

# *Blitzer*



College Algebra Essentials  
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# COLLEGE ALGEBRA: ESSENTIALS

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# COLLEGE ALGEBRA: ESSENTIALS



**Robert Blitzer**

*Miami Dade College*

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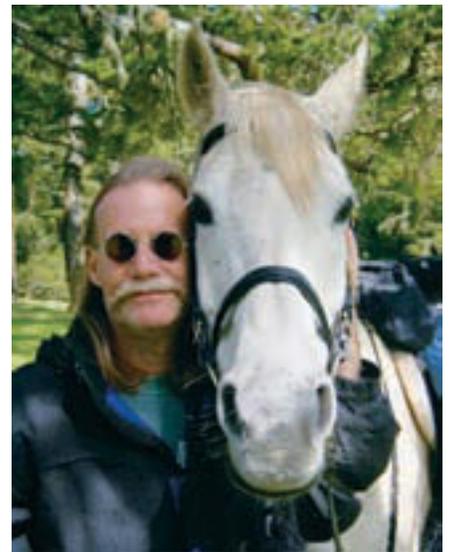
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# DEDICATION

## For Jerid (1985–2012)

And for those who have loved their pets  
and have been loved by them



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# PREFACE

I've written *College Algebra: Essentials, Fourth Edition*, to help diverse students, with different backgrounds and future goals, to succeed. The book has three fundamental goals:

1. To help students acquire a solid foundation in algebra, preparing them for other courses such as calculus, business calculus, and finite mathematics.
2. To show students how algebra can model and solve authentic real-world problems.
3. To enable students to develop problem-solving skills, while fostering critical thinking, within an interesting setting.

One major obstacle in the way of achieving these goals is the fact that very few students actually read their textbook. This has been a regular source of frustration for me and for my colleagues in the classroom. Anecdotal evidence gathered over years highlights two basic reasons that students do not take advantage of their textbook:

- “I’ll never use this information.”
- “I can’t follow the explanations.”

I've written every page of the Fourth Edition with the intent of eliminating these two objections. The ideas and tools I've used to do so are described for the student in “A Brief Guide to Getting the Most from This Book,” which appears at the front of the book.

## A Note on the Essentials Version of College Algebra

*College Algebra: Essentials, Fourth Edition* is a concise version of the **Sixth Edition** of *College Algebra*. The essentials version differs from the Sixth Edition only in terms of length. Chapter 6 (Matrices and Determinants), Chapter 7 (Conic Sections), and Chapter 8 (Sequences, Induction, and Probability) have been eliminated. The essentials version provides a lighter, less expensive alternative to the Sixth Edition for instructors who do not cover the topics in Chapters 6, 7, and 8.

## What's New in the Fourth Edition?

**New Applications and Real-World Data.** I'm on a constant search for data that can be used to illustrate unique algebraic applications. I researched hundreds of books, magazines,

newspapers, almanacs, and online sites to prepare the Fourth Edition. Among the 78 worked-out examples and exercises based on new data sets, you'll find applications involving modeling blood-alcohol concentration (Section P.1), starting salaries for college graduates (Section 1.3), the world's vanishing tiger population (Section 3.2), and the year humans become immortal (Section 4.1).

### Concept and Vocabulary Checks.

The Fourth Edition contains 358 new short-answer exercises, mainly fill-in-the-blank and true/false items, that assess students' understanding of the definitions and concepts presented in each section. The Concept and Vocabulary Checks appear as separate features preceding the Exercise Sets.

**Great Question!** This feature takes the content of each Study Tip in the Third Edition and presents it in the context of a student question. Answers to questions offer suggestions for problem solving, point out common errors to avoid, and provide informal hints and suggestions. ‘Great Question!’ should draw students' attention and curiosity more than the ‘Study Tips.’ As a secondary benefit, this new feature should help students not to feel anxious or threatened when asking questions in class.

### New Chapter-Opening and Section-Opening Scenarios.

Every chapter and every section open with a scenario based on an application, many of which are unique to the Fourth Edition. These scenarios are revisited in the course of the chapter or section in one of the book's new examples, exercises, or discussions. The often humorous tone of these openers is intended to help fearful and reluctant students overcome their negative perceptions about math.

**New Blitzer Bonuses.** The Fourth Edition contains a variety of new but optional enrichment essays. Examples include “Using Algebra to Measure Blood-Alcohol Concentration” (Section P.1), “Seven Ways to Spend \$1 Trillion” (Section P.2), and “Addressing Stress Parabolically” (Section 3.1).

**Sample Homework Assignments.** Within each Exercise Set, I have chosen odd-numbered problems, primarily from the Practice Exercises, that can serve as sample homework assignments. These are indicated by a blue underline in the Annotated Instructor's Edition. Based on the goals and objectives of your course, you may wish to enrich each sample homework assignment with additional exercises from the other categories in the Exercise Set.



**New Interactive Figures.** These new figures bring mathematical concepts to life and are included in MyMathLab. Used as a lecture tool, the figures help engage students more fully and save the time spent drawing figures by hand. Questions pertaining to each figure are assignable in MyMathLab and reinforce active learning and critical thinking. Each figure has an accompanying Exploratory Exercise that encourages further study and can be used as a presentation tool or as an open-ended learning assignment.



## What Content and Organizational Changes Have Been Made to the Fourth Edition?

- **Section P.1 (Algebraic Expressions, Mathematical Models, and Real Numbers)** contains a new essay, now called a Blitzer Bonus, on using algebra to measure blood-alcohol concentration. This Blitzer Bonus should set the stage for the book's engaging collection of unique applications.
- **Section P.6 (Rational Expressions)** presents a new example on excluding numbers from a rational expression with a trinomial denominator.
- **Section 1.2 (Linear Equations and Rational Equations)** contains examples involving both inconsistent equations and identities.
- **Section 2.5 (Transformations of Functions)** has a more thoroughly developed discussion of how stretching or shrinking changes a graph's shape.
- **Section 2.6 (Combinations of Functions; Composite Functions)** has a new example on finding the domain of a function with a square root in the denominator. There is also a new example that ties in with the section opener (number of births and deaths in the United States) and illustrates an application of the algebra of functions.
- **Section 3.2 (Polynomial Functions and Their Graphs)** contains a new example on graphing  $f(x) = -2(x - 1)^2(x + 2)$ , a polynomial function whose equation is given in factored form.
- **Section 3.5 (Rational Functions and Their Graphs)** has a variety of exercises where students must factor to find vertical asymptotes or holes.
- **Section 3.6 (Polynomial and Rational Inequalities)** contains a new example on solving a polynomial inequality with irrational boundary points that requires the use of the quadratic formula.
- **Section 4.1 (Exponential Functions)** presents an intriguing new Blitzer Bonus on the year humans become immortal. The section also contains a new table clarifying interest plans in which interest is paid more than once a year.

- **Section 4.4 (Exponential and Logarithmic Equations)** has a new discussion (within the context of the Great Question! feature) on whether a negative number can belong to the solution set of a logarithmic equation.
- **Section 5.3 (Partial Fractions)** uses the Great Question! feature to include a discussion on speeding up the process of finding partial fraction decompositions.

## What Familiar Features Have Been Retained in the Fourth Edition?

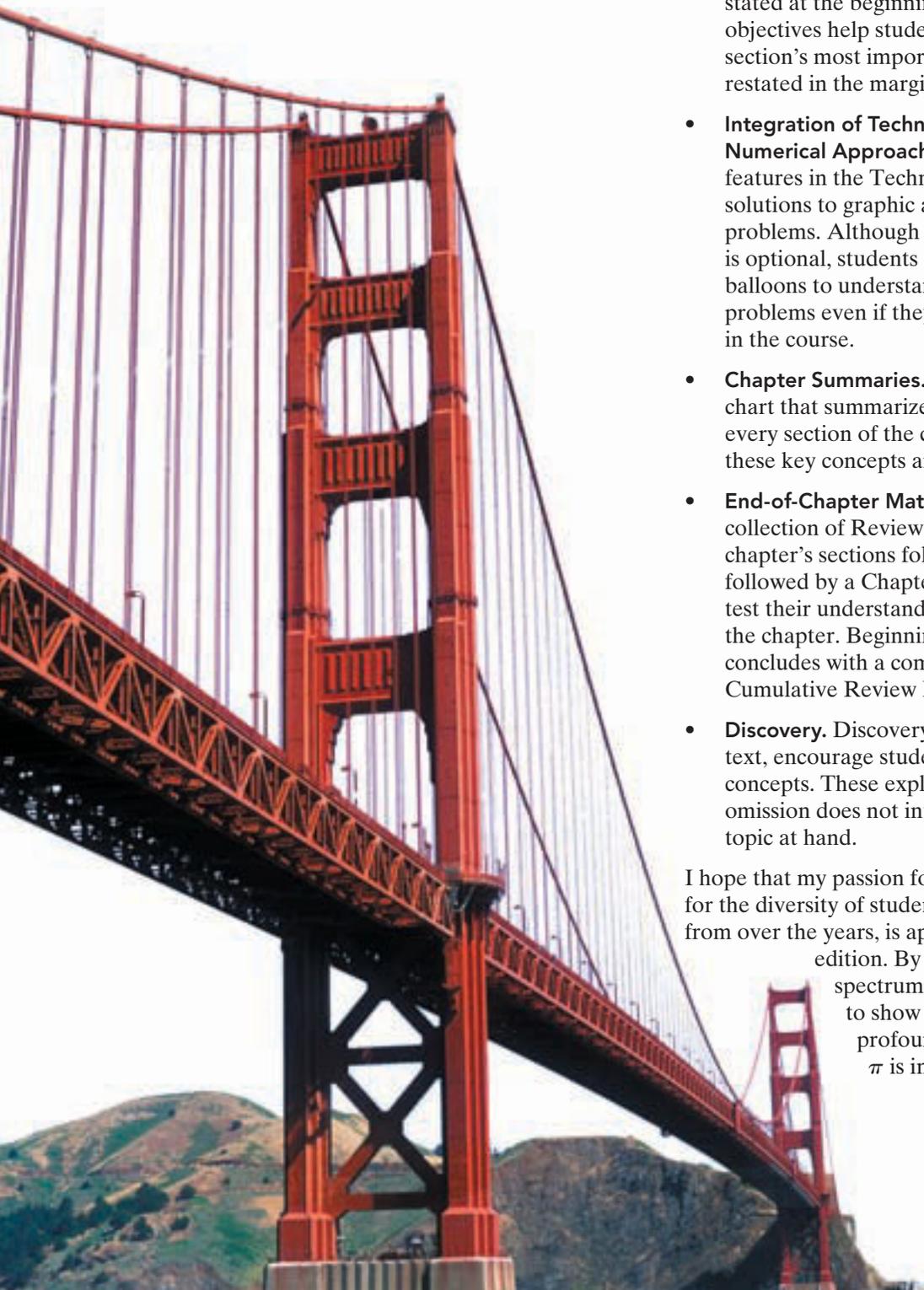
- **Detailed Worked-Out Examples.** Each worked example is titled, making clear the purpose of the example. Examples are clearly written and provide students with detailed step-by-step solutions. No steps are omitted and key steps are thoroughly explained to the right of the mathematics.
- **Explanatory Voice Balloons.** Voice balloons are used in a variety of ways to demystify mathematics. They translate algebraic ideas into everyday English, help clarify problem-solving procedures, present alternative ways of understanding concepts, and connect problem solving to concepts students have already learned.
- **Check Point Examples.** Each example is followed by a similar matched problem, called a Check Point, offering students the opportunity to test their understanding of the example by working a similar exercise. The answers to the Check Points are provided in the answer section.
- **Extensive and Varied Exercise Sets.** An abundant collection of exercises is included in an Exercise Set at the end of each section. Exercises are organized within eight category types: Practice Exercises, Practice Plus Exercises, Application Exercises, Writing in Mathematics, Technology Exercises, Critical Thinking Exercises, Group Exercises, and Preview Exercises. This format makes it easy to create well-rounded homework assignments. The order of the Practice Exercises is exactly the same as the order of the section's worked examples. This parallel order enables students to refer to the titled examples and their detailed explanations to achieve success working the Practice Exercises.

- **Practice Plus Problems.** This category of exercises contains more challenging practice problems that often require students to combine several skills or concepts. With an average of ten Practice Plus problems per Exercise Set, instructors are provided with the option of creating assignments that take Practice Exercises to a more challenging level.
- **Mid-Chapter Check Points.** At approximately the midway point in each chapter, an integrated set of Review Exercises allows students to review and assimilate the skills and concepts they learned separately over several sections.

- **Graphing and Functions.** Graphing is introduced in Chapter 1 and functions are introduced in Chapter 2, with an integrated graphing functional approach emphasized throughout the book. Graphs and functions that model data appear in nearly every section and Exercise Set. Examples and exercises use graphs of functions to explore relationships between data and to provide ways of visualizing a problem's solution. Because functions are the core of this course, students are repeatedly shown how functions relate to equations and graphs.
- **Section Objectives.** Learning objectives are clearly stated at the beginning of each section. These objectives help students recognize and focus on the section's most important ideas. The objectives are restated in the margin at their point of use.
- **Integration of Technology Using Graphic and Numerical Approaches to Problems.** Side-by-side features in the Technology boxes connect algebraic solutions to graphic and numerical approaches to problems. Although the use of graphing utilities is optional, students can use the explanatory voice balloons to understand different approaches to problems even if they are not using a graphing utility in the course.
- **Chapter Summaries.** Each chapter contains a review chart that summarizes the definitions and concepts in every section of the chapter. Examples that illustrate these key concepts are also referenced in the chart.
- **End-of-Chapter Materials.** A comprehensive collection of Review Exercises for each of the chapter's sections follows the Summary. This is followed by a Chapter Test that enables students to test their understanding of the material covered in the chapter. Beginning with Chapter 2, each chapter concludes with a comprehensive collection of mixed Cumulative Review Exercises.
- **Discovery.** Discovery boxes, found throughout the text, encourage students to further explore algebraic concepts. These explorations are optional and their omission does not interfere with the continuity of the topic at hand.

I hope that my passion for teaching, as well as my respect for the diversity of students I have taught and learned from over the years, is apparent throughout this new edition. By connecting algebra to the whole spectrum of learning, it is my intent to show students that their world is profoundly mathematical, and indeed,  $\pi$  is in the sky.

*Robert Blitzer*



## Acknowledgments

An enormous benefit of authoring a successful series is the broad-based feedback I receive from the students, dedicated users, and reviewers. Every change to this edition is the result of their thoughtful comments and suggestions. I would like to express my appreciation to all the reviewers, whose collective insights form the backbone of this revision. In particular, I would like to thank the following people for reviewing *College Algebra*, *Algebra and Trigonometry*, *Precalculus*, and *Trigonometry*.

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I would like to thank my editors at Pearson, Katie O'Connor and Dawn Murrin, who, with the assistance of Joseph Colella, guided and coordinated the book from manuscript through production. Thanks to Beth Paquin for the beautiful covers and interior design. Finally, thanks to Peggy Lucas for her innovative marketing efforts and to the entire Pearson sales force for their confidence and enthusiasm about the book.

*Robert Blitzer*

# DYNAMIC RESOURCES

## MyMathLab® Online Course (access code required)

MyMathLab delivers **proven results** in helping individual students succeed. It provides **engaging experiences** that personalize, stimulate, and measure learning for each student. And it comes from a **trusted partner** with educational expertise and an eye on the future.

To learn more about how MyMathLab combines proven learning applications with powerful assessment, visit [www.mymathlab.com](http://www.mymathlab.com) or contact your Pearson representative.

In Blitzer's **MyMathLab®** course, you have access to the most cutting-edge, innovative study solutions proven to increase student success. Noteworthy features include the following:

### Ready to Go Courses.

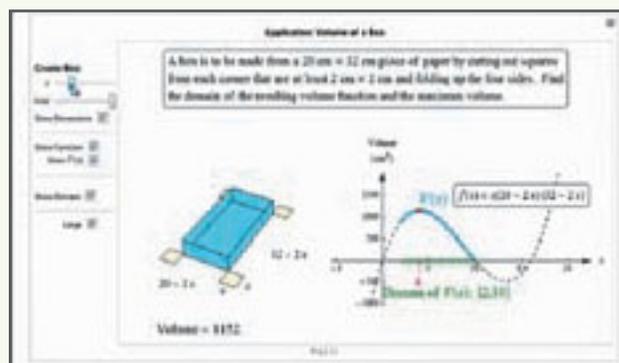
These new courses provide students with all the same great MyMathLab features that you're used to but make it easier for instructors to get started. Each course includes author-chosen, preassigned homework, integrated review questions, quizzes, and cumulative review exercises to make creating your course even simpler.

### Interactive Figures.

These *Mathematica*-based figures make the figures from the text come alive. Used during a lecture, interactive figures engage students more fully and save time that would otherwise be spent drawing them by hand. Exercises pertaining to each interactive figure are assignable in MyMathLab to reinforce active learning, critical thinking, and conceptual reasoning.

### Integrated Review.

Skill review quizzes are assignable throughout the course, testing students on prerequisite knowledge. From these quizzes, each student receives a personalized, just-in-time review assignment, allowing them to refresh forgotten concepts.



### MathTalk Videos.

Engaging videos connect mathematics to real-life events and interesting applications. These fun, instructional videos show students that math is relevant to their daily lives and are assignable in MyMathLab.

### Video Assessment.

Assignable MXL exercises are available for MathTalk videos to help students retain valuable information presented in the videos.

### Section-Lecture Videos.

These videos provide lectures for each section of the text to help students review important concepts and procedures 24/7.

### Concept and Vocabulary Check.

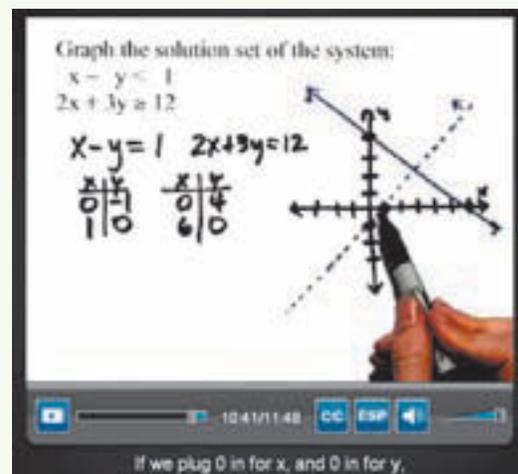
New and assignable in MyMathLab, these short-answer and fill-in-the blank exercises provide a quick check for understanding of concepts. These questions also test for reading comprehension before the student moves on to the exercises.



### Chapter Test Prep Videos.

Students can watch instructors work through step-by-step solutions to all the Chapter Test exercises from the textbook. These are available in MyMathLab and on YouTube.

[www.youtube.com/BlitzerColAlgEss4e](http://www.youtube.com/BlitzerColAlgEss4e)



### Instructor Resources

Additional resources can be downloaded from [www.pearsonhighered.com](http://www.pearsonhighered.com) or hardcopy resources can be ordered from your sales representative.

#### TestGen.

Enables instructors to build, edit, print, and administer tests using a computerized bank of algorithmic questions developed to cover all the objectives of the text.

#### PowerPoint Lecture Slides.

Fully editable lecture slides that correlate to the textbook.

#### Instructor's Solutions Manual.

Fully worked solutions to all textbook exercises.

#### Mini Lecture Notes.

Additional examples and helpful teaching tips for each section.

#### Annotated Instructor's Edition.

Shorter answers are on the page beside the exercises. Longer answers are in the back of the text.

### Student Resources

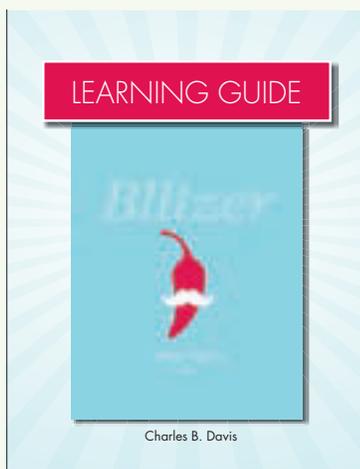
Additional resources to help student success are available to be packaged with the Blitzer textbook and MyMathLab access code.

#### Student's Solutions Manual.

Fully worked solutions to odd-numbered exercises and available to be packaged with the textbook.

#### Learning Guide.

This note-taking guide is organized by objective and begins each chapter with an engaging application, providing additional examples and exercises for students to work through for greater conceptual understanding and mastery of mathematical topics. The Learning Guide is available as PDFs and customizable Word files in MyMathLab. They can also be packaged with the textbook and MyMathLab access code.

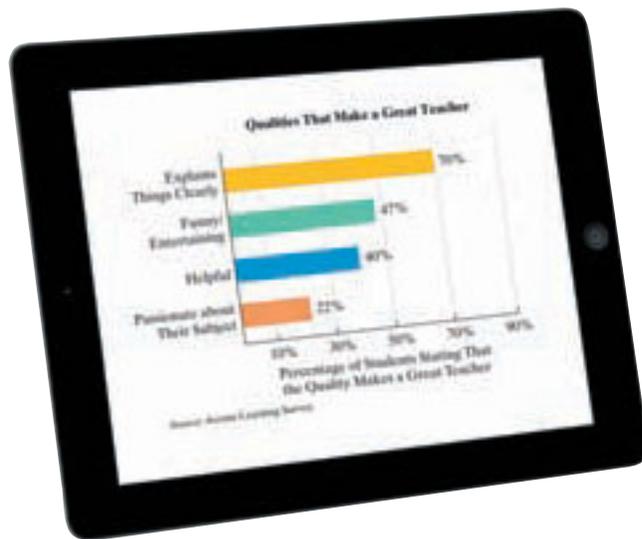


# TO THE STUDENT

The bar graph shows some of the qualities that students say make a great teacher. It was my goal to incorporate each of these qualities throughout the pages of this book.

## Explains Things Clearly

I understand that your primary purpose in reading *College Algebra: Essentials* is to acquire a solid understanding of the required topics in your algebra course. In order to achieve this goal, I've carefully explained each topic. Important definitions and procedures are set off in boxes, and worked-out examples that present solutions in a step-by-step manner appear in every section. Each example is followed by a similar matched problem, called a Check Point, for you to try so that you can actively participate in the learning process as you read the book. (Answers to all Check Points appear in the back of the book.)



## Funny & Entertaining

Who says that an algebra textbook can't be entertaining? From our quirky cover to the photos in the chapter and section openers, prepare to expect the unexpected. I hope some of the book's enrichment essays, called Blitzer Bonuses, will put a smile on your face from time to time.

## Helpful

I designed the book's features to help you acquire knowledge of college algebra, as well as to show you how algebra can solve authentic problems that apply to your life. These helpful features include

- **Explanatory Voice Balloons:** Voice balloons are used in a variety of ways to make math less intimidating. They translate algebraic language into everyday English, help clarify problem-solving procedures, present alternative ways of understanding concepts, and connect new concepts to concepts you have already learned.
- **Great Question!:** The book's Great Question! boxes are based on questions students ask in class. The answers to these questions give suggestions for problem solving, point out common errors to avoid, and provide informal hints and suggestions.
- **Chapter Summaries:** Each chapter contains a review chart that summarizes the definitions and concepts in every section of the chapter. Examples from the chapter that illustrate these key concepts are also referenced in the chart. Review these summaries and you'll know the most important material in the chapter!

## Passionate about the Subject

I passionately believe that no other discipline comes close to math in offering a more extensive set of tools for application and development of your mind. I wrote the book in Point Reyes National Seashore, 40 miles north of San Francisco. The park consists of 75,000 acres with miles of pristine surf-washed beaches, forested ridges, and bays bordered by white cliffs. It was my hope to convey the beauty and excitement of mathematics using nature's unspoiled beauty as a source of inspiration and creativity. Enjoy the pages that follow as you empower yourself with the algebra needed to succeed in college, your career, and your life.

Regards,

*Bob*

**Robert Blitzer**

# ABOUT THE AUTHOR

**Bob Blitzler** is a native of Manhattan and received a Bachelor of Arts degree with dual majors in mathematics and psychology (minor: English literature) from the City College of New York. His unusual combination of academic interests led him toward a Master of Arts in mathematics from the University of Miami and a doctorate in behavioral sciences from Nova University. Bob's love for teaching mathematics was nourished for nearly 30 years at Miami Dade College, where he received numerous teaching awards, including Innovator of the Year from the League for Innovations in the Community College and an endowed chair based on excellence in the classroom. In addition to *College Algebra: Essentials*, Bob has written textbooks covering introductory algebra, intermediate algebra, trigonometry, algebra and trigonometry, precalculus, and liberal arts mathematics, all published by Pearson. When not secluded in his Northern California writer's cabin, Bob can be found hiking the beaches and trails of Point Reyes National Seashore and tending to the chores required by his beloved entourage of horses, chickens, and irritable roosters.



*Bob and his buddy Casper Cockatoo*

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