SUCCESS WITH WORD PROBLEMS
Using Mathematical Model Drawing

If you’ve picked up this book, you already know the benefits of Mathematical model drawing. Model drawing is essentially a pictorial representation of a word problem, a visual reference for students that bridges the gap between concrete and abstract. Students who use model drawing techniques to solve various word problems consistently score much higher on standardized tests.

However, this book isn’t an exposition of the benefits of model drawing. Instead, Success with Word Problems is essentially a workbook, arranged as a progression of math topics. The pretest, posttest, quizzes, presentation problems, and assessment problems may be reproduced for use in your classroom.

Success with Word Problems is the culmination of two years of work by the Mathematical Committee in the Roswell Independent School District. It is our sincere desire that you use this book to the greatest extent possible in your classroom, to the benefit of your students.

(While every effort was made to edit the book for accuracy, this first edition may contain an overlooked typographical mistake. If you discover such a mistake, the Mathematical Committee would like to know about it so that it can be corrected in future editions. Please email Martha Cruz at mcruz@risd.k12.nm.us with any such information.)

How to Use This Book

There are various ways in which you, as a teacher, may use this book to help your students find success in working word problems.

- **20 minutes a day:** Each lesson has been designed to be taught and assessed in approximately 20 minutes. Many teachers, especially in grades 5 and above, may choose to go through the entire book, from start to finish in a semester, using 20 minutes a day in addition to their regular math curriculum. Used in this fashion, you will model the three “Presentation Problems” for each day with your students. Then, using the same skill that was just demonstrated, students will practice the two “Assessment Problems” which you will score with a rubric.

- **Topical supplement:** Rather than progress straight through Success with Word Problems in one semester, some teachers may choose to incorporate sections of this book as they encounter those same topics in their curriculum maps. For example, you may use the section on “Fractions” as a supplement when you are teaching fractions during the school year.

- **Bank of problems:** This book contains over 400 CRT-style word problems with answer keys. Some teachers may appreciate having a bank of problems which can be solved using model drawing techniques. This may particularly true if you teach grades 1 and 2, where many of the problems may be too difficult for the youngest students. You may simply select the problems that are appropriate for your grade level.
How This Book Is Organized

With the exception of the quizzes, each day's lesson consists of two parts: three “Presentation Problems” that you may choose to model for your students and two “Assessment Problems” which students will work independently. The answer keys for these lessons are arranged in this book so that they are right after that particular day’s problems. This means you will not have to flip to the back of the book to find the answers. You may want to look over these answer keys before you model the problems with your students.

Each topic, or unit, is arranged so that succeeding days are progressively more difficult and build upon the skills learned in previous days. In many of the units, one day has the students working in “reverse”—models are provided and students must write a word problem which would fit that model. This engages students at a much higher cognitive level of Bloom’s Taxonomy.

At the end of each unit is a quiz, which is designed to be taken in 20 minutes. On that particular day, there are no presentation problems for you to work with your students. The quiz covers all of the skills for that particular topic. The answer keys for the quizzes are right after them in this book. In addition, a pretest and posttest are included so that you can measure your students’ success.

How to Assess Students’ Work

While you are welcome to create your own method for assessing (grading) your students’ work, it is important to look for some key components. First of all, if you are teaching the model drawing technique, students need to demonstrate this technique in their work. Some students, especially particularly bright students, will express their frustration with this. Such students will claim they can do the work “in their head” or that they don’t need a model to do the work, so it is vital you show them your rubric so they know that they will be assessed based upon their model.

Second, not all student models will be identical. Many models can be drawn in several different ways yet still convey the same information. Also, student models may be different from the answer keys found in this book. While the solution will be the same and the computations similar, the models themselves may be drawn differently. It is your job to determine whether the student’s model accurately describes the word problem. Finally, it is important for a student’s model drawing to be labeled clearly and correctly. Students also need to have a question mark on their model to identify what they are trying to determine. Much of this will come naturally to students who see their teachers modeling the work in detail.

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This is one possible rubric you may consider using when assessing students’ work on the word problems:
Model Drawing Rubric

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical Concepts</td>
<td>Explanation shows complete understanding of the mathematical concepts used to solve the problem.</td>
<td>Explanation shows substantial understanding of the mathematical concepts used to solve the problem.</td>
<td>Explanation shows some understanding of the mathematical concepts needed to solve the problem.</td>
<td>Explanation shows very limited understanding of the underlying concepts needed to solve the problem.</td>
</tr>
<tr>
<td>Mathematical Errors</td>
<td>No mathematical errors in either the steps or solution.</td>
<td>Almost all of the steps and solution have no mathematical errors.</td>
<td>Most of the steps and solution have no mathematical errors.</td>
<td>More than 75% of the steps and solution have mathematical errors.</td>
</tr>
<tr>
<td>Model Drawing</td>
<td>Model is clear and greatly adds to the reader’s understanding of the procedure.</td>
<td>Model is clear and easy to understand.</td>
<td>Model is somewhat difficult to understand.</td>
<td>Model is difficult to understand.</td>
</tr>
<tr>
<td>Neatness and Organization</td>
<td>The work is presented in a neat, clear, organized fashion that is easy to read.</td>
<td>The work is presented in a neat and organized fashion that is usually easy to read.</td>
<td>The work is presented in an organized fashion but may be hard to read at times.</td>
<td>The work appears sloppy and unorganized. It is hard to know what information goes together.</td>
</tr>
</tbody>
</table>

How to Teaching Model Drawing Strategies

As you work through the seven steps of model drawing with students, it is important to use a method of intensive questioning. Rather than *tell* students how to create a model and do the work, you constantly ask students questions based upon the word problem and lead them to discover the technique. (“Which is greater, 4 or 5? Good. How can we adjust our model drawing to show that?) Good teachers are good questioners. Each day has a new skill with three presentation problems which can be modeled using good questioning techniques.

Most often, once we arrive at an answer, we stop working and stop thinking about the problem; however, a model drawing can be used to answer a host of additional questions related to that information. So, it is important, that we, as teachers, continue to ask those questions even after we’ve solved the original problem. (“Okay, now that we know that Susie has $43, can we tell how much more money she has than Gloria?”) To illustrate how you might do that, we’ve included an italicized “Milk It!” question for some of the presentation problems.
RISD “Mathematical”
STEP-BY-STEP MODEL-DRAWING APPROACH

1. Read the entire problem.

2. Decide who/what is involved in the problem.

3. Draw unit bar (or bars of equal length).

4. Chunk the problem, placing information on model as indicated.

5. Put the question mark in place.

6. Work computations to the side or underneath.

7. Answer the question in a complete sentence.