

PREALGEBRA

4TH EDITION

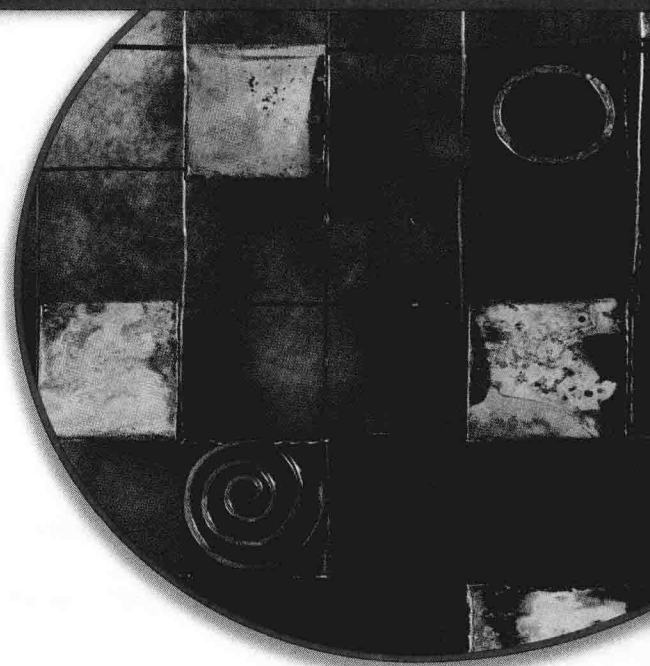


CHARLES P. MCKEAGUE

Prealgebra

Fourth Edition

Charles P. McKeague
CUESTA COLLEGE



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Preface to the Instructor

Prealgebra was originally written to bridge the gap between arithmetic and introductory algebra. The basic concepts of algebra are introduced early in the book and then applied to new topics as they are encountered.

General Overview of the Text

The commutative, associative, and distributive properties are covered in Chapter 1, along with the arithmetic of whole numbers. Chapter 2 gives a thorough coverage of negative numbers, along with an introduction to exponents and polynomials. Fractions (both positive and negative), mixed numbers, and simple algebraic fractions are covered in Chapter 3. Linear equations in one variable are covered in Chapter 4, along with graphing in two dimensions. All the material on positive and negative numbers and linear equations is carried into Chapter 5 on decimals. Chapters 6 and 7 cover ratio and proportion, measurement, and percent.

Features of the Text

Flexibility In a lecture-format class, each section of the book can be discussed in a 45- or 50-minute class session. A technique that I have used successfully in lecture classes is to have the students work some of the Practice Problems in the margins of the textbook after I have done an example on the board or overhead projector.

In a self-paced class, the Practice Problems in the margins allow the student to become actively involved with the material before starting the Problem Set that follows that section.

Emphasis on Visualization of Topics This edition contains many more diagrams, charts, and graphs than the previous edition. The purpose of this is to give students additional information, in visual form, to help them understand the topics covered.

Practice Problems The Practice Problems, with their answers and solutions, are the key to moving students through the material in this book. Our method of getting students through the material is unique and successful. We call it the EPAS system for Example, Practice Problem, Answer, Solution. Here is how it works: In the margin, next to each example, is a Practice Problem. Students begin by reading through the text, stopping after they have read through an example. Then they work the Practice Problem in the margin next to the example. When they are finished, they check the answer to the Practice Problem at the bottom of the

page. If they have made a mistake, they try the problem again. If they still cannot get it right, they look at the solution to the Practice Problem in the back of the book. After working their way through the section in this manner, they are ready to start on the problems in the Problem Set. As an added bonus, there is a video lesson to accompany each section of the text. Each video lesson is 10 to 20 minutes in length. On the video I work some of the odd-numbered problems in the Problem Set.

Descriptive Statistics Beginning in Chapter 1 and then continuing through the rest of the book, students are introduced to descriptive statistics. In Chapter 1 we cover tables and bar charts, as well as mean, median, and mode. These topics are carried through the rest of the book. Along the way we add to the list of descriptive statistics by including scatter diagrams and line graphs. In Chapter 4, we move on to graph ordered pairs and linear equations on a rectangular coordinate system.

Using Technology Scattered throughout the book is new material that shows how scientific calculators, graphing calculators, spreadsheet programs, and the Internet can be used to enhance the topics being covered. This material is easy to find because it appears in the box *Using Technology*.

Facts from Geometry The material on perimeter, area, and volume is introduced in Chapter 1, and then integrated throughout the rest of the book. Each new idea from geometry is introduced with the heading *Facts from Geometry*. In most cases, an example or two accompanies each of the facts to give students a chance to see how topics from geometry are related to the algebra they are learning.

Chapter Openings Each chapter opens with an introduction in which a real-world application, many of which are new to this edition, is used to stimulate interest in the chapter. These opening applications are expanded on later in the chapter. Most of them are explained using the rule of four: in words, numerically, graphically, and algebraically.

Section Openings Many sections begin with a real-world application that leads into the topic developed in the section. This way, we let the application motivate the mathematics, rather than having the mathematics motivate the application.

Blueprint for Problem Solving The Blueprint for Problem Solving is a detailed outline of the steps needed to successfully attempt application problems involving equations. See Section 4.5 for more details.

Study Skills The first five chapter introductions contain a list of study skills to help students organize their time efficiently. More detailed than the general study skills listed in the Preface to the Student, these study skills point students in the direction of success. They are intended to benefit students not only in this course but also throughout their college careers.

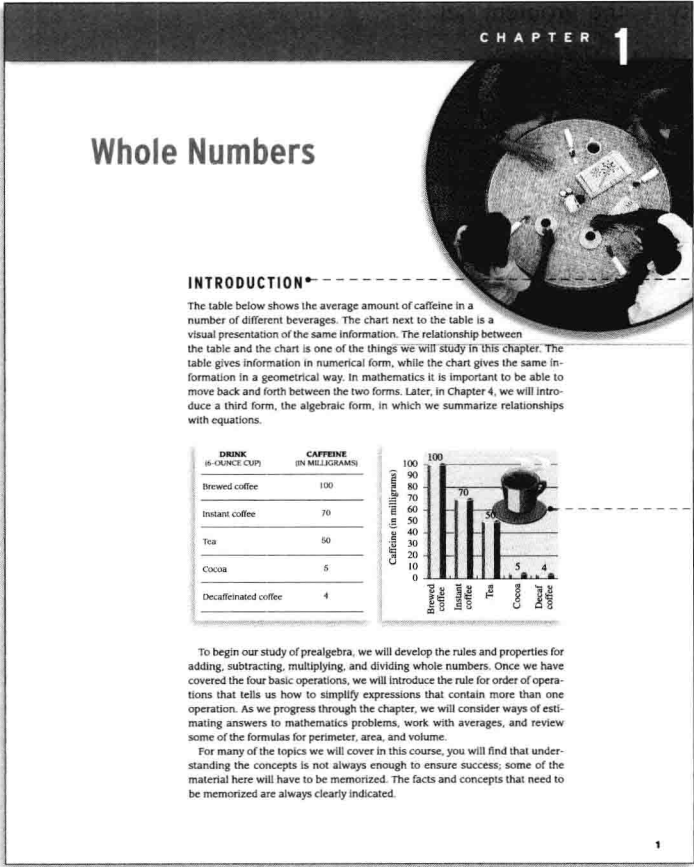
Problem Set Organization Following each section is a Problem Set. For this edition, Problem Sets have been expanded to include more work on estimation and reading and using graphs. Problem Sets contain the following items:

1. *Drill*: There are enough drill problems in each Problem Set to ensure that students working the odd-numbered problems become proficient with the material.

2. *Progressive Difficulty*: The problems increase in difficulty as the Problem Set progresses.
3. *Odd-Even Similarities*: Whenever possible, each even-numbered problem is similar to the odd-numbered problem that precedes it. The answers to the odd-numbered problems are listed in the back of the book.
4. *Applying the Concepts*: Application problems are emphasized throughout the book. The placement of the word problems is such that the student must do more than just read the section title to decide how to set up and solve a word problem. For example, Problem Set 1.7 covers multiplication with whole numbers. The solutions to some of the application problems in the Problem Set require multiplication, but others require addition and subtraction as well.
5. *Calculator Problems*: Most of the Problem Sets contain a set of problems to be worked on a calculator.
6. *Review Problems*: Beginning in Chapter 2, each Problem Set contains a few review problems. Whenever possible, these problems review concepts from preceding sections that are needed for the development of the following section.
7. *Extending the Concepts*: These problems, most of which can be categorized as critical thinking problems, extend the concepts covered in the section.
8. *Answers*: The answers to all odd-numbered problems in the Problem Sets and Chapter Reviews, and the answers to all problems in the Chapter Tests, are given in the back of the book.

End-of-Chapter Retrospective Each chapter ends with the following items that together give a comprehensive reexamination of the chapter and some of the important problems from previous chapters:

1. *Chapter Summary*: These list all main points from the chapter. In the margin, next to each topic being reviewed, is an example that illustrates the type of problem associated with the topic being reviewed.
2. *Chapter Review*: An extensive set of problems that review all the main topics in the chapter. The chapter reviews contain more problems than the chapter tests.
3. *Chapter Test*: A set of problems representative of all the main points of the chapter.
4. *Cumulative Review*: Starting in Chapter 2, each chapter ends with a set of problems that reviews material from all preceding chapters. The cumulative review keeps students current with past topics and helps them retain the information they study.



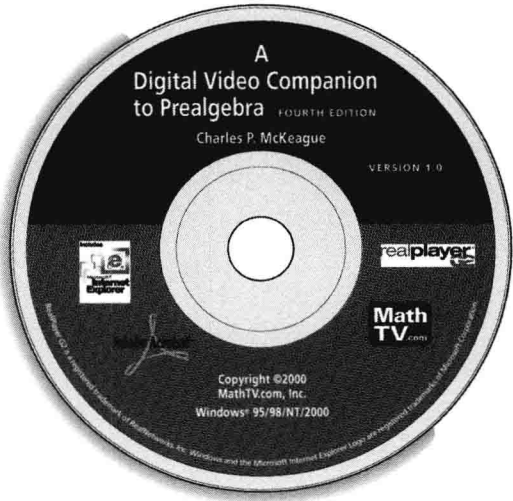
A Sample of the Features of *Prealgebra*

Chapter Introduction

A real-world application now opens each chapter, and is often expanded and reiterated in the book.

Emphasis on Visualization of Topics

Clear, informative diagrams, charts, and graphs enliven the new edition and help students visualize the topics they are studying.



New! A *Digital Video Companion to Prealgebra (DVC)* Packaged with each book is a single CD-ROM containing over eight hours of video instruction. The foundation of the DVC is video instruction presented by author Charles P. McKeague. There is one video lesson for each section of the book. Each video lesson is eight to twelve minutes long. The problems worked during each video lesson are listed next to the viewing screen, so that students can work them ahead of time, if they choose. In addition, each section of the DVC contains a study guide to help students work their way through the book and prepare for the video lesson. In order to help students evaluate their progress, each chapter of the DVC contains a chapter test, with answers.

More Application Problems

Each section of the text contains a number of application problems under the heading *Applying the Concepts*. There are many new application problems in this edition. Each application problem has a title for easy classification.

Increased Use of Charts and Graphs

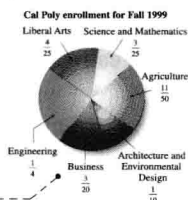
This edition contains many pie charts, bar charts, and line graphs to give a visual component to the topics being studied.

Increased Use of Tables

Tables are used throughout the text, beginning in Chapter 1. Students learn to use tables to help organize data and to assist them in recognizing patterns that occur regularly in their study of mathematics.

Applying the Concepts

The pie chart below was introduced at the beginning of Section 3.1. Use the information in the pie chart to answer questions 71 and 72.



71. **Reading a Pie Chart** If there are approximately 15,800 students attending Cal Poly, approximately how many of them are studying agriculture?

72. **Reading a Pie Chart** If there are exactly 15,828 students attending Cal Poly, exactly how many of them are studying engineering?

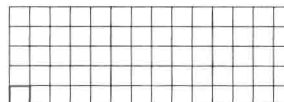
73. **Cooking** A recipe calls for $\frac{1}{2}$ cup of flour. If you were going to make only $\frac{1}{3}$ the recipe, how much flour would you use?

74. **Cooking** A recipe calls for $\frac{1}{2}$ cup of sugar. If the recipe is to be doubled, how much sugar should be used?

75. Perimeter and Area

SQUARE INCHES

a. The lengths of the sides of each of the squares in the grid below are all $\frac{1}{4}$ inch, as is each side of the dark square in the corner. Draw three more squares on the grid. Each side in the first one will be $\frac{1}{4}$ inch, each side of the second square will be $\frac{1}{2}$ inch, and each side of the third square will be 1 inch.



b. Use the squares you have drawn above to complete the following tables. (You need not add fractions to find the perimeters; just multiply the length of each side by 4.)

Table 1

PERIMETERS OF SQUARES	
LENGTH OF EACH SIDE (IN INCHES)	PERIMETER (IN INCHES)
$\frac{1}{4}$	
$\frac{2}{4} = \frac{1}{2}$	
$\frac{3}{4}$	
$\frac{4}{4} = 1$	

Table 2

AREAS OF SQUARES	
LENGTH OF EACH SIDE (IN INCHES)	AREA (IN)
$\frac{1}{4}$	
$\frac{1}{2}$	
$\frac{3}{4}$	
1	

15. Simplify: $6 \cdot 3^2 + 64 \cdot 2^3 - 2$

EXAMPLE 15 Simplify: $9 \cdot 2^3 + 36 \cdot 3^2 - 8$

SOLUTION $9 \cdot 2^3 + 36 \cdot 3^2 - 8 = 9 \cdot 8 + 36 \cdot 9 - 8$
 $= 72 + 4 - 8$
 $= 76 - 8$
 $= 68$

Exponents first
Then multiply and divide,
left to right
Add and subtract,
left to right

USING TECHNOLOGY

Calculators

Here is how we use a calculator to work the problem shown in Example 14:

Scientific Calculator: $5 \div 2 \div 3 \div 7 \div 1 \div 1 \div 1$

Graphing Calculator: $5 \div 2 \div 3 \div 7 \div 1 \div 1 \div 1$

Example 15 on a calculator looks like this:

Scientific Calculator: $9 \div 2 \div 3 \div 36 \div 3 \div 2 \div 8 \div 1$

Graphing Calculator: $9 \div 2 \div 3 \div 36 \div 3 \div 2 \div 8 \div 1$

16. Simplify:
 $5 + 3(24 - 56 - 2)$

EXAMPLE 16 Simplify: $3 + 2(10 - 3(5 - 2))$

SOLUTION The brackets, [], are used in the same way as parentheses. In a case like this we move to the innermost grouping symbols first and begin simplifying:

$3 + 2(10 - 3(5 - 2)) = 3 + 2(10 - 3(3))$
 $= 3 + 2(10 - 9)$
 $= 3 + 2(1)$
 $= 3 + 2$
 $= 5$

Examples 13–16 all involve expressions that contain more than one operation. We want to be able to translate phrases written in English that involve more than one operation into symbols. Table 1 lists some English expressions and their corresponding mathematical expressions written in symbols.

Table 1

IN ENGLISH	MATHEMATICAL EQUIVALENT
5 times the sum of 3 and 8	$5(3 + 8)$
Twice the difference of 4 and 3	$2(4 - 3)$
6 added to 7 times the sum of 5 and 6	$6 + 7(5 + 6)$
The sum of 4 times 5 and 8 times 9	$4 \cdot 5 + 8 \cdot 9$
3 subtracted from the quotient of 10 and 2	$10 \div 2 - 3$

Descriptive Statistics: Mean, Median, and Mode

Next we turn our attention to averages. If we go online to the Merriam-Webster dictionary at www.m-w.com, we find the following definition for the word average when it is used as a noun:

Answers
15. 56 16. 17

Practice Problems

A hallmark of the McKeague texts, Practice Problems in the margin are the key to moving students through the material. Answers are at the bottom of the page. Solutions are at the back of the book

Using Technology

This boxed material is spread throughout the text. It shows how calculators, both scientific and graphing, can be applied to the topics being studied. Spreadsheet programs and the Internet are also considered in *Using Technology* boxes.

Descriptive Statistics

Also spread throughout the text, this material is set off from the surrounding material. Among the topics covered under this heading are bar charts, line graphs, mean, median, and mode.

Supplements to the Text

For the Instructor

Annotated Instructor's Edition This is a specially bound version of the complete student text with exercise answers printed adjacent to each exercise and teaching notes written for the instructor by the author.

Test Bank The test bank includes three tests per chapter as well as three final exams. The tests are made up of a combination of multiple-choice, free-response, true/false, and fill-in-the-blank questions.

BCA Testing With a balance of efficiency and high performance, simplicity and versatility, *Brooks/Cole Assessment* gives you the power to transform the learning and teaching experience. This revolutionary, Internet-ready testing suite is text-specific and allows instructors to customize exams and track student progress in an accessible, browser-based format. BCA offers full algorithmic generation of problems and free-response mathematics. No longer are you limited to multiple-choice or true/false test questions. The complete integration of the testing and course management components simplifies your routine tasks. Test results flow automatically to your gradebook and you can easily communicate to individuals, sections, or entire courses.

Videotapes Created and hosted by the author, this set of videotapes is available free upon adoption of the text. Each tape offers one chapter of the text and is broken down into 10- to 20-minute problem-solving lessons that cover each section of the chapter.

For the Student

Student Solutions Manual The student solutions manual provides worked-out solutions to the odd-numbered problems.

BCA Tutorial This text-specific, interactive tutorial software is delivered via the Web (at <http://bca.brookscole.com>) and is offered in both student and instructor versions. Like *BCA Testing*, it is browser-based, making it an intuitive mathematical guide even for students with little technological proficiency. So sophisticated it's simple, *BCA Tutorial* allows students to work with real math notation in real time, providing instant analysis and feedback. The tracking program built into the instructor version of the software enables instructors to carefully monitor student progress.

A Digital Video Companion (DVC) This single CD-ROM containing over eight hours of video instruction is packaged with each book. The foundation of the DVC is the video lessons. There is one video lesson for each section of the book. Each video lesson is eight to twelve minutes long. The problems worked during each video lesson are listed next to the viewing screen, so that students can work them ahead of time, if they choose.

Video Notebook This workbook contains all of the problems that are worked out on the videotapes in a format that allows the student to work along with the video.

Acknowledgments

What a wonderful team of people we had working on this book! To begin, Bob Pirtle, my editor at Brooks/Cole, was very helpful and encouraging in all parts of the revision process. Mary Vezilich and Margaret Pinette handled the production part of this revision, and I am delighted to have been able to work with such efficient, professional, pleasant people. Because of them, the production process on this book has been one of the best experiences I have had in publishing. Assisting Mary and Margaret was the team at Brooks/Cole: Vernon Boes, Art Director; Roy Neuhaus, Senior Design Editor; Jennifer Mackres, Photo Permissions Editor; Lisa Torri, Art Editor; and Rachael Bruckman, Assistant Editor. They all worked together to integrate the different parts of this project, and I think you will agree that they did an outstanding job. Dudley Brooks, and my son, Patrick, suggested many new applications and exercises for the problem sets. Their suggestions have strengthened this revision. Mark Turner and John Banks did an excellent job of accuracy checking and proofreading. Mark's input and suggestions for the Digital Video Companion that accompanies the text were also very helpful. Finally, Sue Ewing worked very hard to get the many permissions and sources straightened out for the new real-data problems. My thanks to all these people; this book would not have been possible without them.

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Shirley Daniels, *Cuesta College*

Mary Ellen Gallegos, *Santa Fe Community College*

—Pat McKeague

Preface to the Student

Many of the people who enroll in my introductory math classes are apprehensive at first. They think that since they have had a difficult time with mathematics in the past, they are in for a difficult time again. Some of them feel that they have never really understood mathematics and probably never will.

Do you feel like that?

Most people who have a difficult time with mathematics expect something from it that is not there. They believe that since mathematics is a logical subject, they should be able to understand it without any trouble. Mathematics is probably the most logical subject there is, but that doesn't mean it is always easy to understand. Some topics in mathematics must be read and thought about many times before they become understandable.

If you are interested in having a positive experience in this course and have had difficulty with mathematics in the past, then the following list will be of interest to you. The list explains the things you can do to make sure that you are successful in mathematics.

How to Be Successful in Mathematics

- 1. If you are in a lecture class, be sure to attend all class sessions on time.** You cannot know exactly what goes on in class unless you are there. Missing class and then expecting to find out what went on from someone else is not the same as being there yourself.
- 2. Read the book and work the Practice Problems.** It is best to read the section that will be covered in class beforehand. Reading in advance, even if you do not understand everything you read, is still better than going to class with no idea of what will be discussed. As you read through each section, be sure to work the Practice Problems in the margin of the text. Each Practice Problem is similar to the example with the same number. Look over the example and then try the corresponding Practice Problem. The answers to most of the Practice Problems are given on the same page as the problems. If you don't get the correct answer, see if you can rework the problem correctly. If you miss it a second time, check your solution with the solution to the Practice Problem in the back of the book.
- 3. Work problems every day and check your answers.** This is especially important if you are studying in a self-paced environment. The key to success in mathematics is working problems. The more problems you work, the better you will become at working them. The answers to the odd-numbered problems are given in the back of the book. When you have finished an assignment, be sure to compare your answers with those in the book. If you have made a mistake, find out what it is, and correct it.

4. **Do it on your own.** Don't be misled into thinking someone else's work is your own. Watching someone else work through a problem is not the same as working the same problem yourself. It is okay to get help when you are stuck; as a matter of fact, it is a good idea. Just be sure that you do the *work* yourself.
5. **Don't expect to understand every new topic the first time you see it.** Sometimes you will understand everything you are doing, and sometimes you won't. That's just the way things are in mathematics. Expecting to understand each topic the first time you see it will only lead to disappointment and frustration. The process of understanding mathematics takes time. It requires that you read the book, work the problems, and get your questions answered.
6. **Review every day.** After you have finished the assigned problems on a certain day, take at least another 15 minutes to go back and review a section you did previously. You can review by working the Practice Problems in the margin or by doing some of the problems in the Problem Set. The more you review, the longer you will retain the material. Also, there are times when material that at first seemed unclear will become understandable when you review it.
7. **Spend as much time as it takes for you to master the material.** There is no set formula for the exact amount of time you will need to spend on the material in this course in order to master it. You will find out quickly—probably on the first test—if you are spending enough time studying. Even if it turns out that you have to spend 2 or 3 hours on each section to master it, then that's how much time you should take. Trying to get by with less time will not work.
8. **Relax.** It's probably not as difficult as you think.

Prealgebra

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