE?

Reduce the waste and save the space

Reducing waste starts at home! So what's in a typical household garbage bin?

1. Rank the composition in order from least in volume (1) to most in volume (8).

Table 1.4a

Composition of a typical household garbage bin		
Contents (typ(e)	**% by volume**	**Rank**
Food scraps	21%	
Metals	11%	
Plastics	10%	
Wood/garden waste	21%	
Paper	23%	
Glass	4%	
Other	10%	

2. Using graph paper, graph the results from Table 1.4a in the form of a *cumulative column graph to scale.* This should be done in rank order and drawn in the shape of a garbage or "wheelie" bin. Make the side of the bin 100mm long.

3. Using the information from Table 1.4a:

   3.1 What % of waste could be recycled or reused? .....

   3.2 What % cannot be recycled or reduced? .....

TOPIC 2: COMPOSTING (ADAM AND EVE)

Rationale

This topic enables students to use **number** and **measurement** skills whilst investigating methods of reducing organic resources.

You will need

Activity 2.1: Handout 2.1, *Compost in a milk container*

Empty 2L milk container with lid on (cut around the neck to allow access to ingredients). Make small holes in the top of the container, for air.

Ingredients for compost, as per recipe

Activity 2.2: Handout 2.2, *What a waste!*

Activity 2.3: Handout 2.3, *Rate of composting/mulching*

Two containers (old margarine tubs); compost to fill one container; ordinary garden soil to fill the other. Radish seeds or quick growing herb etc. Water

Teachers' notes on activities

Activity 2.1: Compost in a milk container (90 minutes overall)

This activity is designed for the students to develop knowledge, understanding and skills by:

- using geometric techniques and tools to construct lines and 2D figures;
- using a variety of techniques and tools to measure and compare quantities;
- organising and displaying collected data in a variety of ways;
- drawing outlines to represent relationships, given descriptions or tables of values;
- planning, carrying out and reporting on a statistical investigation with guidance;
- interpreting and using ratios and rates to solve simple problems; and
- showing a willingness to work cooperatively and to value the contributions of others.

Extension: Compare the weight and temperature at the beginning and then after each week of composting. Record and display data. How much has the top level dropped? What has caused this? Discuss. After three weeks mark the new levels with a different colour pen.

Activity 2.2: What a waste! (40 to 50 minutes overall)

This activity is designed for the students to develop knowledge, understanding and skills by:

- selecting and using appropriate mathematical techniques effectively;
- using appropriate problem-solving strategies which include selecting and organising key information and breaking the problem into smaller parts;
- selecting and using appropriate mental, written or calculator techniques to perform a variety of operations;
- interpreting and using ratios and rates to solve simple problems; and
- using formulae to find the volume of prisms and solving simple problems involving volume and capacity.

Activity 2.3: Rate of composting/mulching (40 to 50 minutes overall)

This activity is designed for the students to develop knowledge, understanding and skills by:

- showing the importance of visualisation when solving problems;
- using formulaes to find the volume of right prisms and cylinders and solve simple problems involving volume and capacity; and
- interpreting and using written and graphical information to solve problems related to arithmetic.

Alternative activities

- Students discuss ways in which they could establish a school compost system for the food scraps and garden refuse regularly discarded at school. Analyse, prepare data and graphs to show outcomes which could be achieved.
- How much is compost worth? Research current wholesale and retail prices and estimate how much the school could save by producing compost.

Background information

In terms of overall waste reduction, composting is possibly the most important single factor for every one of us to consider. On average, about half of the garbage put out by households is organic material that can be composted.

So, what is compost? Compost is rich organic matter which has thoroughly decomposed. Organic matter is anything that was once part of a plant or an animal: for example, grass clippings, garden waste and food scraps from the kitchen. You can also compost such things as vacuum cleaner dust, soiled paper (such as used tissues or paper food wrappers), and hair from brushes and shower drains.

The 3Rs apply to composting in the following ways:

Reduce: Composting greatly reduces your volume of garbage, and by keeping organic waste out of landfills the amount of toxic leachate going into our waterways is also greatly reduced. If products cannot be composted or recycled when you have finished with them, don't buy them.

Re-use: If you are building a compost system for yourself (or someone else) try to re-use second-hand materials (e.g. wooden pallets, wire mesh, timber and bricks). If you are buying a compost bin, buy one made of recycled plastic and get one that can be used for a long time.

Recycle: Composting is a natural recycling process; plant and animal tissue are transformed into a very useful and valuable product. This is the 'giving back' principle. Recycling our organic materials back to our gardens also greatly reduces our dependence on synthetic fertilisers and pesticides.

ADAM and EVE = The principles of composting

Aliveness: compost is a living system.

Diversity: diversity of ingredients is the key to good composting.

Aeration: for a fast working, sweet smelling compost it is essential to get air (oxygen) into the heap.

Moisture: for the "living" compost heap to work well, it needs adequate moisture.

and

Energy: you gain energy by eventually giving the finished compost to your plants. You also save energy by not having to have all your organic waste carted away by truck to landfill sites.

Vitality: the vitality of your garden will be increased by using compost. Your own health and vitality will also improve as you begin to eat more home-grown organic food.

Environment: the whole environment will benefit as we all reduce our "waste" going to landfill and give back finished compost to our depleted soils.

Earth Works: living with less waste. Why don't you join the effort?

Earth Works is a new and interesting community education program about waste. It teaches people to make waste minimisation a part of their daily lives. If you join an Earth Works course, you'll learn skills in composting, worm farming, recycling and minimising waste production. To learn more about the course and be a part of the community effort to protect the environment, contact your local council or community college. Earth Works was developed by the Environment Protection Authority.

Handout

2.1: COMPOST IN A MILK CONTAINER

Compost recipe:		
20-30mm soil	*1mm fertiliser (sprinkl(e)*	*1mm fertiliser*
10-20mm garden waste	*5mm soil*	*5mm soil*
10-20mm food scraps	*20-30mm soaked newspaper*	*Repeat steps 1-8 to top of container*

1. Working in groups and using the above recipe make your own compost by using a 2L milk container as a compost bin.

   (i) Begin the layering process which is important to achieving good compost and spray water on each layer. Push back the top section of the container and add layers in the order and depths as suggested in the above recipe.

   (ii) Tape the top section down but make sure air can get in.

   (iii) Draw lines on the container to show where each layer stops.

   (iv) Write the date on each container. Leave the containers in a warm place.

   (v) Observe the compost twice a week, for three weeks, spray compost with water each time to keep it moist.

   (vi) Make a record of any changes, such as colour, size and shape of material.

2. Draw a scaled outline of your container, labelling each layer of ingredients.

3. From your scaled outline, answer the following:

   3.1 What fraction of the complete compost does each of the listed ingredients take up in total?

   3.2 Express each fraction as a percentage.

   3.3 Work out the total volume of all the ingredients.

Table 2.1a

Ingredient	Fraction	%
Soil		
Garden Waste		
Food scraps		
Fertiliser		
Newspaper		

4. From Table 2.1a, what is the total volume of the ingredients after:

   (a) one week? .....

   (b) two weeks? .....

   (c) one month? .....

Handout

2.1: COMPOST IN A MILK CONTAINER (CONT.)

5. What is the change in volume, expressed as:

a fraction after

(a) one week? .....

(b) two weeks? .....

(c) one month? .....

a percentage after

(d) one week? .....

(e) two weeks? .....

(f) one month? .....

Balanced compost

6. **For "good" compost we need a balance between the amount of elements CARBON** (energy) and **NITROGEN** (body building). The ideal mix is 25 parts carbon to 1 part nitrogen. From the list below of common materials that can be used for compost, select the three materials which are *nearest* the ideal mix.

Table 2.1b

Ingredient	C/N ratio	Ingredient	C/N ratio	Ingredient	C/N ratio
Lawn clippings	80: 4 or 20:1	Weeds	57: 3	Food scraps	75:5
Fowl manure	70:10	Leaves	180:3	Paper	340:2
Straw	700:7	Cow manure	48: 4	Seaweed	100:4

The 3 materials which are nearest to the ideal mix are:

Answers: 1. ..... 2. ..... 3. .....

Handout

2.2: RATE OF COMPOST

Every compost heap has a life cycle of its own. Some composts are quick and hot. Others are cool and take a long time to break materials down. All of them eventually "compost" because it is an inevitable process.

From the graph below:

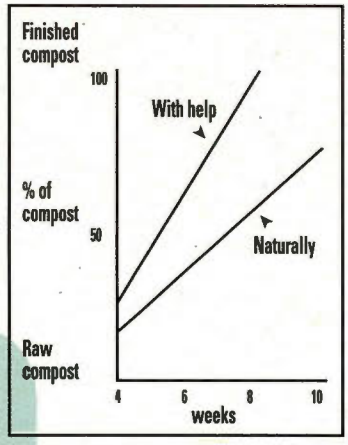


Figure 2.2a - Rate of Composting Mulching

1. How long will it take to make compost

   (a) with help? .....

   (b) naturally? .....

2. What % of the composting is done after 6 weeks

   (a) with help? .....

   (b) naturally? .....

3. How many lots of compost can we make in 6 months

   (a) with help? .....

   (b) naturally? .....

4. Gather leaves, grass etc. - place in a milk carton and calculate the volume of your material. .....

5. Empty carton into an ice cream container. Now shred, cut leaves and grass into small pieces. Place shredded material back in the milk carton and calculate the new volume. .....

6. Calculate the percentage change. .....

Do plants grow quicker in good soil?

7. Fill two clean containers (margarine tubs), one with compost and the other with ordinary garden soil. Place a couple of seeds in each container and water. Mark each container to distinguish between the two soil types.

8. Regularly check each container and record on a chart when the seeds were planted, how many sprouted, when they sprouted and how much they grew. Select one plant from each container to follow through: measure plant at set intervals (e.g.: every two days). Did the mixture make a difference to the growth rate?

9. From your data find out how much each plant grows daily! Given this growth rate, how long would it take for the plants to be two metres tall?

   (a) Plant A: .....

   (b) Plant B: .....

Handout

2.3: WHAT A WASTE!

Lucas Heights Waste Management Centre

The Lucas Heights landfill site in Sydney's south is Australia's largest for putrescible waste (food scraps), which consists of rotting and degrading material. Over half of Sydney's putrescible waste approximately a million tonnes — is delivered to Lucas Heights each year. WHAT A WASTE! On a typical weekday, this involves about 600 trucks and about 150 trailer loads. On weekends, truck numbers drop back to about 100 per day but on work days the number of trailer loads increases to about 1 000 per day.

The landfill is situated on 200 hectares of land, of which 120 hectares are used to bury waste. The remainder constitutes a buffer zone, where facilities such as the recycling centre are sited. Each day, an area (pit) about 60 metres long, 7 metres wide and 3 metres deep is filled with compacted waste. At the end of the day this is covered with a 0.3 metre deep layer of the soil which was previously excavated from the site.

Show all workings

1. At the end of **each day** what is the volume of waste put into the pit? .....
2. What % of the total landfill area is set aside to bury waste? .....
3. What is the rate of waste
   (a) in tonnes/day? .....
   (b) in volume/week? .....
4. When the landfill site is full, what will the volume of waste be? .....
5. If the centre charges $7.80 per trailer load, how much money could be made:
   (a) each weekday? .....
   (b) each weekend? .....
6. What could be done with a lot of this waste, which would help the environment and save the above costs?

TOPIC 3: WORM FARMING

Rationale

This topic enables students to use **geometry**, **algebra** and **number** skills whilst observing populations and habitats.

You will need

Activity 3.1: Handout 3.1: *Worm farm*
Ingredients as per handout instructions
Activity 3.2: Handout 3.2: *Worm population*
Spades; sifter or sieve; plastic containers; tape measure or trundle wheel
Activity 3.3: Handout 3.3: *Count the worms*

Teachers' notes on activities

Activity 3.1: Worm farm (40 to 90 minutes overall, including observations)

This activity is designed for the students to develop knowledge, understanding and skills by:

- using geometric techniques and tools to construct lines and 2D figures;
- organising and displaying data in a variety of ways; and
- drawing graphs to represent relationships, given descriptions or tables of values.

Activity 3.2: Worm population (40 to 90 minutes overall, including observations)

This activity is designed for the students to develop knowledge, understanding and skills by:

- using sampling techniques to estimate large numbers;
- substituting into a given formula and evaluating the resulting expression;
- estimating measurements appropriately in various contexts; and
- selecting and using appropriate common units and converting between measurements.

Activity 3: Count the worms

This activity is designed to take approximately one period with the students developing knowledge, understanding and skills by:

- using sampling techniques to estimate large numbers;
- identifying, describing and extending number patterns; and
- interpreting and using ratios and rates to solve simple problems.

Background information

Worms can do wonders for the garden: they aerate the soil and their castings are an excellent fertiliser. An earthworm is like a hollow tube made up of 90-150 muscular dough-nut-shaped segments lying side-by-side. It has a mouth at one end, which is the entrance for rubbish, and an anus at the other end, which is the exit for castings. An earthworm breathes through its skin, has five hearts and a circulatory system, calciferous glands for neutralising food, a crop and gizzard with stones for grinding food, a digestive system, mucus-forming systems, a brain and nervous system, several hundred kidney-type organs, and both male and female organs. Redworms and tigerworms meet each other more often than field-type worms, and they populate at a faster rate. Worms mature in 60-90 days and are then ready to breed. Worms exchange sperm and each lays one or more egg capsules.

Each capsule can hatch 2-20 tiny worms. A worm can produce a capsule every seven days. The tiny worms are self-sufficient. Worms limit their breeding to suit available space and food, so the smart breeder expands the breeding space.

Worm farms are simple structures that you can make yourself. They consist of three or four stackable crates or bins made of plastic, wood or any other lightweight, waterproof material. The worms live in the bins and simply wriggle their way up from the lowest bin into the one above, where they can smell fresh foods — fruit, vegetable and other scraps that might otherwise go to waste. Some local councils sell worm farms at a cost of $45–$60 for four bins. To create congenial living conditions for the worms, you need newspaper and soil to start the farm and a continuing supply of suitable food scraps. These scraps are turned into the castings that make such good fertiliser. Castings can go straight onto the garden or pot plants. If they are covered with mulch their moisture and nutrient content will be conserved.

Handout

3.1: WORM FARM

1. Work in small groups to collect the following items for the experiment:
   - One 2L PET bottle (cut top off where neck begins to taper)
   - One 350mL clear plastic bottle
   - One litre compost or rich soil
   - 250mL water
   - 500mL sand
   - Black cardboard 220mm x 430mm
   - Handful of fresh leaves, newspaper and food scraps
   - Camera for photographs (optional)
   - Pens, pencils, rule and paper
   - 10-20 worms (Red or Tiger worms can be bought from most plant nurseries or fishing stores)
   - 4L ice-cream container

2.
   - Stand a rule up next to the 2L bottle and fill the bottle with compost or rich soil to about 40mm. Place a thin layer of torn pieces of newspaper on top.
   - Fill the small bottle with water and put the lid on; stand it in the middle of the 2L bottle to push the worms to the outside of the bottle for observation.
   - Add 30mm of sand to the 2L bottle (around the small bottle).
   - Add thin layer of cut food scraps (non-citrus, no onions).
   - Follow this with another 30mm of soil or compost.

   Continue these layers until the 2L bottle is three quarters full.
   - Spread the leaves on top and add the worms (count how many worms you add and write it on the side of your bottle) to the surface. Observe the worms at this stage and note what they do.
   - Tape the short edges of the cardboard together to form a tube and slip it over the 2L bottle.
   - Keep the wormery moist but not wet enough to drown the worms. Leave worms in a shady area.
   - Photograph or draw the wormery at this stage.
   - Every day, remove the black tube and observe your wormery. Note the position of the worms and their activities. Photograph or draw the worms again at the end of the first and third week.
   - Continue to add food scraps to the top of the wormery once a week.
   - After one month, turn your worms out into an ice-cream container and count how many worms you now have. Check the soil for eggs (light brown, oval shaped, size of a match head) and count how many eggs your container holds.

   How many worm farms can you now make? Could your school start up a business by supplying worms to the local fishermen and households?

3. How many worms are there after one month? .....
4. How many eggs did you find? .....
5. Describe what has happened to your worm farm. Has your population increased or decreased? Why do you think this is?
6. Measure the lengths of the worms; categorise into large, medium or small. How many of each category did you find?

   Large: ..... Medium: ..... Small: .....
7. Graph your results.

Handout

3.2: WORM POPULATION

To find the population of worms in a study area, e.g.: school oval, we use a technique called *sampling*. This can provide a representative picture of the larger population.

1. Divide class into groups, each group to dig one spade-full (sample) of soil in the area to be studied. Each sample should be 30cm x 30cm x 10cm.

   (a) Find the volume of your sample. .....

   (b) Estimate the number of worms found in your sample. .....

   (c) How many worms do you think are in the total study area? .....

   (d) Count actual number of worms found in your sample. .....

   (e) Work out the average number of worms from total class samples. .....

2. Use tape or trundle wheel to find dimensions of total study area

   (a) Calculate the volume in m^3 (depth of 10cm) .....

   (b) Calculate the total worm population for the total study area .....

   (c) Compare your *estimate* and calculated population. Express your answer as a percentage or fraction. .....

3. Estimate population of worms using the formula used by the Australian Worm Growers Association:

   250g of 'bed run' compost = 1 000 worms

   3.1 How many worms in 'bed run' compost if the weight was:

   (a) 1kg? ..... (b) 5kg? .....

   (c) your weight? ..... (d) 700g? .....

   3.2 How much would the following number of worms in 'bed run' compost weigh?

   (a) 10 worms ..... (b) 100 worms .....

   (c) 42 worms ..... (d) 1 million worms .....

   3.3 If 'bed run' compost worms are worth $20 per 500 worms, how many worms would we get for:

   (a) $3.60? ..... (b) $81.00? ..... (c) $123.00? .....

Extension

- If there were areas where few worms were found, how could the soil be improved to encourage worms to breed?
- Estimate your soil's pH. Check and document your pH findings with your information regarding worm populations. Record your findings and make comparisons regarding worms and their preferred soil pH levels.

Handout

3.3: COUNT THE WORMS

Estimating worm populations from photographs:

1. Draw up a grid on the photo using 2cm x 2cm.
2. Sample six squares; count the number of worms in each square.
3. Find the average amount of worms from your sample.
4. Count the total number of squares.
5. What is the population?

   Population = average of one square x total number of squares.

Worms are **hermaphrodites** (both male and female). Adult worms can lay on average one egg once a week. Each egg contains, on average, six baby worms. After birth it can take at least six months before a worm can reproduce.

6. Using the information above, fill in Table 3.3a. How many worms would we have in four week's time, if we start with 10 adult worms? Show the number sequence of adults and young each week.

Table 3.3a

	Start	Week 1	Week 2	Week 3	Week 4
Adults (A)	10				
Young (Y)					
TOTAL					
Ratio A:Y					

Is there any pattern? Give your answer in words. .....

.....

6.1 How many worms will we have in four month's time? .....

6.2 What percentage increase is there in population after four months? .....

7. We start off with two adult worms; how many worms will we have after one month? .....
8. If one 2L bucket of 500 worms costs $20, how much money would we make on selling all our worms?
9. How many adult worms would we need to start with to end up with 500 worms after one month? .....

TOPIC 4: BIODIVERSITY AND ECO-SYSTEMS

Rationale

This topic enables students to use **chance and data** and **algebra** skills and to gain an understanding of the similarities and differences within and between groups of familiar living things.

You will need

Activity 4.1: Handout 4.1: *Life on Earth*
Geometry set

Activity 4.2: Handout 4.2: *What lives there?*
Metre rule, string
Trundle wheel

Activity 4.3: Handout 4.3: *Then and now*

Activity 4.4: Handout 4.4: *Living things grow!*

Teachers' notes on activities

Activity 4.1: Life on Earth (40 to 50 minutes overall)

This activity is designed for the students to develop knowledge, understanding and skills by:

- organising data in diagrams to solve problems;
- reading, describing and interpreting information in diagrams to make comparisons and describe relationships;
- drawing graphs to represent relationships, given descriptions or tables of values; and
- interpreting data represented in tables and graphs.

Activity 4.2: What lives there? (40 to 90 minutes overall)

This activity is designed for the students to develop knowledge, understanding and skills by:

- finding the perimeters and areas of triangles and quadrilaterals;
- estimating the results of calculations and checking the reasonableness of results;
- organising and displaying collected data in a variety of ways; and
- planning, carrying out and reporting on a statistical investigation with guidance.

Activity 4.3: Then and now! (20 to 40 minutes overall)

This activity is designed for the students to develop knowledge, understanding and skills by:

- interpreting data represented in tables; and
- drawing informal conclusions from data displays.

Activity 4.4: Living things grow (40 minutes overall)

This activity is designed for the students to develop knowledge, understanding and skills by:

- identifying, describing and extending number patterns;
- interpreting and using ratios to solve simple problems; and
- selecting and using appropriate calculator techniques to perform a variety of operations.

Alternative activities

Water "Bugwatch" (spring and autumn). Sample your local creek to estimate populations and test water quality. Contact your **local** Department of Land and Water Conservation or Sydney Water Corporation for further information.

Human population: Photocopy an aerial photograph of a suburb. Divide photo into a grid. Select six random squares. Count number of houses in each square. Assuming each house has an average of 2 adults and 2.4 children, multiply number of houses by 4.4 for each sample. Find the average for the six samples. Count total number of squares. Estimate population = total nunber of squares x average population per square.

Background information

Biodiversity is the concept that underpins conservation management programs world wide as an increasing number of animal and plant species move towards extinction. Biodiversity refers to the variety of life forms: the different plants, animals and micro-organisms, the genes they contain, and the ecosystems they form. This living wealth is the product of hundreds of millions of years of evolutionary history. In places as ancient as Australia, this history can still be seen today in "living fossils". Australia has a rich and distinctive flora and fauna. The major reason for this is related to the history of the Australian landmass. Australia's long isolation has resulted in a flora and fauna that are both highly endemic (unique to a region) and have great richness of species compared with many other parts of the world.

Handout

4.1: LIFE ON EARTH

It is estimated that there are about 13 million different species of organisms living in the world today. Using the following estimated numbers of species for major organism groups, draw a pie chart and answer the questions provided.

Table 4.1a:

Organism	Species	Angle required for pie chart
Viruses	500 000	
Bacteria	400 000	
Protozoa	200 000	
Fungi	1 000 000	
Algae	200 000	
Plants	300 000	
Vertebrates	50 000	
Insects	8 000 000	
Arachnids	750 000	
Other invertebrates	1 000 000	
Total	12 400 000	360°

Pie chart

1. What major group of organisms is the most diverse in terms of numbers of species? .....

2. If 25% of the world's insects are beetles, estimate how many different species of beetles there are. .....

3. What percentage of the world's living organisms are vertebrates (i.e. mammals, birds, reptiles, amphibians and fis(h) .....

4. Rank the following groups of organisms in order from the most known to the least known, relative to their individual estimated total numbers (Table 4.1a). The numbers next to each group below indicate the number of species actually identified and named.

   - viruses: 5 000 species identified Rank: .....
   - vertebrates: 45 000 species identified .....
   - plants: 250 000 species identified .....
   - insects: 950 000 species identified .....

Approximately four billion micro-organisms can be found in every teaspoonful (1 teaspoon = 5ml) of finished compost! Billions of tiny bacteria interact with millions of protozoa, fungi, nematodes, worms, mites, springtails, spiders, centipedes, slaters, and beetles etc. The micro-organisms need two basic nutrients: the elements carbon (the energy source) and nitrogen (the body building source). The ideal mix is about 25 parts of carbon to 1 part nitrogen. All living matter contains both of these elements in varied amounts.

5. How many micro-organisms would be found in:

   (a) a metric cup

   (b) a 10L bucket

   (c) a cubic metre ($1\ cm^3 = 1mL$)

Handout

4.2: WHAT LIVES THERE?

1. Choose a study site on the sport's field or a selected area; divide into small groups.
2. Using a metre rule and string, lay out a one metre x one metre square.
3. Observe, count and record the type and number on a tally sheet of each type of animal found, e.g.: caterpillars, ants, worms, beetles, snails etc. (Do not pick up any animal).

Table 4.2a

Animal type	Tally	Total
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		

4. Find the total area in square metres of the selected study site (e.g.: total area of sport's fiel(d) .....

5. Combine group results to find out how many of each animal are in sampled areas:

   Animal 1 ..... Animal 2 ..... Animal 3 .....

   Animal 4 ..... Animal 5 ..... Animal 6 .....

   Animal 7 ..... Animal 8 ..... Animal 9 .....

6. Find the average number of each type of animal found (above answer divided by number of groups):

   Animal 1 ..... Animal 2 ..... Animal 3 .....

   Animal 4 ..... Animal 5 ..... Animal 6 .....

   Animal 7 ..... Animal 8 ..... Animal 9 .....

7. Using the above information, estimate the total populations of each of the types of animals found:
   (average number of animals x total square metres).

   Animal 1 ..... Animal 2 ..... Animal 3 .....

   Animal 4 ..... Animal 5 ..... Animal 6 .....

   Animal 7 ..... Animal 8 ..... Animal 9 .....

8. Graph your results (e.g.: frequency histogram, polygon, picture graph, bar or column graph).

Handout

4.3: THEN AND NOW!

Table 4.3a

Number of animal species extinct or declared threatened in NSW					
Group	**No of species at time of European settlement**	**Presumed extinct in NSW (a)**	**%**	**Existing but threatened in NSW**	**%**
Amphibians	69 (b)	1		14 (c)	
Birds	511 (b)	11		88 (c)	
Mammals: * terrestrial * marine	 118 (b) 36	 26 Unknown		 40 (c) Unknown	
Reptiles	228 (b)			15 (c)	
Invertebrates	Unknown	Unknown		Unknown	

(a) May be existing elsewhere in Australia

(b) National Parks and Wildlife Services (NPWS) Atlas of NSW Wildlife

(c) Number of species on both Part 1 (threatened) and Part 2 (vulnerable and rare) of Schedule 12 of the NPWS Act

1. From the information provided in Table 4.3a, complete the missing data. Fill in percentage for "presumed extinct" and "existing but threatened in NSW". .....

2. Which group has suffered the greatest percentage of extinctions? .....

3. Which group is the most threatened? .....

4. What is the future for each of these groups over the next 100 years? Predict the level of extinctions (each group) using the trends of the last 200 years.

   Amphibians ..... Birds ..... Mammals .....

   Reptiles ..... Invertebrates .....

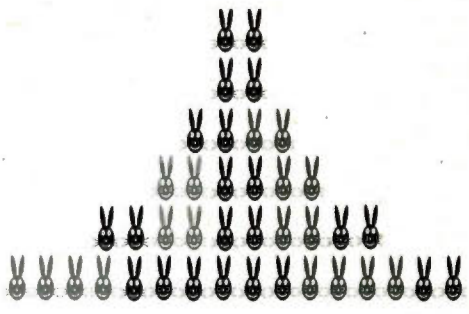
Handout

4.4: LIVING THINGS GROW!

Exploring Fibonacci numbers!

Fibonnaci numbers occur in nature in several unlikely places. For example, the spirals of sunflowers and pineapples and the petals of many flowers follow the pattern of consecutive terms of the Fibonnaci sequence.

1. Find some examples of these yourself.



Population studies of Rabbits!

If we look at the number of breeding *pairs* in a population of rabbits, we come up with the following pattern.

Each row shows the number of pairs per breeding season.

2. In Table 4.4a provided, show the number of breeding pairs each season (extend to Season 13)

Table 4.4a

Breeding season	1	2	3	4	5	6	7	8	9	10	11	12	13
Pairs of rabbits													

3. Describe the pattern formed, in words.

4. Using the information from **Table 4.4a** and a calculator, find the value from the ratio of successive pairs of rabbits per breeding season, that is: first breeding season divided by second breeding season; second breeding season divided by third breeding season.

Table 4.4b

Seasons	$^1/_2$	$^2/_3$	$^3/_4$	$^4/_5$	$^5/_6$	$^6/_7$	$^7/_8$	$^8/_9$	$^9/_{10}$	$^{10}/_{11}$	$^{11}/_{12}$	$^{12}/_{13}$
Value												

5. Describe the pattern formed, in words.

TOPIC 5: WATER USAGE AND WASTE

Rationale

This topic enables students to use **measurement, algebra** and **number** skills and to gain an understanding of the importance of conserving our water.

You will need

Activity 5.1: Handout 5.1, *Every drop counts!*
Activity 5.2: Handout 5.2, *No more water!*
Activity 5.3: Handout 5.3, *Spraying it around!*
Activity 5.4: Handout 5.4, *Living clean!*
Gloves or tongs

Teachers' notes on activities

Activity 5.1: Every drop counts! (40 to 80 minutes overall)

This activity is designed for students to develop knowledge, understanding and skills by:

- interpreting and using rates to solve simple problems;
- interpreting and using mathematical information presented in a variety of forms; and
- organising and displaying collected data in a variety of ways.

Activity 5.2: No more water! (40 minutes overall)

This activity is designed for students to develop knowledge, understanding and skills by:

- estimating the results of calculations and checking the reasonableness of the results;
- interpreting and using written information to solve problems relating to consumer arithmetic; and
- selecting and using appropriate common units and converting between measures.

Activity 5.3: Spraying it around! (15-20 minutes overall)

This activity is designed for students to develop knowledge, understanding and skills by:

- finding area of a circle using given formula; and
- interpreting and using rates to solve simple problems.

Activity 5.4: Living clean! (40 to 80 minutes overall)

This activity is designed for students to develop knowledge, understanding and skills by:

- substituting into given formula and evaluating the resulting expression;
- organising and displaying collected data in a variety of ways; and
- locating and plotting positions on a number plane.

Alternative activities

- Take the students into the playground and, using a trundle wheel, measure out a rectangle 100 metres by 10 metres. Have the students stand around the edge and hold their hands up to a height of one metre. Ask the students to estimate how much water a container this size would hold. (Answer: One million litres or one megalitre).

  This could also be done using a number of one-metre rules to show one cubic metre and the volume of 1000 litres or one kilolitre.

- Streamwatch:
  - tabulate the results
  - graph results over the year
  - interpret: draw conclusions using mode, median, mean and range.
- Water absorption: place three bottomless containers in soil around the school grounds (i.e. bare vegetation, some vegetation and natural scrub). Tip the same amount of water in each container, measure the rate (time) of absorption into soil.
- How much water do we have available for our use? More than two thirds of the Earth's surface is water, but only 0.003% of the water on Earth is fresh water that we can use for household purposes. 97% of the Earth's water is salt water found in the sea. 2.5% is fresh water locked in polar ice caps, glaciers, the atmosphere and soil. 0.5% is fresh water found in rivers, lakes and ground water. If the Earth's water supply is represented by 100 litres, how much fresh water is available for household use?
- Cost analysis of water conservation. How much water and money are saved when we change from single to dual flush toilets? Research the costs and provide informative data.
- Evaporation rates at different locations around the school, measuring volumes, weight, units, percentages and fractions.

Background information

Almost all the world's water is in the sea. Sea water is salty and cannot be used for drinking or on farms for growing crops. The world's fresh water is mostly locked up in the polar ice caps or under the ground. Only a small amount of the world's water is available for people to use. Water is a resource which should not be wasted. When people leave the tap running while they clean their teeth or when they spend a long time in the shower, water is wasted. Water can be saved in many ways, for example, by fixing leaking taps, by not turning on the tap any further than is necessary, by using a dual flush toilet, and by using a bucket instead of a hose to wash the car.

Water shortages are a major problem facing many governments as demand increases. New dams or the use of groundwater stores are common options. In NSW around seven million megalitres of water are used each year, of which about five million are for urban use, 500 000 megalitres for rural households and livestock, and 100 000 megalitres for industry and power generation. Communities also expect their water supplies to be of a high quality and reliable.

Handout

5.1: EVERY DROP COUNTS!

How much water is wasted by dripping taps? In many parts of the world, water is taken for granted. Where there are large dams like Warragamba Dam, people think that there is plenty of water. This is not always true. In Sydney alone our population is growing, but the amount of water we store remains the same. Also we are using much more water today than people used forty years ago. In 1951 each person used about 185 litres of water per day; in 1994 each person used about 285 litres per day. How much water do you use every day? One drip every second equals 7 000 litres a year. What a waste!

1. Find the volume of water from a dripping tap (check science labs, staff office or school grounds). Collect water over a set time, e.g.: one minute. This will give rate: volume per minute. From this information, find how much water is wasted:

   (a) per hour ..... (b) per day ..... (c) per week .....

   (d) per month ..... (e) per year .....

2. If water costs $0.30 per kilolitre, how much money is going down the drain?

   (a) per hour ..... (b) per day ..... (c) per week .....

   (d) per month ..... (e) per year .....

How to read your water meter:

The illustrations below show you how to read your meter. To make a reading subtract the last reading taken from the current one.

Eight digit meters ❼❾❶❷③①⑨④ **Black numbers measure kilolitres (thousands of litres)**

Red numbers (on meter) measure fractions of kilolitres

Therefore, our example reads: 7 912 kilolitres + 319.4 litres

Six digit meters ❶❺❶❸⑨⑥ **Black numbers measure kilolitres**

Red numbers (on meter) measure fractions of kilolitres

Therefore, our example reads: 1 513 kilolitres + 960 litres

3. Find out where the school water meter is. Measure the amount of water used in a 24 hour period by recording the kilolitres of water at the same time, two days in a row.

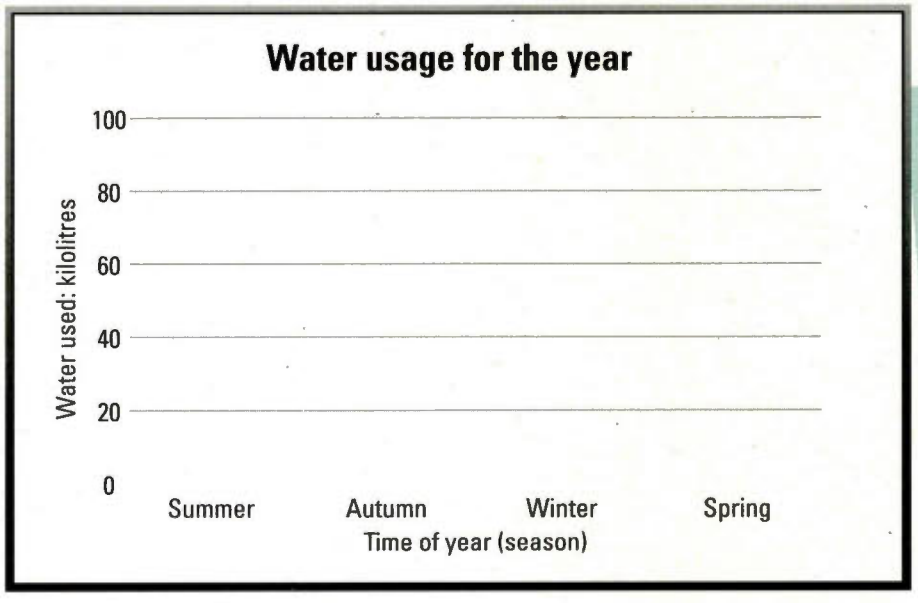
   Day 1: Date..... Time ..... kilolitres of water .....

   Day 2: Date..... Time ..... kilolitres of water .....

4. Ask if you can see the water bills for the past year. Record the water used.

WATER USE AND COST		
Time of year	**Water used: kilolitres**	**Cost $**

5. Draw a histogram of water used for the year.



Handout

5.2: NO MORE WATER

How often do you think about water? Probably not very often except maybe when you're thirsty. Try to imagine living in a house without water. At least there would be no washing up! But there would also be no water for drinking or cooking, no showers or toilets and no water for washing clothes. Without water there would be no life at all - nearly 70% of your body is WATER.

How much water is used in everyday activities:

- Toilets: most dual flush toilets use 9 litres for a full flush and 4.5 litres for a half flush.
- An average shower uses 15 litres a minute.
- A standard bath holds 120 litres when half full.
- Cleaning teeth will use 5 litres with the tap running and 1 litre with the tap turned off.
- Washing hands and faces will use 3 to 5 litres.
- An average sink holds 9 litres of water, whilst a modern dishwasher uses about 25 litres each cycle.
- Front loading washing machines average 100 litres each cycle whilst a top loading washing machine averages 155 litres each cycle.
- Car washing uses on average 200 litres for washing with a hose.
- To fill an average inground swimming pool it would take about 50 000 litres of water.
- Using a garden sprinkler would use about 18 litres of water per minute.
- Cooking a meal uses about 10 litres of water.

Brainstorm the activities in which water is used daily around the house.

1. Estimate how many litres would be used by you to:
   - clean your teeth .....
   - wash your hands .....
   - flush the toilet .....
   - wash dishes in the kitchen sink .....
   - have a bath or shower .....
   - wash the car .....
2. In your daily routine, how many litres of water would you use on average, per day? .....
3. If you conserved water more, how many litres of water do you think you could save, on average, per day? .....

Check the taps!

4. Check all the school taps for leaks. One drip per second equals 7 000 litres per year.

   4.1 How many taps in the school are leaking? .....

   (If no taps are leaking, use an example of 4 leaking taps which drip every two seconds)

   How many litres of water is being wasted (time the drips) per 24 hours? .....

4.2 If one litre costs $0.03, how much money is wasted per 24 hours?

4.3 How long would it take to fill an average inground swimming pool with the wasted water? .....
The average pool contains 50 000 litres.

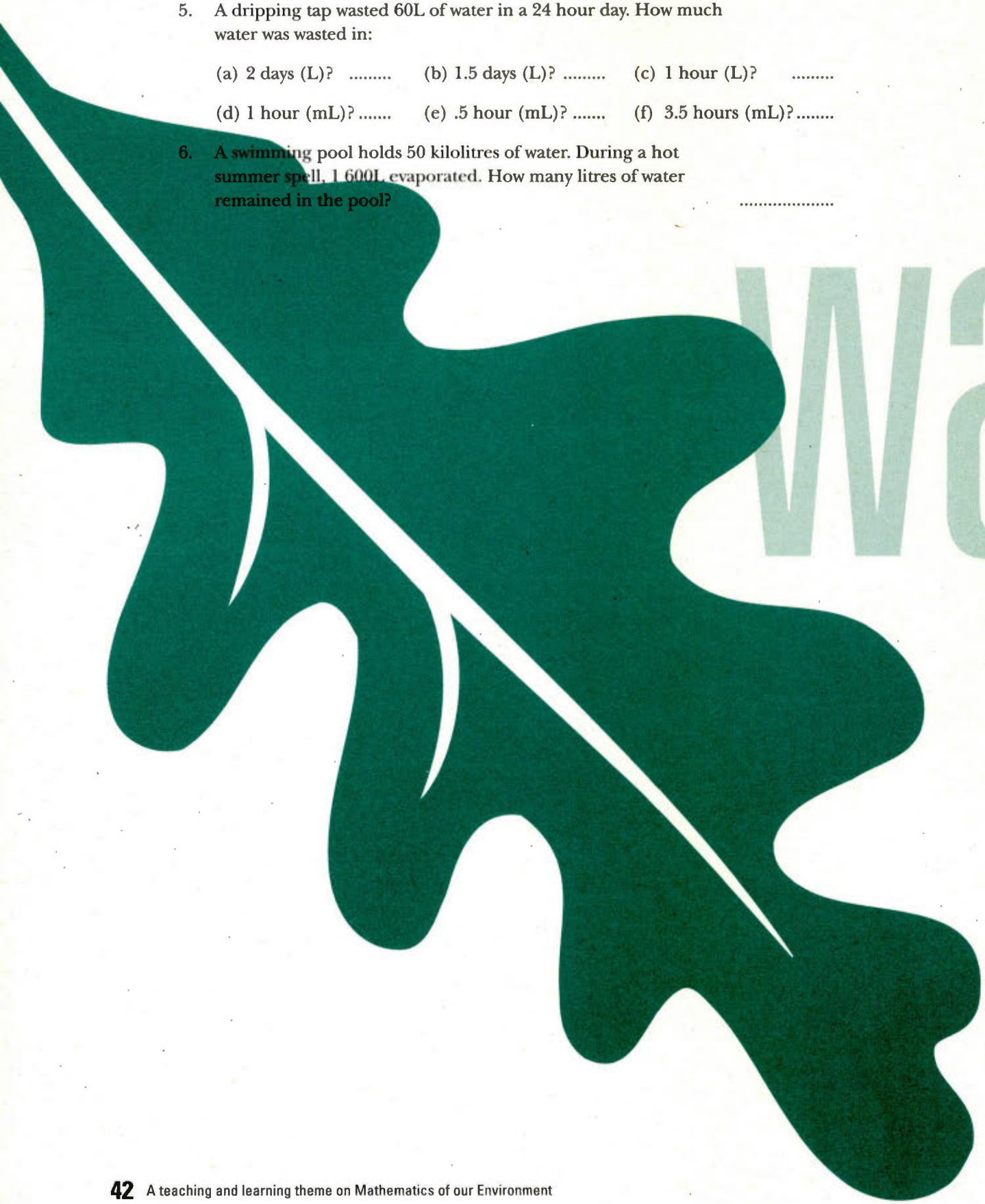
4.4 Can you do anything to stop the taps leaking? .....

5. A dripping tap wasted 60L of water in a 24 hour day. How much water was wasted in:

(a) 2 days (L)? ..... (b) 1.5 days (L)? ..... (c) 1 hour (L)? .....

(d) 1 hour (mL)? ..... (e) .5 hour (mL)? ..... (f) 3.5 hours (mL)? .....

6. A swimming pool holds 50 kilolitres of water. During a hot summer spell, 1 600L evaporated. How many litres of water remained in the pool? .....



Handout

HANDOUT 5.3: SPRAYING IT AROUND!

Company X produces approximately two million litres of waste water per day. Rather than throw it away, they use it to irrigate pastures. To do this, very large sprinkler systems are used. The sprinkler covers a circular area, once every 12 hours.

Find:

1. the diameter .....

2. Using the formula $C=\pi d$, find the circumference .....
   (Use π on your calculator.)

3. Find the area by (a) drawing a grid and counting the squares .....

   (b) using the formula $A=\pi r^2$ .....

Using the information in the box above answer the questions below:

4. How much area does the irrigator cover in:

   (a) 3 hours? .....

   (b) 7 hours? .....

5. How much water is used in :

   (a) 12 hours? .....

   (b) 5 hours? .....

6. What is the rate of water used per hour? .....

7. How many pastures of 100 metres are there? .....

Handout

HANDOUT 5.4: LIVING CLEAN!

Human-made litter may be blown or dumped in the waterway or washed down stormwater drains. The litter may float or sink, decay quickly or slowly, and some can contribute to a rise in nutrients and contaminating chemicals including heavy metals and pesticides. Litter may change the chemical composition of the water, decrease light penetration, affect the amount of available oxygen and kill aquatic life. Although large pieces of human-made litter are a visual pollutant, it is the little pieces ingested by small creatures which are quite often fatal.

How fast does the water flow?

1. On some flat ground near your local waterway record, in metres and centimetres, how far you can travel in ten seconds when running, walking fast and walking slowly.

   Running..... Walking fast..... Walking slowly.....

2. Place or throw a floating twig near the middle of the waterway. Walk along the bank at the same speed. How are you moving (running, walking fast or walking slowly). .....

3. Measure how far the twig has travelled in ten seconds. .....

4. At this speed, how long would it take the twig to travel one kilometre?

   $$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

How clean is the waterway?

5. Walk around the local waterway to observe any litter in the area.

   Record the type and amount of litter found floating on the water, in the water or near the waterway.

   .....

6. Make an assessment of the extent of litter on the waterway using the scale below:

   0 = lots of human-made litter. Sunken and floating objects such as car bodies, tyres, plastics; oily film or slicks on the water surface; algae growth.

   2 = a lot of human-made litter, cans, plastics or algae

   5 = some human-made litter such as garden rubbish and plastics

   7 = one or two pieces of human litter: local vegetation, such as leaves floating in the water

   9 = only natural vegetation present

   10 = pristine, no human use at all, preserved in its natural state.

   0 10

7. Construct a graph comparing the total for each different type of litter found.

Which litter do you think is the greatest problem in your local waterway?

Why? .....

8. What percentage of the litter found can be recycled? .....

9. What percentage of the litter found could have been composted? .....

10. What percentage of the litter found could have been reused for a new purpose? .....

Give some examples! .....

11. What can be done to prevent the litter reaching the waterway in the future?

.....

.....

.....

.....

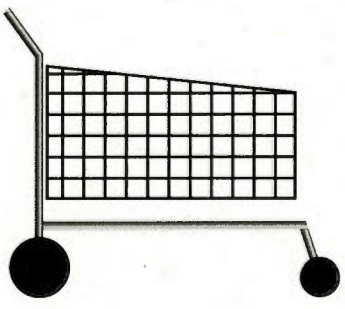
.....

.....

.....

.....

Did you find any of these?



TOPIC 6: AUDITS

Rationale

This topic enables students to use **algebra, chance and data** and **number** skills and to gain an understanding of the current management of our resources.

You will need

Activity 6.1: Handout 6.1, *How tall are your trees?*
Metre rule; string; calculator; thermometer

Activity 6.2: Handout 6.2, *How much stormwater falls on the school?*
Rain gauge

Activity 6.3: Handout 6.3, *How do you rate your school?*
Copy of school's electricity bill

Activity 6.4: Handout 6.4, *School Energy*

Teachers' notes on activities

Activity 6.1: How tall are your trees? (80 minutes overall)

This activity is designed for the students to develop knowledge, skills and understanding by:

- using a variety of techniques and tools to measure and compare quantities;
- selecting into given formulae and evaluating the resulting expression; and
- selecting and using appropriate calculator techniques to perform operations.

Activity 6.2: How much stormwater falls on the school? (40 minutes overall)

This activity is designed for the students to develop knowledge, skills and understanding by:

- substituting into given formulae and evaluating the resulting expression; and
- interpreting and using rates to solve simple problems.

Activity 6.3: How do you rate your school? (40 minutes overall)

This activity is designed for the students to develop knowledge, skills and understanding by:

- interpreting data represented in graphs;
- organising and displaying collected data; and
- investigating a problem by posing suitable questions and planning data collection.

Activity 6.4: School energy (40 minutes overall)

This activity is designed for the students to develop knowledge, skills and understanding by:

- interpreting and using written and graphical information to solve problems related to consumer arithmetic;
- appreciating the contribution of mathematics to our society;
- appreciating the impact of mathematical information on daily life;
- selecting and using appropriate common units and converting between measures; and
- organising and displaying collected data in a variety of ways.

Extension: Re-do this exercise after six months to check whether there has been any decrease in the amount of electricity used in your school. How much (energy/money) has your school saved? This exercise can also be done by checking the overnight or daily readings of the school's electricity meters.

Alternative activities

- "Home Greenhouse Scorecard": use of software package on energy.
- Design your own survey or attitude sheet to suit your classroom situation. Use questions relating to all types of waste, such as: water, paper, litter, energy. Use the results to investigate ways that the school could reduce waste.
- Collect a series of round objects, e.g.: containers, balls etc. Using a piece of string find the circumference of each. Record data. Measure or estimate the diameter of each. Use the formula $\pi = \frac{C}{D}$.

  Find the value for π for each object. Find the average value for π. Compare your value with the value from the calculator.
- Calculate the volume of air in a balloon. Have each student blow up a balloon and set the problem to find "C" (circumference). This could be used to check the lung capacity of all students by having them each blow up their balloon using say, eight breathes, and calculating the volume of air. What is the average for the class?
- Toilet tally: Run a toilet tally by having a sheet of paper placed within the cubicle and each time the toilet is used the occupier should note one tally on the sheet. These could be collected at the end of the day and used to find different outcomes, such as, volume of water used.
- Create an environmental action group to request different bins for different purposes to be placed in the school grounds. Decide on the purposes of each bin (for example, cans, recyclable paper goods, non-recyclable materials). Label each bin clearly.
- Investigate how well these bins are used over a period of time, by investigating the contents of the bins, state the percentage of the total contents of each bin that are materials which have been correctly placed. Investigate the frequency of collection at the school for each type of material.
- Calculate the mass and volume of the contents of these bins before each collection and draw up a table and graph of the results.
- Prepare a report for the school administrators and staff and students of the school on your findings and the conclusions you have reached, incorporating the information you have collected.

Background information

Schools have been implementing various strategies to promote appropriate environmental knowledge, skills and values. Auditing is the process of measuring and monitoring the use of resources. It allows you to effectively manage the environmental impact and provides a comprehensive strategy to encourage ongoing environmental improvements. Best Practice Environmental Management (BPEM) has been widely accepted throughout industry, commerce and governments at all levels. In schools, key competencies and other measurable outcomes can all be evaluated. Any change that involves better management practices and more efficient use of school resources must be in the long-term interest of the whole school, students and the community. The results of any surveys can be reported to school committees and in newsletters. By adopting a strategy of BPEM, schools will be able to make their day-to-day operations consistent with the educational goals of the NSW Environmental Education Curriculum Statement.

Handout

HANDOUT 6.1: HOW TALL ARE YOUR TREES!

To find the variations (such as girth, height) in trees: Fill in Table 6.1a by:

1. doing a survey of trees in your school (not in the middle of the day)
2. measuring the girth of ten trees (girth is the circumference of the tree 1.3 metres above the ground).
3. using the formula $C=\pi d$, find the diameter of each tree.
4. using a shadow stick and similar triangles to find the height of the trees.

Example: Stick = 1 metre in height

Shadow cast by stick = 0.50 metres in length

Shadow cast by tree = 3.0 metres in length

Ratio of: shadow cast by stick : stick (0.5:1) or (1:2)

shadow cast by tree : tree (3:?)

Shadow cast by stick is $^1/_2$ the length of the stick's height. Tree shadow is $^1/_2$ the length of the tree's height.

Therefore, tree is 6 metres tall

Table 6.1a

Tree	circum-ference (c)	diameter (d)	estimated height of tree	length of stick	length of shadow cast by stick	length of shadow cast by tree	ratio of shadow cast by tree: shadow cast by stick	height
2								
3								
4								
5								
6								
7								
8								
9								
10								
	$C=\pi d$	$d=\frac{C}{\pi}$		$\pi=\frac{C}{d}$				

5. Estimate how many people could stand in the shade of the school's tallest tree. .....

6. What is the temperature in:

the shade of the tree? ..... in the open? .....

7. Are there sufficient trees in the school grounds to provide shade for the whole school to sit and have lunch? How did you determine your answer? .....

8. At a certain time of the day, a tree 25 metres high casts a shadow 32 metres long. At this time of day, what angle do the rays of the sun make with the ground? .....

9. (a) Collect the paper and cardboard in your class, grade or school to be recycled or sent to landfill for one day.

   (b) Weigh the paper. .....

   (c) How many trees would have been destroyed to make this paper if 12 052 tonnes of paper make 150 650 trees? .....

   (d) At the present rate, how long would it take for your class, grade or school to recycle or waste one tonne of paper? .....

   (e) Suggest ways in which the school could reduce, reuse or recycle the waste paper? .....

Handout

6.2: HOW MUCH STORMWATER FALLS ON THE SCHOOL?

1. With a rain gauge measure the rate of rainfall during a heavy storm. You can use any flat-bottomed, straight-sided vessel as a rain gauge, for example, a jam tin. Note how long the rain gauge was collecting water.

   ..... mm period of time .....

2. Compare your answers with data published by the Bureau of Meteorology in newspapers etc.

   If 90% of stormwater runs off the school playground and 16mm of stormwater was collected in a storm (70 minutes), how many litres (volume) of stormwater ran off the school playground during the storm? The playground is a rectangle 20m by 30m.

   For example: We first need to change mm to m (since the playground is in metres)

   $\therefore$ 16mm = 0.16m

   Find the amount of rain that fell on the playground

   V = area of playground x height

   = 20 x 30 x 0.16

   = 96L

   This means 96L of rain fell on the playground

   If 90% of the stormwater runs off the playground we need to find 90% of 96L

   i.e. $\frac{90}{100} \times 96L$

   = 86.4L

   So 86.4L ran off the playground

3. Find the volume of runoff:

   (a) per second: ..... (b) per minute: ..... (c) per 24 hours: .....

4. Compare how much water is used per day against how much water is lost in stormwater runoff.

   Record the readings from the school's water meter at the same time each day, two days in a row.

   Day 1: Date ..... Time ..... Kilolitres of water .....

   Day 2: Date ..... Time ..... Kilolitres of water .....

   Day 2 - Day 1 = ... kilolitres of water used

   24 hours of stormwater runoff = ... kilolitres of water

5. Can you collect and reuse stormwater in your school? How many activities could the collected stormwater replace?

   .....

   .....

6. Identify all points of actual and potential areas of the school where water can be wasted. These may include: leaking taps and drinking water fountains; toilet cisterns that don't shut off properly; and sprinklers that are operated above normal requirements. Make a class list of problems and present these to the principal. Estimate how much money is being wasted by losing this water.

Handout

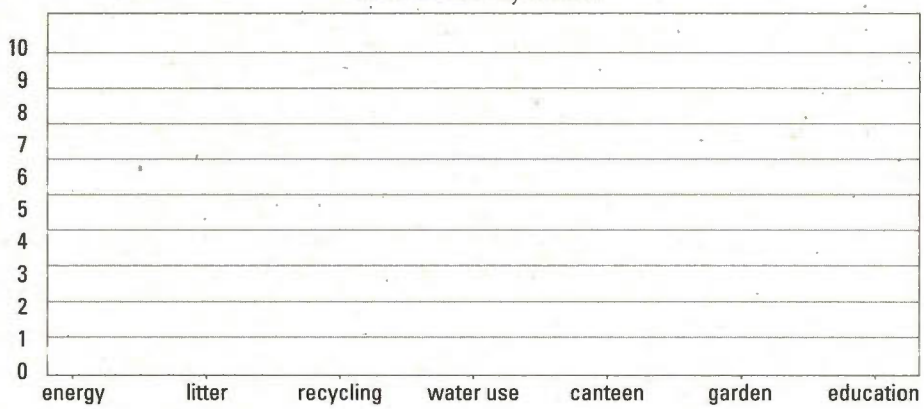
6.3: HOW DO YOU RATE YOUR SCHOOL?

1. Discuss the issues below. How "environmentally friendly" is your school? Give each item a score from 1 to 10 based on a rating from poor to excellent.

	Poor		Excellent	Score
Energy use	1	5	10	.....
Litter reduction	1	5	10	.....
Waste management	1	5	10	.....
and recycling	1	5	10	.....
Water use	1	5	10	.....
Healthy green canteen	1	5	10	.....
Trees, garden	1	5	10	.....
Environmental education	1	5	10	.....

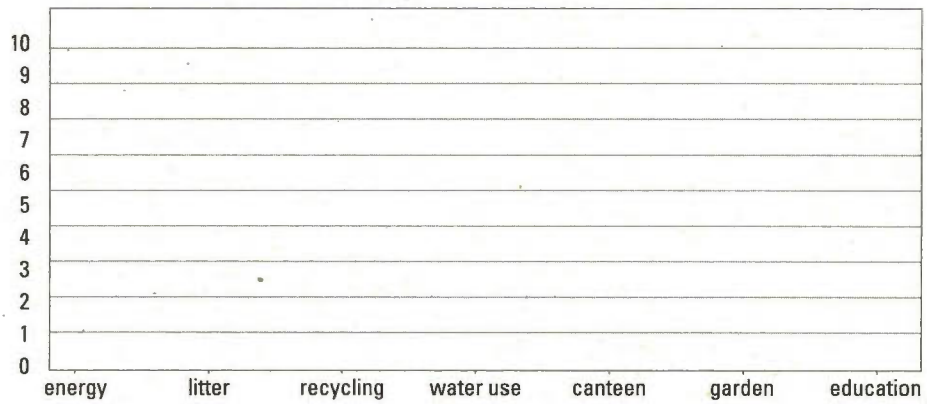
2. Graph your results.

How I rate my school



Graph the class results.

How the class rates the school



3. Which areas need **HELP?** How can you and your friends help make the school more environmentally friendly?

Handout

6.4: SCHOOL ENERGY

We get most of our energy by burning non-renewable fossil fuels. This releases carbon dioxide into the atmosphere and contributes to the greenhouse effect. By using energy more efficiently we: conserve resources; reduce carbon dioxide production; and save money. How much energy does your school use?

1. Obtain a copy of the school's electricity bills for the year (or an average of two or more years if they are available).

2. Gather the following information: total use per quarter; total cost per quarter; number of billing days; size of school population (including staff). Use this information to calculate:

   Daily use
   (total use per quarter/number of billing days (kWH/day) .....

   Personal daily use
   (daily use/size of school population (kWH/person/day) .....

   Daily cost
   (total cost per quarter/number of billing days) .....

   Personal daily cost
   (daily cost/size of school population) .....

3. Identify where electricity is used in the school and where electricity could be saved. Organise teams to inspect the different areas of the school: classrooms, offices, library, canteen, school hall, outside areas etc, making sure all areas are studied. Draw up a table to show: location; use; comments; and how electricity is wasted. Check all equipment and fittings such as: lights; fans; heaters and air-conditioners; computers, printers, photocopiers and office equipment; videos, TVs, slide projectors; stoves, refrigerators; science equipment etc.

   for example:

Location	Use	Comments	Ideas for reducing waste
Classroom 1	lights	left on during lunchtime	use stickers to remind the users to conserve energy
	video	left on all day	use timers
Library	heater	room too hot	turn thermostat down

4. Discuss your results. What are some of the best ideas to save energy in your school?

   .....

5. Where could stickers or signs be placed to remind people not to waste electricity?

   .....

6. Make posters, stickers, flyers etc to display around the school.

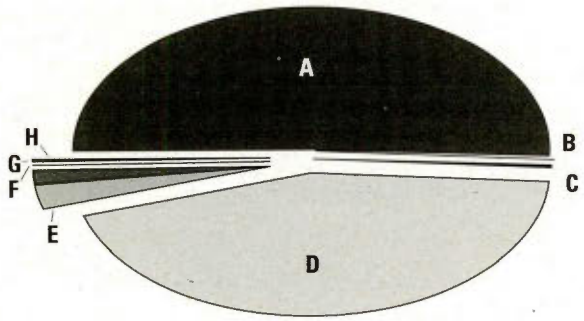
ANSWERS TO ACTIVITIES

HANDOUT 1.3, Page 6

Q.1 (TABLE)

	Materials	Tonnes	%	Angle (sector graph)*
A	*Paper/cardboard*	12 052	51.0	183.6°
B	*Steel cans*	56	0.2	0.7°
C	*Aluminium cans*	10.4	0.04	0.1°
D	*Glass*	10 400	44.0	158.4°
E	*PET (plastic bottles)*	707	2.99	10.8°
F	*HDPE (plastic milk cartons)*	398	1.68	6°
G	*Cardboard milk cartons*	5	0.02	0.04°
H	*Plastic bottles (detergent)*	3	0.01	0.03°
	TOTAL	23 631.4	100.00	360°

Q.2 (PIE GRAPH)



Q.3 (a) $\frac{\text{number of trees}}{\text{tonnes}} = \frac{150\ 650}{12\ 052}$

$= 12.5$ trees

(b) $\frac{\text{number of trees}}{\text{kilograms}} = \frac{150\ 650}{12\ 052\ 000}$

$= 0.0125$ trees

Q.4 $\frac{\text{tonnes}}{\text{number of trees}} = \frac{12\ 052}{150\ 650}$

$= 0.08$ tonnes or 80 kg

HANDOUT 1.4, Page 17

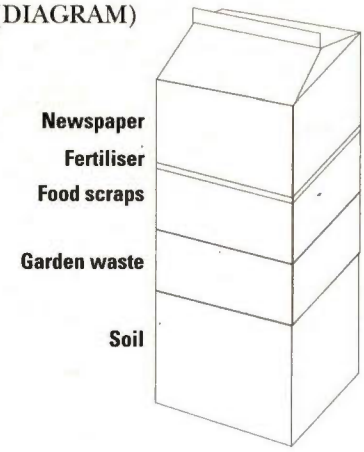
Q.1

Food scraps	2
Metals	4
Plastics	5
Wood etc.	2
Paper	1
Glass	7
Other	5

Q.3.1 90% Q3.2 10%

HANDOUT 2.1, Page 21

Q.2 (DIAGRAM)



Q.3 (TABLE)

Ingredient	Fraction	%
Soil	40/112	35.7
Garden waste	20/112	17.9
Food scraps	20/112	17.9
Fertiliser	2/112	1.8
Newspaper	30/112	26.7
Total	112/112	100.0

BALANCED COMPOST (TABLE)

Ingredient	C/N ratio	Ingredient	C/N ratio	Ingredient	C/N ratio
Lawn clippings	80:4 20:1	weeds	57:3 19:1	Food scraps	75:5 15:1
Fowl manure	70:10 7:1	Leaves	180:3 60:1	Paper	340:2 170:1
Straw	700:7 100:1	Cow manure	48:4 12:1	Seaweed	100:4 25:1
Answers:	1 seaweed	2 lawn clippings	3 weeds		

HANDOUT 2.2, Page 23

Q.1 (a) 8 weeks
(b) 13 weeks

Q.2 (a) 66%
(b) 33%

Q.3 (a) 3
(b) 1.8

HANDOUT 2.3, Page 24

Q.1 Volume = l x b x w
= 60 x 7 x 3
= 1 260 m^3

Q.2 $\frac{120}{200} \times \frac{100}{1} = 60\%$

Q.3 $\frac{\text{tonnes}}{\text{day}} = \frac{1\,000\,000}{365}$
= 2 740 tonnes/day

$\frac{\text{volume}}{\text{week}} = 1\,260 \times 7$
= 8 820 m^3/week

Q.4 volume = area of landfill x depth (3)
= 120 x 100 x 100 x 3
= 3 600 000 m^3

Q.5 (i) 150 x \$7.80 = \$1 170.00
(i(i) 1 000 x \$7.80 = \$7 800.00

HANDOUT 3.2, Page 28

Q.3.1 4 000 (ii) 20 000 (iii) (iv) 2 800
Q.3.2 2.5 g (ii) 25 g (iii) 10.5 (iv) 250 kg
Q.3.3 90 (ii) 2 025 (iii) 3 075

HANDOUT 3.3, Page 29

Q.2 sample Q.3 Average = $\frac{67}{6}$ = 11.16 Q.4 Total number of squares =20

9			10
			13
	10		
		13	
12			

Q.5 Population = Av./square x number of squares
= 11.16 x 20
= 223.3 worms

Q.6. (TABLE) The number of worms increases by 60 per week.

	Start	Week 1	Week 2	Week 3	Week 4
Adults (A)	10	10	10	10	10
Young (Y)	0	60	120	180	240
TOTAL	10	70	130	190	250
Ratio A:Y	10:0	1:6	1:12	1:18	1:24

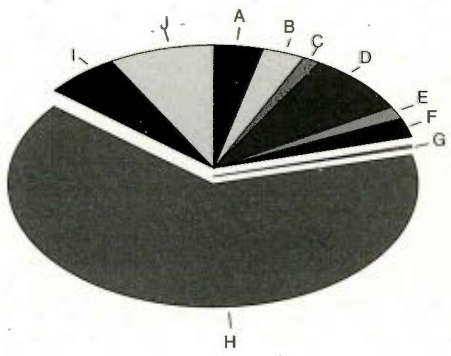
Q.6.1 970 worms Q.6.2 9700% Q.7 after 1 month we have 240 plus 10 = 250 worms
Q.8 if 500 worms = $20 then 250 worms = $10.00 Q.9 20 worms

HANDOUT 4.1, Page 32

(TABLE)

	Organism	Species	Angle required for pie chart
A	Viruses	500 000	14.5°
B	Bacteria	400 000	11.6°
C	Protozoa	200 000	5.8°
D	Fungi	1 000 000	29°
E	Algae	200 000	5.8°
F	Plants	300 000	8.7°
G	Vertebrae	50 000	1.5°
H	Insects	8 000 000	232°
I	Arachnids	750 000	21.7°
J	Other invertebraes	1 000 000	29°
	TOTAL	12 400 000	360°

(PIE CHART)



Q.1 insects Q.2 2 000 000 Q.3 0.4%

Q.4 viruses 4, vertebrates 1, plants 2, insects 3.

Q.5 (a) 200 billion (b) 8 000 billion (c) 800 million

HANDOUT 4.3

Q.1 (TABL(E)

Number of animal species extinct or declared threatened in NSW					
Group	No. of species at time of European settlement	Presumed extinct in NSW (a)	%	Existing but threatened in NSW	%
Amphibians	69 (b)	1	1.4	14 (c)	20.3
Birds	511 (b)	11	2.2	88 (c)	17.2
Mamals: terrestrail marine	118 (b) 36	26 unknown	22 unknown	40 (c)	33.9
Reptiles	228 (b)	–	–	15 (c)	6.6
Invertebrates	unknown	unknown	unknown		

(a) May be existing elsewhere in Australia
(b) National Parks and Wildlike Services (NPWS) Atlas of NSW Wildlife
(c) Number of species on both Part 1 (threatened) and Part 2 (vulnerable and rare) of Schedule 12 of the NPWS Act

Q.2 terrestrial mammals Q.3 terrestrial mammals

Q.4 amphibians 2.1%, birds 3.3%, mammals 33%.

HANDOUT 4.4, Page 36

Q.2

Breeding season	1	2	3	4	5	6	7	8	9	10	11	12	13
Pairs of rabbits	1	1	2	3	5	8	13	21	34	55	89	144	233

Q.3 The next term is equal to the sum of the two preceeding terms after the second.

Q.4

Seasons	$^1/_2$	$^2/_3$	$^3/_4$	$^4/_5$	$^5/_6$	$^6/_7$	$^7/_8$	$^8/_9$	$^9/_{10}$	$^{10}/_{11}$	$^{11}/_{12}$	$^{12}/_{13}$
Value	1	0.50	0.66	0.63	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62

Q.5 After the first four (4) values the ratio has a constant value of 0.62.

HANDOUT 5.2, Page 41

Q.4.1 4 Q.4.1 $4(\text{taps}) \times \frac{3\,500}{365} = 38.4$ litres Q.4.3 $\frac{50\,000}{38.4} = 1\,302$ days or 3 years 207 days

Q.4.2 $1.15

Q.5 a) 120 L b) 90 L c) 2.5 L d) 2 500 mL e) 1 250 mL f) 8 750mL Q.6 48 400 L

HANDOUT 5.3, Page 43

Q.1 200 m Q.2 628.32 m (most accurate using the π button) Q.3 (a) (b) 31 415.93 m^2

Q.4 (a) 7 853.98 m^2 (b) 18 325 m^2 Q.5 (a) 1 000 000 litres (b) 416 666.7 litres

Q.6 83 333.3 litres/hour

GLOSSARY:

arachnid A class of animals which includes spiders, scorpions, mites, etc.

bacteria Microbes, very small single-cell organisms. Singular - bacterium.

compost A warm, moist mixture of organic material undergoing decay and decomposition with or without air which can be used to fertilise land.

decomposing A breaking down process which occurs when living organisms die.

disposal Getting rid of something, throwing away, finishing.

ecosystem A network of relationships among organisms in the environment.

environment The sum total of organisms, objects and relations in a given place.

fungus Spongy growth, reproduced through spores and surviving on living or decomposing organic material e.g., mushrooms, toadstools etc.

invertebrate Micro-organism, tiny animal, often an insect which has its skeleton on the outside of its body as a shell or skin-like cover e.g., nematode, mites

litter Waste material that has been discarded or scattered as rubbish in the environment.

micro-organism Tiny organism, a living being usually existing in soil or decomposing organic material.

mite An invertebrate micro-organism, a transparent bodied arachnid living in decomposing organic material. Mites feed mainly on yeasts.

nematode An invertebrate micro-organism, a thin worm without segments living on bacteria, fungi and protozoa.

organic Substances having a living (or dying) physical structure, organs, plants and animals. Organic farming uses only organic material, no chemicals.

pollution Waste; a group of pollutants which combine or act separately in degrading, fouling and destroying the environment.

protozoa Single celled microscopic animals, microbes. Singular: protozoon.

putrescible Organic waste that can decompose. Often called compost, compostibles or organics.

recycling The reprocessing of products after they have been used so that they may become the raw materials for new and recycled or "downcycled" products.

reduce To use less, to trim down or limit the amount and range of products used. Creating less waste. This is the best way to achieve waste minimisation. Reusing and recycling are less effective ways.

reuse Finding or adapting products after their initial use so that they have the same, similar or alternative uses. These reuses extend the life of the products.

sustainable Able to be sustained, carried on far into the future. In the case of the environment it means waste minimisation through reduction, reuse, recycling and a proper appreciation of the environment and management of resources, especially by using renewable resources.

waste Anything left over or superfluous, such as excess materials or by products, rubbish, garbage, mess etc.

RESOURCES:

1 *Environmental Guidelines: Solid Waste Landfills.* EPA 1996.

2 Kiama Municipality Council - leading NSW in recycling (042 320 222).

3 *Glass Packaging and the Environment.* ACI Glass Packaging (047 300 700).

4 *Do the Right Thing* - Litter Reduction Campaign. Volume One 1981.

5 *Earthworks - Living with less waste* - participants notes - EPA 1996.

6 *The Complete Guide to COMPOST* - Peter Rutherford and David Lourie 1995 (phone/fax 02 9918 0879).

7 *Worm Farming.* Environment Matters No 26 - EPA 1996.

8 *Kids for Landcare - Wormwatch* - Education Department of South Australia 1992.

9 *Sustainability and Biodiversity, Teachers Guide.* EPA 1997.

10 *The NSW Spring Water Bug Survey.* Dept of Land and Water Conservation (Rosie Rowe: 02 9895 7179).

11 *Streamwatch* - Sydney Water Corporation (Renato Ramsey: 02 9350 5393).

12 *Let's Clean the Water.* A workbook on water pollution. SPCC 1989.

13 *Water Care - Caring for Water in your Local Environment* - Water Board 1993.

14 *Water Wise: Water in the Home.* Water Board 1993.

15 *Catchment Management* - Water Board 1990.

16 Draft *Caring For Your Catchment.* Gould Leaguer - 1996.

17 *Australian Home Greenhouse Scorecard.* Distributed through EDSOFT (Toll Free: 1800 674 899).

18 *Environmental Audits.* Eco-Focus. Stuart DeLandre 1996.

19 *There's something you can do.* Clean Up Australia Campaign. CEPA.

20 *Schools Environmental Audit. Best Practice Environmental Management.* Keep Australia Beautiful. 1994.

FURTHER CONTACTS:

1. Environment Protection Authority - Pollution Line and Publications (Free Toll: 131 555).
2. Environment Protection Authority - Debbie Maddison (042 268 100)
3. Environment Protection Authority - Internet Access - Home Page: http://www.epa.nsw.gov.au
4. Department of School Education - Home Page: http://www.dse.nsw.ed.au
5. Department of School Education - Ross Tanswell (042 614 011).

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