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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

Chance & Data

Angela is one of the best batters in the school softball team. The chart below shows the number of hits she's had in the last five games. As you can see, she's in a bit of a slump since game 2.

Game 1: 5

Game 2: 7

Game 3: 2

Game 4: 3

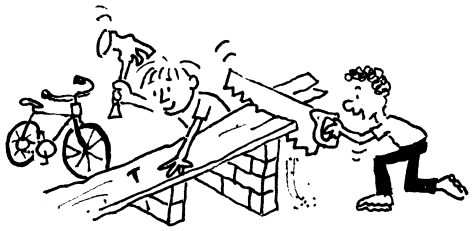
Game 5: 3

Make a bar graph that shows Angela's hits for each game. What percentage of her total hits occurred in game 3?

2

Space

Thomas and Dean built a bike ramp from twenty sheets of 2 m by 4 m plywood and propped it up on one end with some bricks. If the finished ramp is rectangular, show three ways they might have arranged the wood and give the measurements for each side. Assuming that they used every sheet of plywood, what is the total area of the ramp (regardless of its shape)?



3

Measurement

The tallest mountain in the world is not Mt Everest–it is the entire island of Hawaii! Hawaii's tallest peak is Mauna Kea which rises 4205 metres above sea level. The base of the mountain reaches down 5486 metres below sea level. If you are planning to climb the entire mountain, you'd better take along your deep-sea diving equipment. Find out what percentage of your climb will actually be underwater.

4

Number

Introducing today's guest—*a mystery number!*

- I am a very popular number. In addition to being the lowest common multiple of 15, 18 and 20:
- I am 20 times larger than the square of 3;
- If you use a protractor to measure me as an angle, I form a semi-circle.
- Who am I?

Daily Problems

5

Number

There are big problems at Pendelo's Parrot Farm. Yesterday, 1000 of his best green wonders flew the coop. 105 of them went north; six times that number went south. The number of birds flying west was one-third of the number of south-flying birds, and 50 fewer birds headed east than headed north. How many birds went in each direction? Also, if Papa Pendelo offers a ten-cent reward for each parrot returned, how much would he pay for herding every one of his wayward birds home to roost?

6

Number

James and Jason have been working on a computer project, and want to protect their work. They decide to use the sum of all of the prime numbers between 0 and 50 as the password. What is their password?

7

Chance & Data

Adam is an insect collector who has been losing a lot of insects lately. His favourite insect, a common house fly with green wings, disappeared last week—along with several other insects. He began his collection with 48 insects. At the beginning of each week he adds six more, but every time he opens the lid, 12 insects escape. Create a line graph that shows how many insects Adam will have at the beginning of weeks 1 through to 5. How many weeks will it take before Adam has no insects left in his collection?

8

Measurement

Use cubes.

All the clowns working for Beacon and Bonkers Circus weigh exactly the same amount. All the circus bears also weigh the same as one another. Here is their high-wire balancing act. How can you add the proper number of bears and clowns to B and C so that they balance too?