



Curriculum Units by Fellows of the Yale-New Haven Teachers Institute  
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## Word Problems Solved By S.M.S.

Curriculum Unit 80.07.05

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We often ask, "Why can't Johnny solve word problems?" Many teachers stress the teaching of basic skills and vocabulary. Others work on improving the reading levels. Motivation is another area that many teachers concentrate on to teach word problems. We feel that these are all important, and we will discuss them, but our main objective is to stress organized thinking.

We are going to discuss a technique, which we will call The S.M.S. Method (Solutions Made Simple), for use with your problem solving classes. We often get frustrated and seek help in this area of mathematics. Teaching the solving of word problems is not an easy task.

Our unit is designed for many different levels. We plan to use this unit with grades nine and ten in Consumer Mathematics and Basic Algebra. We will use our S.M.S. Method next year as a heuristic approach to the attack of most word problems.

The National Council of Teachers of Mathematics is encouraging a total organization around problem solving as a creative activity. Solving word problems is a thinking process relating past knowledge with a present situation and seeking an outcome; it requires the skills of interpretation, translation, and identification of "key words". Our Method will look at each of these skills in helping to guide an unorganized thinker.

Mathematics is not just arithmetic and algebraic skills; it is the ability to solve problems. Our method, "Solutions Made Simple", involves four steps:

1. Knowing the Problem
2. Making a Plan
3. Solving Your Problem
4. Testing Your Solution.

Let us observe and compare the possible techniques used by both unorganized and organized thinkers. Here is an example (Problem One) from an Algebra Class'

There are twice as many boys in the roller skating rink as there are girls. There are 42 people in the rink. How many boys are in the rink?

The typical unorganized thinker will see some numbers and merely operate on them. They often make a guess at the solution. The solutions may be ' 21, 40, 44, or 84. Hopefully the word "twice" will not cause a hangup."

The organized thinker will read the problem possibly several times and look to see what the question asks. One has to "Know the Problem". Looking at key words, one must make a plan. The word "twice" means to multiply by 2. One should also recognize that some information is implied: the sum of the boys and girls is 42. The unorganized thinker often ignores this implied information. Next, the organized thinker will write an equation after picking a variable'  $x + 2x = 42$ .

The next step is to "Solve Your Problem."  $3x = 42$ ,  $x = 14$ . An unorganized thinker might possibly get this far, but a thorough thinker will know that the question was not answered. How many boys are in the rink?

One must analyze the problem again and check whether  $x$  or  $2x$  represents the number of boys. Obviously, it is the  $2x$ . The solution, when properly stated, should be: "There are 28 boys in the rink."

The four steps of the S.M.S. Method can be explained more explicitly as follows:

## I. Knowing Your Problem

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Read the word problem carefully. The vocabulary and the grammar may pose some problems to your students. Try to read the word problem aloud, as a group, to teach the students good reading habits. The vocabulary should be taught in such a way that the students can translate what they see into terms that they can handle, either symbolic or diagrammatic. In the reading the student should be taught to look for similarities and differences among mathematical ideas. In doing this, the nonessential will be distinguished from the essential information, and they should recognize the unknown(s).

From reading the problem and possibly restating it, the students may begin to make associations that tie the words to a possible solution. It is useful at this point to use diagrams, charts, symbols, approximations, and synthesize a plan of attack to divide the large problem into a set of smaller sub problems. The children should be forced to think the problems through. They must be active participants. One does not learn how to swim, for example, by watching someone else do it. It is the same with solving a word problem.

Let us look at this simple Consumer Math problem, (Problem Two):

Your sister's gross salary is 15% more than yours in a week's time. Your gross weekly salary is \$ 182.00. What is your sister's gross salary?

From reading this problem, one should note that the following might be the "key words" gross salary, 15% more than, and \$ 182.00. One should also note possible associations. Both yours and your sister's salaries are listed as gross pay. The question asks for gross pay, your solution will be gross pay.

There are two numbers to operate with. The reader should realize that "your sister's salary" is "more than" yours. The solution, therefore, will be more than \$ 182.00. Please note, we are not solving the problem in this step, but merely analyzing the written words.

A large collection of key questions will assist the student in "Knowing the Problem", such as these'

What data is given?

What units of measurement are used?

Do you need to set up a graph?

Can you write an algebraic expression?

Can you compare the problem to a similar one?

Do you have enough data to solve the problem?

Are there any words or symbols to introduce?

An understanding of the word problem must be a prerequisite to the next step. We can easily aide the student by using language games and a series of strategically planned exercises to test, and if necessary, to further develop their understanding of the concepts in the word problem at hand. You can use such exercises as a word search, crosswords with numbers, and games using codes.

The first step in our method is the most essential. This step enables the person to follow through and solve the problem. Any mishaps at this point will probably result in the failure to reach the desired outcome.

## **II. Making a Plan (Focusing on the Solution)**

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At this point we should decide what the main questions are and organize a plan. If it is possible, one should approximate an answer. Hopefully, step one has already laid out the ground work in translating the words into a mathematical problem. By paying close attention to details, we are ready to arrive at an equation or another plan to find our true solution.

Students often formulate questions and thus set up different discovery exercises. Although there are always some standard means of solving particular problems, other plans may be much more interesting. Alternative methods may also lead to new discoveries. In any mathematics class it is very probable that more than one solution process will arise from any particular word problem.

Do not let your students think that once they have made a plan, they must stick with it. In order to obtain a true solution, that is accurate, the plan may be revised many times.

We suggest a stimulated discussion to encourage alternative plans to find a solution. Then the students are not "locked in" to one specific plan that they may not have been able to memorize. By stressing alternatives and exploration, they have a chance to continue from one unsuccessful approach to another until they finally do find some comfortable plan of their own'

It is such a joy to watch your students investigate until they find their own paths towards a solution. Heuristic teaching, the discovery method, will be most prevalent in Step Two of our S.M.S. method. Let us also emphasize that a good plan deserves some thought. We should teach the students how to draw a good plan so that the problem will indeed have relevance.

(Problem Three)'

Suppose the student is to find the area of the property diagrammed next to purchase fertilizer for the lawn'

(figure available in print form)

One student may total the areas of the house and the pool before subtracting them from the overall lot's area. Another one may subtract the house and the pool immediately, individually, from the overall lot. Alternative methods should also help to approximate an answer. When we approximate, we are tapping the intuitions which are sometimes totally neglected in mathematics.

### III. Carry Out The Plan (Solve The Problem)

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Arithmetic and algebraic computations should be carried out to solve the problem. In Problem One, the student has the equation'  $x + 2x = 42$ ,  $3x = 42$ ,  $x = 14$ .

This is the step where we want to emphasize the reviewing, or reteaching if necessary, of the basic skills of mathematics. It is all too often that teachers try to introduce new material to their students only to find that the necessary prerequisites are lacking. We suggest that time be spent on pre tests or worksheets to determine whether or not the students have the necessary skills. For example, in Problem Two it may be necessary to review percentage and decimal skills.

### IV. Testing Your Solution

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At this point we should review the questions that were formulated and asked in Step One. We should have answered all of the questions that made up the problem as well as the questions that we used in order to solve the problem. To truly test the answer, it is necessary to go through the entire process, using all previous steps, and to test that your solution works. It is also suggested that you teach your students how to word their answers. In the same way that they translated words into symbols in order to make a plan, they must translate their symbols back to words to answer the question correctly in the solution.

The student should compare the approximate answer with the actual solution to see if the solution is reasonable. One should check to see if one's solution makes sense. For example, in Problem One,  $x = 14$ . One should check by substitution of this value into the original equation'  $x + 2x = 42$ .  $14 + 28 = 42$ . The result makes sense.

Of course, there is more to solving word problems than having a systematic technique. We must also consider one's retention and sharpness of basic skills, reading habits, verbal skills, and motivation.

The basic skills include any prerequisites necessary to complete a particular unit of work. It is up to you to devise a plan to test whether or not your students have the appropriate skills.

Mathematics can be written in a language that is compact and precise. One cannot be expected to read a passage from a mathematics text like one would read a narrative novel. Concepts are often hidden or

assumed. Because of varying sentence structure, literal translation of the material might be confusing. In mathematics one cannot rely on the direct application of basic skills used in reading, such as the use of context clues or structural analysis, to decode and assume a meaning of some vocabulary words. For example, many students read “A number less than 5...” and will translate it as “Five less than a number”. Such words as “constant”, “variable”, “coefficient”, or “exponent” are often translated incorrectly as applied to mathematics. Words like “gross income” and “net income” are also often misinterpreted. Through context clues, one cannot define “gross” or “net”.

Reading habits play an important role in solving any word problem. The student is often not trained properly to read a page from a mathematics text. Important information must be “sifted out” and certain relationships must be noted in order to reach an understanding of the material. We suggest that you have your students read aloud at least once a week to determine any problems relating to reading ability. When one gains in the ability to read and comprehend from a mathematics text, it follows that one will find that mathematics comes easier.

Another problem in the reading is the use of many mathematical symbols that the reader should be familiar with. Many students get “hungup” on the use of symbols. It is up to you to emphasize their usage.

Reading a mathematical passage requires a higher level of conceptual development than most students have achieved. We suggest that a mathematics text be chosen so that the readability level is a grade or two below the actual grade level of the student. There are quite a few reasons for this. Most passages are conceptually packed and have a high content density factor. The reading may require eye movements other than the conventional left to right. The eyes may need to have vertical, regressive, circular, or wordto charttoword movements. We encourage some silent reading in your classroom so that you can watch the student’s eye movements to diagnose some poor reading techniques. If a problem is detected, you should work with the students individually. It is useful to check for these handicaps early in the year so that one would be conscious of any weaknesses.

The rate at which one reads mathematics is usually slower than most other content areas, and one might be required to do multiple readings. This is necessary to grasp the total idea, to note the sequence of order, to relate two or more significant ideas, to find the key question, to determine what operation or process is necessary, or to conceptualize or generalize the passage. The use of symbolic devices such as graphs, diagrams, charts, or other mathematical devices is highly prevalent in the language of mathematics. This language is technical and precise’ common words are used that carry a special meaning. An example of this would be the word “function”.

As was mentioned before, a major stumbling block to the success in solving word problems is one’s weakness in vocabulary. Mathematical vocabulary is not just defining a word, but knowing any symbolic translations that go along with the definition. Using symbols is also using vocabulary.

One of the major objectives in Consumer Related Mathematics is to teach a mathematics course that relates to business. The student should complete the course with a working knowledge of some basic business principles and terms. The mathematics that is taught should be relevant to the student in the event that one elects not to take any further mathematics courses. You might consider this course as a class in survival skills in mathematics. The problems that are taught should be relevant to the students. The subject material of the problems should relate to everyday arithmetic or mathematical skills.

Any business course has within its structure a set of vocabulary words. It is imperative that the student learn

these words. A good tactic would be to write problems that contain the business vocabulary within them. The student will remember the vocabulary as well as to translate these words into mathematical symbols. An example of this would be to write a problem relating to a checking account. The problem would have the phrase '...reconcile the bank statement'. Here the student should realize that one should check the bank's balance with one's own.

We do not recommend just giving your students an isolated list of words to define as an introduction. Vocabulary should be discussed after giving a reading assignment and when you give sample problems to the class. You can give quizzes or tests having the student define certain vocabulary words. An outline for a test should include all important vocabulary. These words should be repeated often and be incorporated into many problems. The student will learn them from constant usage.

As with the Consumer Mathematics Curriculum, the Algebra Curriculum states that the student not only understands any concept taught, but also acquire new skills. The student has many symbols and quite a few vocabulary words to work with. It works well, again, to make up problems which will include practical terms that your students will be using once they have completed their formal training in mathematics.

We have noticed through our own teaching that many secondary students may not have the mathematical insight necessary to solve seemingly simple word problems. We feel that a broader set of experiences involving the more difficult concepts may help with the vocabulary, a dominate weakness. The use of color in the diagrams you present, using the overhead projector to illustrate as many concepts as possible, and such activities as trips to local businesses, using a weekly subscription to a mathematics journal in the classroom, and using charts and illustrations will bring more reality to the concepts being used. (Problem Four)'

Tell your students that they are given \$ 1,500.00. Using the newspaper, have the students furnish a 12 feet by 16 feet living room. They must choose the furniture through ads, cut out the ads, and keep an accurate record of the money spent (including a 7 1/2% sales tax).

It should be noted that many students who may not possess the cognitive skills for solving problems in a structured manner do, in fact, possess a strong intuition for solving problems. We, as teachers, should not discourage this intuitive approach. We believe that there are two different types of thinkers' the structured and the intuitive. An intuitive thinker will constantly attack the problem in a seemingly haphazard fashion with the emphasis on redesigning the original problem. For example, given the equation'  $x + 8 = 14$ , the intuitive thinker asks, "What number plus 8 gives me 14?" The structured thinker may use the additive inverse of 8 and add to both sides of the equal sign.

As is true in any classroom situation, the student will learn more if motivated. For instance, a good motivational question for our classes would be to find the thickness of a piece of paper, and to ask for suggestions as to the different methods to solve the problem. One suggested method would be to measure 500 sheets of paper and then divide by 500. You can also talk about the possible error involved. With this type of question, the students may need some coaching or steering into the proper direction. It usually is to the benefit of the student if a method is discovered on his/her own.

Teachers have unlimited sources of motivational techniques. We will include some possibilities in our unit, but in no way are you limited.

Study guides and teaching guides are very helpful to the student. Here you outline the material and stress the vocabulary that is essential in that section or chapter. Before something is to be read by the students, you

should point out the important ideas, symbols, and vocabulary. This gives the student some purpose to read the material, and helps him/her make note of the points that should be stressed.

Pulling the vocabulary apart and looking at the prefix, suffix, and root is helpful in analyzing many words. For example, the suffix “nominal” means term. One’s knowledge of the prefixes “mono”, “bi”, “tri”, and “poly” will aide in the introduction of the words “monomial”, “binomial”, “trinomial”, and “polynomial”, in Algebra.

Giving assignments can be a drawback if not done properly. When giving assignments, it is a good practice to include a study guide, vocabulary aide, and/or background experiences necessary for any symbol interpretation so that the student has a goal to work toward. It is senseless to have someone do an assignment incorrectly. One would probably have to unlearn and relearn the material again’ this is much more difficult and very frustrating.

Skills and abilities do not grow in isolation from different content areas however different subjects do develop their own language and symbols. If a person trains oneself in the symbols of mathematics, it usually makes it easier to see the logic involved in the representations used in different areas.

The broader an education one attains, the more effectively one can integrate the skills needed to relate to one’s environment. We believe that our classes should be interdisciplinary and stress certain social requirements. It is true that our students will need skills, knowledge, and sensitivity to come to feel comfortable in their world. We suggest that you visit other classrooms in other subject areas. This way you will not only see different teaching techniques, but get a good idea of what particular topics your students are discussing. You should integrate material obtained in the other disciplines into your own word problems.

Most children are taught to solve word problems from memory. The problems are written in such a way that they are nearly identical to the other problems that one has seen. There is very little thinking or comprehension in this method. There is nothing wrong with either you or the student rewording a problem into a form in which one is familiar. In fact we encourage it.

We find, especially in the lower levels, that the ability to analyze is not yet developed. Much time should be spent on this, and the students should practice with many problems of the same type. It is our suggestion that the wording in the problems be changed. This is something you do not find in many mathematics texts.

Using quotations either orally or posted around the classroom are always useful in getting your students to be creative, and to realize that mathematics is indeed integrated among all aspects of daily living. A good reference will be found in the *Mathematics Teacher*, January 1976, pages 4044. These are a collection of quotations compiled by Barbara Curcic of Bloom Township High School in Chicago Heights, Illinois.

Here is a list of some other motivational techniques we have been using in our classrooms’ discuss the historical mathematical events about the ideas you are introducing, have the students write their own word problems and use creativity in their illustrations, have the students find word problems in their private reading, write problems that are individualized to the students (use their names and special things about them)’ have the students solve puzzles which contain words relating to mathematics, and help them to use calculators correctly in computing the basic computations.

Some motivational techniques that we suggest are trips to various businesses, teamteaching, or the use of the computer.

## Examples Mapped Through the S.M.S. Method

Let us look at this example in a Consumer Mathematics Course and use the S.M.S. Method to solve it: (Problem Five)

Amy wants to buy a new winter coat. She found the one that she wants to buy in O'Maller's Store. The original price was \$ 89.95. She decided that she could not afford it. The following week the same store was having a 30% off sale. How much money will she save on the coat from the original selling price and what would be the sales price? If there is a 7 1/2% sales tax, what would be the total bill?

Before we look at the S.M.S. Method, please observe the way the above problem is written. Most mathematics texts shorten the problem and make the wording more concise. Few people will think of a problem in that shortened concise manner. To the students, the above problem is more realistic because it tells a story of events. Also notice that the problem asks several questions. Here the teacher will find which student will read the problem and answer all of the questions. Too many students fail to answer all of the questions.

As a prerequisite, the student must have solved several problems dealing with every question asked in the problem above. This might be a typical questioning technique used on a worksheet'

I. Know your problem:

A. Read the problem carefully.

B. What is the unknown(s)? answers:

1. How much will she save from the original selling price?
2. What is the sales price?
3. How much is the sales tax?
4. What is the total price including the sales tax?

C. Are there any key words and what do they mean? answers:

1. Original price
2. 30% off sale
3. Save
4. Sales price
5. 7-1/2% sales tax
6. Total bill

D. Can you compare your problem to other problems similar to it? answer: Yes, there are three questions; there are 3 separate problems.

E. What data is given: answer:

1. The coat costs \$ 89.95.
2. It is on sale at 30% off.
3. The sales tax is 7 1/2%

F. Which form will the solution(s) be in? answer: Each solution will be in dollars and cents.

G. Can you draw a diagram or graph? answer'

(figure available in print form)

II. Make a Plan'

A. Write any equations or expressions answer:

- |          |                        |
|----------|------------------------|
| \$ 89~95 | Original price         |
| X 30%    | What you save from the |



original selling price

what you save sales price

sales price sales price

x 7-1/2% + sales tax

sales tax total bill

B. Approximate a solution answer:

You will save a little less than \$ 30.00. The sales price will be a little more than \$ 60.00. The sales tax will be about \$ 4.20. The total bill will be about \$ 64.00.

III. Carry Out Your Plan answer:

(figure available in print form)

IV. Test Your Solution'

A. Did you answer all of the questions? answer' yes

B. Check your work; go through all of the steps.

C. Did you write your solutions so that anyone will know what solution goes with what question, and did you write the solution(s) in the proper form? answer:

Yes.

Some other possible problems that deal with everyday situations and can be used with the S.M.S. Method are listed below'

*Problem 6:*

You will be having a Disco Party next Friday evening. You have invited 52 other people, including the chaperone. All of the recipes that you plan to follow are written to serve eight people. By how much do you need to increase each ingredient in the recipe to feed everyone, including yourself? Do not hesitate to have "leftovers" because your Aunt just bought you "SealAMeal". What is the minimum amount that you should cook?

In problem (6) you are being creative in the introduction of the problem which adds to the motivation; your students will want to read the word problem story. Once again, you have not only asked more than one question, but in the answer you have left many possibilities for your students to work out. The use of proportion is illustrated, and when you include yourself you will have 53 people, not just 52.

*Problem 7:*

You live approximately one mile from the school. If you walk three miles per hour and you must be in homeroom at 8:30 a.m., what is the latest time that you can leave your house?

You are reinforcing the skills of fractions and units of measurement in hours and minutes. They will feel more comfortable with this problem because it is very real to them. It is also possible that the solution to this problem will be a constant reminder to them to be on time to homeroom in the morning.

*Problem 8:*

You have received the following grades during the second marking period at R. D. Tee High School' 85 in mathematics, 95 in Spanish, 70 in history, 75 in gym, 80 in science, and 80 in art. In order to make the school "honor roll" your average must be at least 85, and you can not receive a grade lower than 70 in any course you take. Did you make the "honor roll"?

The skills necessary in the concept of averaging are included in problem (8). Once again we need to emphasize that the above problem includes the basic skills of addition and division with the introduction of the concept of averaging.

*Problem 9:*

Your mother has agreed to pay you \$ 2.00 an hour for you to baby sit with your little sister, Tachema, during the weekends this summer while your parents go away on their boat. You have offered your brother 10% of your weekend salary if he and his wife will watch Tachema on Saturday night from 9 p.m. until Sunday morning at about 3:00 a.m. for you to go out. Your parents usually leave at about 7:00 p.m. on Friday evenings and return at about 10:00 p.m. on Sundays. How much money will you receive for an entire weekend? How much will you have to give your brother and sisterinlaw? How much will you have left as your earnings?

By using lengthy and complex stories, you are reinforcing good reading habits, giving an appropriate practice with basic skills, and introducing new concepts.

*Problem 10:*

You have borrowed a book from the New Haven Public Library which is now overdue. They charge five cents a day for each day the book is overdue during the first month, and then they charge eight cents a day after the first month. If your book was due on April 11, and it is now May 29th, how much money will you have to pay when you return the book today?

In an Algebra Book you will usually find the problems which involve a mixture of prices and ask for a total cost of a combination. The above problem introduces the same concept differently.

## Lesson Plans

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The S.M.S. Method should be taught early in the year and the teacher should refer to it throughout the year in and out of the classroom, with the various types of word problems that develop. The introduction of the S.M.S. Method will take at least four days if you spend one day on each step, depending on the ability levels within your classes. An actual unit on working with the S.M.S. Method and improving problem solving skills should be at least two weeks.

Our sample lesson plans, discussed separately, will develop a sample twoweek unit for both the Consumer Related Mathematics Curriculum and the Basic Algebra Curriculum. Please note that there may be repetition between the two developments, as we do want to introduce much of the Method similarly. We encourage that these plans be as diversified as possible, leaving judgment on presentation up to the individual teacher.

### Consumer Related Mathematics

#### *Lesson 1.*

Write a few simple word problems on the board and have the students solve them. Have an extensive discussion after each one about the steps that the class used to solve each problem. Ask for a series of similar steps. This is an introduction of the S.M.S. Method.

#### *Lesson 2.*

Continue the discussion on how a word problem is solved and list the S.M.S. Method for the class. It would be best if the class could “discover” the method on their own.

#### *Lesson 3.*

Do a few problems mapped through the S.M.S. Method. Hand out a worksheet asking questions that could relate to any problem. Be sure to state that not all of the questions need to be answered. For homework, have the students solve three or four problems using the worksheet, listing the steps. See Appendix A for a sample worksheet.

#### *Lesson 4.*

Have the students solve the problems on the board. Discuss any variations to find the solutions to the problems. See if anyone can come up with a few other methods to solve the problems. Make sure to go through all four steps of the S.M.S. Method.

### Lesson 5.

Have the students write several word problems with the assumption that they will be distributed to the class to be solved by everyone. The teacher should not make any corrections or include the names of the students. Have the class criticize the use of grammar, structure, and vocabulary.

### Lesson 6.

Give the students a map of the school or any other area. Have the students organize a set of directions to get from one place to another. You might ask for directions from one spot to another and then an alternative route.

Sample Lesson Plans for both Consumer Related Mathematics and Algebra should continue for about a two week period. You can use the Science Research Associates Inc. kit for a day of individualized exploration. You may spend one day going over some of the basic 'skills that seem weak among your students, as evidenced in a diagnostic test.

A typical problem that may take a full lesson would be the following:

A new school needs school colors. The colors have to be chosen from a given list:

light:   dark:  
yellow blue  
silver red  
orange black  
white green  
          purple

Students will have to vote by picking one light and one dark color from the list. How many different color combinations could be made with one color from each list? A diagram will help. The use of Venn diagrams may be introduced.

Many different types of problems can be solved with the S.M.S. Method. The following is a partial list of some concepts that you could include in problem solving units:

1. Proportions to compute the rate of heartbeats in humans and animals.
2. To interpret scale drawings.
3. To figure atmospheric pressure at different depths below sea level.
4. Reading maps.
5. Comparing consumer prices at different stores.
6. Using formulas and writing formulas.
7. Completing tables.
8. Estimating and rounding off.
9. Measuring in English and Metric Units.
10. Laboratory activities.
11. Career questions; hairstylist, musician, medical researchers, insurance agents, architecture.
12. Mechanical comprehension.

13. Interest problems including compounded interest.
14. Writing checks and keeping an account.
15. Discount and commissions.
16. Installment payments including interest.
17. Making a budget
18. Taxes.

## Basic Algebra

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### *Lesson 1.*

The first day is your introduction of the S.M.S. Method to your students. Using a large piece of oak tag, carefully label the four steps. The more colorful and expressive the poster is, the easier it will be for all your students to see it and feel eager to use it as a guide. In Algebra it is very advisable to have each student record the steps in his or her own notebook as follows:

Step One: Knowing Your Problem

Step Two: Making a Plan

Step Three: Carving Out Your Plan

Step Four: Testing Your Solution

On the first day, the introduction, it is a very good practice to draw more questions from your students and to include their ideas in step one. Let them feel that they are active in developing the plan. As a summary, choose a simple algebraic word problem and run through the use of the Method with them. For homework you can assign a simple word problem and tell them to list the steps in their solving of the problem.

### *Lesson 2.*

On the second day you should begin with a summary or a review of the S.M.S. steps that were given on the first day. It is a good practice to check their notebooks to see the homework problem and to make sure they have copied the steps correctly.

Using an overhead projector or the blackboard, display the homework problem for a class discussion of procedures and different possible plans.

Assign about 10 similar problems for homework and tell them to begin in class. Walk around and help them get started.

### *Lesson 3.*

Find a page in their mathematics text book that will introduce some new concepts in Algebra and also contain some word problems. Have them read aloud today and have various discussions on ideas and vocabulary mentioned in these sections.

Hand out a study guide for a test that will be given on day 5, Lesson 5. Let them fill in the study guide for homework.

### *Lesson 4.*

Have prepared about 10 or 15 word problems that you have creatively made up; include the words and concepts that have been already introduced in the readings and discussions. Let your students begin using the S.M.S. Method to solve all of these problems, and when most of them are through, begin a class discussion of these problems. This is a review for a test tomorrow. Let them study for the test as homework.

### *Lesson 5.*

Prepare a well written test of the week's work. Allow the entire period to work on them.

## **Appendix A**

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### Sample Worksheet For Solving Word Problems

Read your problem and answer the following questions. Not all questions have to be answered, as all may not apply:

#### A. Know Your Problem

##### 1. What information is given?

2. What is the unknown(s)?
  3. What are the key words?
  4. Can you define the key words?
  5. Do you need to set up a graph?
  6. Can you rewrite and compare this to a similar problem?
- B. Make a Plan
1. Can you write an equation?
  2. Can you draw a diagram?
  3. Do you need to set up a proof?
  4. How can the given information be linked?
  5. Does the vocabulary imply a possible formula?
  6. Estimate a solution.
  7. What is your plan?
- C. Carry Out Your Plan
1. Solve the problem.
- D. Test Your Solution
1. Does your solution make sense?
  2. Does your estimated solution come close to your actual solution?
  3. Did you answer all the questions asked?
  4. Check all of your computations.
  5. Did you write your solutions in the proper form.

## Bibliography for Students' Use

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1. Wiltsie, David H. *An Introduction to Everyday Skills, A Textworkbook in Consumer Education* . Motivation Development, Inc. California, 1977.

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2. Wiltsie, David H. *Skills for Everyday Living* , Books 1, 2. Motivation Development, Inc. California, 1976.

A complete textworkbook in Consumer Education that is individualized and selfpacing. It includes reading bus schedules, mail rate charts, and zipcode charts.

3. Chant, A., Eufing, B., and Montalto, B. *Reading Math Competence* . Cambridge Book Company. New York

This publication provides problems on comparisons.

4. PAL Practical Living Series. *Math That Pays Off* . Xerox Education Publications. Ohio, 1979.

Included within this series are problems to help figure out pay, figure out your deductions, help with shopping, going to the bank, and planning a budget.

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1. Brown, Olene; Charles, Michael; Clifford, Miriam Lien; and Price, Jack. *Mathematics for Everyday Life*. Charles E. Merrill Publishing Company. Columbus, Ohio, 1978.

This textbook has been designed for use in a Consumer Related Course. It introduces many useful skills necessary in daily living.

Allen, Charles E. and Oldaker, Linda M. *Mathematics, Problem Solving Activities* . Houghton Mifflin Company. Boston, Massachusetts, 1978.

This booklet contains activities designed to enrich the experiences involved in problem solving.

3. Kilmer, Warren and Moyer, Sara C. *You + Math = Fun*. The Random House Mathematics Program. New York, 1973.

This is a booklet prepared by children introducing creative word problems with illustrations. It can be used as an example for suggesting that your students make their own problems.

4. Brown, Richard G., Dolciani, Mary P., and Smith, Geraldine D. *Basic Algebra* . Houghton Mifflin Company. Boston, Massachusetts, 1977.

A text for a Basic Algebra Course.

5. Skeen, Kenneth C. and Whitmore, Edward H. *Modern Mathematics Book 1, 2 Number Systems—Structure* . The L. W. Singer Company. U.S.A. 1966.

Book 1 is an excellent transition from Arithmetic to Algebra. Book 2 is a continuation of a Basic Algebra Course along with some



introduction to Basic Geometry and Basic Trigonometry.

7. Judd, Wallace P. *Problem Solving Kit, For Use With a Calculator* . Science Research Associates, Inc. U.S.A., 1977.

This SRA kit helps students to get started in problem solving and develops the skill of using a calculator. This kit is especially designed for heuristic teaching.

8. Cutler, Charles L. and Morrill, George. *The Money Book, Saving and Spending*. An American Reader Book. Xerox Educational Publication Unit Book. 1978. Fortyseven pages on budgets, credits, taxes, etc.

## Bibliography for Teacher's Use

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1. Polya, G. *How to Solve it, a New Aspect of Mathematical Method*. New Jersey: Princeton University Press, 1973.

Polya has provided us with a 253 page edition of his method for using problem solving in the classroom. We suggest that any teacher who is about to use our steps for problem solving should read this book first.

2. Bye, M. F. *Reading in Mathematics and Cognitive Development*. Eric Ed. 124926, 1975.

This is a thesis with eight other sources listed. It deals with a psychologist's point of view.

3. Riley, James D. and Pactman, Andrew B. *Reading In Mathematical Word Problems' Telling Them What To Do Is Not Telling Them How To Do It*. Journal of Reading. Volume 21, March 1978.

In this article the authors discuss the fact that students must be active participants.

4. Lees, Fred. *Mathematics and Reading* . Journal of Reading. Volume 19, May 1976.

Lees discusses the problems with eye movements.

5. Troutman, Andria Price and Lichtenberg, Betty rlunkett. *Problem Solving in the General Mathematics Classroom* . Mathematics Teacher, November 1974.

This reference is similar to Polya's in that it lists steps to solve word problems.

6. Ewing, David W. *Discovering Your Problem Solving Style*. Psychology Today, December 1977.

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8. Curcic, Barbara. *Mathematical Quotations For All Occasions* . The Mathematics Teacher, January 1976.

Curcic discusses the values of quotations in the classroom and lists some excellent quotes from some poets including' Lewis Carroll, Carl Sandburg, Kasner and Newman, Cassius Jackson Keyser, and Leonardo Da Vinci.

9. Mathematics Curriculum For the 1980's Committee, Task Force on Recommendations, and Priorities in School Mathematics Project (Prism) Members. *An Agenda For Action, Recommendations for School Mathematics of the 1980's* . National Council of Teachers of Mathematics, Inc. Virginia 1980.

10. Dunn, Kenneth and Dunn, Rita. *Practical Approaches to Individualize Instruction Contracts and Other Effective Teaching Strategies* . Parker Publishing Company. New York, 1972.

This helps teachers get started with individualizing and developing contract activity packages.

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