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Introduction

This book is one of a series of four books for middle years teachers and students. This series provides a treasury of challenging and engaging problems from all areas of the maths curriculum. The Daily Problems and Weekly Puzzlers are each keyed to the appropriate CSFII strands, and many of them are designed for 'hands-on' problem solving with common classroom manipulatives.

This book helps students become more mathematically literate and develop their mathematical power by:

- Learning to value mathematics
- Becoming confident in their own ability to do mathematics
- Becoming mathematical problem solvers
- Learning to communicate, using the language of mathematics
- Learning to reason mathematically

Students entering the work force in the twenty-first century will need to have had much practice with thinking and processing information in different ways. Being involved in problem-solving activities helps students develop useful approaches, strategies, techniques, methods, and patterns related to thinking.

Each book contains 144 Daily Problems and 36 Weekly Puzzlers. The Daily Problems are presented four per page, and each one is designed to take students about 15 minutes to solve. The Weekly Puzzlers, which are presented two per page, are more complex problems designed to engage students over a longer period of time and to help them develop a variety of problem-solving strategies. Sample solutions are provided for the problems, many of which have multiple solutions. The chart on page vi lists all of the problems and puzzlers related to each CSFII strand. Also included is a blackline master for tangram pieces.

Suggestions for Classroom Use

This series of books is designed for use at all middle years levels (5-9) and increases in difficulty from book 1 to 4. Since ability levels of students vary greatly, you may need to modify the problems to meet the individual needs of your students. For example, you could have your

'struggling' students do portions of whole problems, or do them with a partner. You might require your more advanced students to provide more detailed explanations, or to extend the problems and puzzlers in a different way.

One CSFII strand is referenced for each of the 144 Daily Problems and 36 Weekly Puzzlers. However, you will find that many problems are related to more than one strand. You can refer to these strands to help you decide how to use these problems and puzzlers. You may want to focus on one strand for a week or a month, or you may want to expose students to a variety of strands over a set period of time. The cross-reference chart for the strands is designed so that you can choose the problems and puzzlers you want.

The problems and puzzlers may be given to individual students, pairs of students, or small groups. When problem solving, using partners or small-group contexts provides an opportunity for students to share their thinking verbally. Students are often better able to express their thinking in writing after they've had ample opportunities to express their thoughts verbally—a process which helps students articulate, clarify and modify their ideas.

Many of the Weekly Puzzlers and some of the Daily Problems ask students to extend ideas by writing their own problems. When students have the opportunity to play with operations, algorithms and numbers, and to create their own problems, they understand the concepts more deeply and personally and can construct their own meaning as they undertake this creative process.

Hints for Using Problems and Puzzlers

- Use as an early morning warm-up. Put one or more problems on the overhead or blackboard to start your day; then have 'student teacher' volunteers explain their answers to the class.
- Use as homework. Give students a Daily Problem to do each night or a Weekly Puzzler to work on all week.
- Use as a maths lab activity. Have teams work on the same problem during a 'maths lab' period, then take turns

explaining the problems to the class. Alternately, you can have student groups work on different problems and rotate the problems as they finish.

- Use in a speed contest. Have a race to see who (or which team) can solve a Daily Problem or Weekly Puzzler the fastest and most accurately.
- Use in an explanation contest (the opposite of a speed contest). Have an 'anti-race' to see who (or which group) can best produce a clear and detailed written explanation of a problem or puzzler with no time limit.
- Use as a transformational activity. Have students turn Daily Problems into Weekly Puzzlers, and Weekly Puzzlers into long-term investigations and explorations.
- Use as a quiz. Compile student-created problems into a quiz for everyone to do. Then, correct the quiz together as a whole class so that students can read, answer, and explain their own problems.
- Use as a part of a student's portfolio. Have students select sample Daily Problems and/or Weekly Puzzlers to put in their portfolios and write about why they chose these problems.

Materials Needed

Many of the problems call for the use of manipulatives. We have tried to choose manipulatives that most teachers might have in their classroom. You can use the blackline master for tangram pieces to make paper sets.

Some of the problems specifically call for students to use a calculator. It would be helpful if calculators were available for many of the problems. In some cases students are asked to make estimations first, and then check their estimations using the calculator.

Getting Started

Work through a few daily and weekly problems with your class before having the students work independently or in groups. Help students work through a problem, using a problem-solving process such as the following: (1) FIND OUT what the problem means and what question you must

answer to solve it; (2) CHOOSE A STRATEGY that will help solve the problem; (3) SOLVE IT using the strategy selected; (4) LOOK BACK or reread the problem and check that solution to see that it meets the conditions stated in the problem.

Model both effective and ineffective problem-solving methods when working with your whole class. In addition, model exemplary and incomplete written explanations, as well as productive and unproductive communication in groups. In this way, you will demonstrate and clarify your expectations for students in either individual or collective problem-solving situations.

Show students how to help each other. Emphasise that giving answers to a partner does not help either student to understand the concepts involved. You can make a game out of this by having the students role-play appropriate and inappropriate ways of interacting with a partner and in a group.

Wrapping Up

Discuss the problems as a class after students complete them. Involve students in the discussion by having them share various problem-solving methods and strategies—allowing everyone to acquire new problem-solving tools. During discussions, it is important to emphasise that many problems in maths (and life) have multiple solutions. Seeing a variety of answers to a problem, and hearing how other students reached these different conclusions, underscores the need for students to remain open to more than one path or solution.

Daily Problems

1

Measurement

In science class, Aaron learns that the number and sizes of rings in a cross-section of a tree trunk can give clues about the age of the tree. He finds out that a pine tree grows a 6-millimetre-thick ring per year in its first 60 years of life; it grows an 8-millimetre-thick ring per year in the next 80 years; and it grows an 12-millimetre-thick ring per year in the next 200 years. How many centimetres in diameter would a 50-year-old tree be? What would the circumference of a 123-year-old tree be? What would the radius of a tree with 310 rings be?

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2

Number

How many two-digit whole numbers are there? How many three-digit whole numbers? How many five-digit whole numbers?

.....

3

Number

Davina is in charge of recording the number of people entering and exiting the school gym on the nights of basketball games. For the league championship, the fire brigade has asked her to predict how many people will be entering and exiting the gym. If she assumes that the **difference** between the two numbers for each quarter will follow the same pattern as it did for the previous two games, how should she fill in the blank spaces in the chart below? Explain how you decided what numbers to put in.

		1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Game One	Entering	320	180	440	500
	Exiting	236	131	326	371
Game Two	Entering	624	180	288	684
	Exiting	464	68	212	509
Championship	Entering	436		288	1116
	Exiting		539	212	

.....

4

Chance and Data

Use two regular 6-sided dice.

Do some experiments with your dice to answer the following questions:

- A. Amy and Tamara each roll a die three times. Amy rolls a 4 three times in a row; Tamara rolls a 2, a 6 and a 5. What is the probability that Amy will roll a 4 on her next roll? What is the probability that Tamara will roll a 4 on her next roll? How can you explain any similarities and/or differences in the two probabilities?
- B. Amy rolls a pair of dice. She rolls a 3 and a 4, giving a sum of 7. What is the probability that the sum of her next roll added to the sum of her first roll will be ≤ 9 ? ≤ 13 ? ≤ 18 ? Make a graph showing the relationship of probability to the number she's trying to exceed.

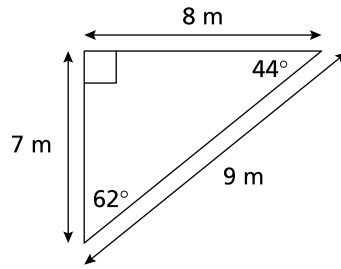
Daily Problems

5

Space

Malcolm likes the plan for his family's new house, except for a triangular room on the first floor. On the plans, the room looks like the diagram shown.

What would Malcolm find incorrect about the plan for this room? Explain your answer with words, numbers, and, if necessary, drawings.



6



Chance and Data

The English teachers' comedy troupe has had financial problems lately. They need to charge more for tickets in order to keep performing. However, the troupe doesn't want to hurt attendance, which has been high. The tickets come in three price categories. Which of the new plans below would bring in more money as well as fill the most seats possible? Justify your answer with numbers and words.

Type of Ticket	Old Plan	New Plan #1	New Plan #2	New Plan #3
A (100 seats)	\$ 8.00	\$10.00	\$ 9.00	\$ 7.50
B (50 seats)	\$12.00	\$15.00	\$13.00	\$14.00
C (25 seats)	\$16.00	\$18.00	\$21.00	\$24.00

7



Number

The average cost for a television commercial during prime-time viewing hours is \$200 000; a half-page newspaper advertisement costs $\frac{3}{8}$ of this amount; and a full-page magazine ad costs $\frac{5}{6}$ the amount of a television ad. Estimate the cost of each advertisement; then use a calculator to check your answers. If your company had a budget of \$700 000, how many different combinations of advertisements could you buy without going over budget?

8



Number

Make a table showing the first 20 perfect square numbers. Note any patterns and similarities you find. Then try to predict whether the following numbers are perfect squares: 15 625; 529; 798; 4624.

Explain your reasoning, basing your explanation on the table you made. Use a calculator to check your answer.