

PREFACE

The opening paragraph in NCTM's *Principles and Standards for School Mathematics* (Standards 2000) states that its recommendations are grounded in the belief that all students should learn important mathematical concepts and processes with understanding. This belief has guided and influenced the writing of the first six editions of *Mathematics for Elementary Teachers: A Conceptual Approach*, which continues to place emphasis on the use of models and processes for providing insights into mathematical concepts before generalizations.

Standards 2000 contains frequent references to the dual need for acquiring *conceptual understanding* and *procedural fluency*. It states that conceptual understanding is essential in learning to solve new kinds of problems. *Mathematics for Elementary Teachers: A Conceptual Approach* develops conceptual understanding and models mathematical procedures through its extensive use of diagrams, applications, and problem solving.

The primary objective of *Mathematics for Elementary Teachers: A Conceptual Approach* is to present mathematics in a format that prepares teachers to teach elementary school mathematics. Teachers need a firm foundation in the theory of mathematics as it pertains to the elementary school curriculum. They also need ideas and methods for teaching mathematics to elementary school children in a way that will provide an understanding of concepts and generate interest and enthusiasm.

This edition of *Mathematics for Elementary Teachers: A Conceptual Approach* contains several features to help future teachers see connections between their college mathematics courses and the mathematics they envision teaching to elementary school students. There is a one-page **Math Activity** at the beginning of each section which involves materials and ideas that can be adapted to teaching elementary school mathematics. New to this edition are **sample pages from elementary school texts** that show the close relationship between some of the mathematical content and processes in *Mathematics for Elementary Teachers: A Conceptual Approach* and the elementary school curriculum. There are also **statements from research** about learning and teaching mathematics in elementary and middle schools that suggest good practices and show some of the common learning difficulties of students. Finally, numerous **statements from Standards 2000** have been added to highlight recommendations for teaching mathematics with conceptual understanding.

NCTM's Process Standards

Standards 2000 has five Content Standards: **Number and Operations, Algebra, Geometry, Measurement, and Data Analysis and Probability**. It also has five Process Standards: **Problem Solving, Reasoning and Proof, Communication, Connections, and Representation**. The Process Standards discuss ways of acquiring and using content knowledge, and the following outline shows how this is accomplished in *Mathematics for Elementary Teachers: A Conceptual Approach*.

PROBLEM SOLVING

Several problem-solving strategies are illustrated in Chapter 1 and additional strategies are introduced in each chapter of the text.

Problem Openers at the beginning of each section provide opportunities for using the problem-solving strategies.

Problem-Solving Applications in each section illustrate specific strategies using Polya's four-step approach.

Reasoning and Problem Solving in each exercise set require explanations and justifications.

REASONING AND PROOF

Inductive reasoning and conjecture forming are introduced in Chapter 1 for extending patterns.

Deductive reasoning and Venn diagrams are introduced in Chapter 2, and both inductive and deductive reasoning are used throughout the text.

Puzzlers occur in each section and provide opportunities to grapple with problems that require extra effort.

Reasoning and Problem Solving in the exercise sets require both inductive and deductive reasoning.

COMMUNICATION

One-page *Math Activities* at the beginning of each section provide problems employing manipulative materials for small group discussions of strategies and solutions.

Research Statements in the margins of the text relate the mathematical content to school-student performance.

Problems for discussion and writing in mathematics for each section of the text are on the website for the text (see following pages).

Problem Openers at the beginning of each section provide opportunities for class or small group discussions of strategies and solutions.

Statements from Standards 2000 have been placed in the margins to relate the content, models, and pedagogy of the text to the proposals in the standards.

CONNECTIONS

Spotlights on Teaching at the beginning of each chapter contain examples from NCTM's standards which show connections to school mathematics.

Elementary School Text Pages relate the content and models of elementary school mathematics to key topics from the text.

Numerous photographs throughout the text of crystals, buildings, and many other types of objects illustrate connections to the real world.

An abundance of models and visuals illustrate mathematical concepts and provide insights and connections across number systems. For example, models help to show that the underlying concepts of the basic operations on numbers remain the same regardless of the type of numbers being used.

Techniques for estimation and mental calculation provide another common thread across the number system chapters.

Historical Highlights show the evolution of key ideas and provide background on some of the world's outstanding mathematicians.

REPRESENTATION

One-page *Math Activities* at the beginning of each section represent concepts with models and diagrams.

Mathematical concepts throughout the text are illustrated with models and diagrams before introducing definitions and generalizations.

Mathematical statements and relationships are represented throughout the text by tables, graphs, equations, and algebraic expressions.

Instruction and exercises for using calculators occur throughout the text and are marked by icons.

Graphing Calculator and Computer Investigations for specific topics are contained on the website. The *Mathematics Investigator* software on the website illustrates the power and convenience of computers in quickly generating large amounts of data.

Models and diagrams provide opportunities for representing relationships at the concrete level, then describing relationships verbally, and finally expressing them by algebraic statements.

Suggestions for Active Student Participation

NCTM's *Curriculum and Evaluation Standards for School Mathematics* (1989) and Standards 2000 recommend that students develop mathematics by looking for patterns, making conjectures, and verifying hypotheses. Many instructors have been influenced by such recommendations and are using instructional methods which involve more active student participation and less time in the lecture format. Following are a few suggestions involving the special features of the text which encourage active student participation.

MATH ACTIVITIES

The one-page Math Activities preceding each section of the text are augmented by the Manipulative Kit of colored, perforated cardstock materials which can be packaged with the text, if requested by the instructor (ISBN 0-07-287392-2). These Math Activities serve as: homework assignments to provide background for a section of the text; ideas for projects or papers involving the design of an elementary school activity; small group instruction for introducing sections of the text. They are designed to: introduce students to activities that develop concepts and mathematical reasoning; provide opportunities for students to look for patterns, form conjectures, and express their thinking; familiarize students with activities that can be adapted to the elementary school curriculum.

PROBLEM OPENERS

Each section of the text begins with a Problem Opener related to the content of that section. Problem Openers may be used for small, group problem solving and class discussions. They can be used to open a lesson before the content of the section is introduced and to motivate interest in the topic. The solution to each Problem Opener and the problem-solving strategies required are contained in the Instructor's Resource Manual. The manual also includes one or more ideas for looking back and extending each Problem Opener for additional problem solving in class or on assignments and tests.

INVESTIGATIONS


The National Council of Supervisors of Mathematics has stated, "Students need to explore mathematics using manipulatives, measuring devices, models, calculators,

and computers.”* At the end of each section of the text there is a website reference for a mathematics investigation that is designed specifically for the mathematical content of the section. These investigations pose open-ended questions that require collecting data, looking for patterns, and forming and verifying conjectures. The investigations can be used for student papers or class reports. There are three types of investigations: computer, calculator, and laboratory. Some of the computer investigations are designed for discovering relationships in geometry with one of several interactive geometry software packages; and some are designed for numerical discoveries with the software Mathematics Investigator which is on the text’s Online Learning Center located at www.mhhe.com/bennett-nelson. This software is described on the following pages under Supplements.

PROBLEM-SOLVING APPLICATIONS

Each section of the text contains one or more Problem-Solving Application, which applies the subject matter of the section and is analyzed with Polya’s four-step plan. These problems can be posed to the class for small group problem solving. A follow-up discussion can involve comparing students’ plans for solving a problem and their solutions with those suggested in the text.

Special Approaches and Features

Reasoning and Problem Solving exercises marked by  icon
Math Activities at the beginning of each section that employ the
 Manipulative Kit of colored, perforated materials
Parity of Exercises for all skills and concepts
Problem-solving Strategies introduced throughout the text
Statements from Standards 2000 in margins of text
Elementary School Text Pages set within the text to illustrate practical
 application of concepts
Problem Openers at the beginning of each section
Research Statements throughout the margins of the text
Calculator Paragraphs and Exercises marked with an icon
Problem-solving Applications developed by Polya’s four-step plan
Spotlights on Teaching from NCTM’s Standards at the beginnings of chapters
Puzzlers for challenges and reasoning
Historical Highlights for origins of important ideas
Mental Calculating and Estimating are required in number systems chapters
Chapter Reviews and Chapter Tests at the end of each chapter
Numerous Photographs to illustrate connections and applications
Boxed Features for key definitions, rules, properties
Answer Section with selected answers for the section-opening Math
 Activities (marked with ★), odd-numbered exercises, puzzlers, and
 chapter tests

*National Council of Supervisors of Mathematics, “Essential Mathematics for the 21st Century” (Minneapolis, MN: NCSNI Essential Mathematics Task Force, 1988), 3–4.

Supplements

ONLINE LEARNING CENTER

The Bennett/Nelson Online Learning Center for the sixth edition of *Mathematics for Elementary Teachers*, located at www.mhhe.com/bennett-nelson includes improved and updated versions of the Bennett/Nelson online material, in addition to many NEW features developed especially for the sixth edition. Online Learning Centers are also compatible with a number of full-service online course delivery systems or outside educational service providers.

Digital Manipulative Kit A new, digitally interactive version of the Bennett/Nelson manipulative kit is now provided on the website for carrying out activities.

Interactive Mathematics Applets Content-specific interactive applets demonstrate key mathematical concepts.

Writing/Discussion Problems Correlated directly to the 34 sections of the text, these exercises raise classroom teaching issues and require explanations of mathematical concepts.

Color Transparencies Color copies of the materials from the Manipulative Kit may be downloaded and used for printing color transparencies.

Grids and Dot paper Black and white masters of geoboards, regular polygons, blank Decimal Squares, base-ten grid, coordinate system, random number chart, and a wide variety of grids, dot paper, and spinners are available to students and instructors.

Math Investigations 34 investigations that are classified as computer, calculator, and laboratory. Data for 14 of these investigations may be generated by the user-friendly, browser-based Mathematics Investigator software. Updated with a new design especially for this edition.

Bibliography An expanded set of bibliographies and Internet links for each of the 34 sections of the text.

Logo Instruction Instruction in Logo, including special commands, worked examples, and exercises. Answers for the odd-numbered exercises are included in the website and answers for the even-numbered exercises are included in the Instructor's Manual.

Network Graphs Instruction Instruction in Network Graphs, including worked examples and exercises. Answers for the odd-numbered exercises are included here on the Online Learning Center and answers for the even-numbered exercises are included in the Instructor's Resource Manual.

NetTutor NetTutor is a revolutionary system that enables students to interact with a live tutor over the World Wide Web. Students can receive instruction from live tutors using NetTutor's Web-based, graphical chat capabilities. They can also submit questions and receive answers, browse previously answered questions, and view previous live chat sessions.

INSTRUCTOR'S RESOURCE MANUAL

The *Instructor's Resource Manual* to accompany *Mathematics for Elementary Teachers: A Conceptual Approach* (ISBN 0-07-253298-X) contains extensions for all problem openers and answers for the problem openers and extensions; answers for all even-numbered Exercises and Problems; answers for the Online Mathematics Investigations, chapter tests with answers (two tests for

each chapter); transparency masters (various grids and dot paper); and a description of the *Mathematics Investigator* website software.

STUDENT'S SOLUTION MANUAL

(ISBN 0-07-253297-1) Newly revised for this edition by its author, Joseph Ediger of Portland State University, this manual contains detailed solutions to the even-numbered exercises and problems and the chapter tests.

MATHEMATICS INVESTIGATOR

The *Mathematics Investigator* is software containing 14 programs (see list below) designed to demonstrate the computer investigations on the website. Students may use this software to gather data and run simulations for the investigations. These investigations pose questions to generate interest in various mathematical topics and encourage students to formulate and investigate their own conjectures. Instructors may use this software to demonstrate computer simulations and the process of forming conjectures and looking for counterexamples. This newly-updated, browser-based software is compatible with both Macintosh and PC platforms. Functionality such as editing, cutting, pasting, copying text to other files, and printing can be used with the programs on this software.

MATHEMATICS INVESTIGATOR

Triangular Numbers	Factorizations
Palindromic Sums	Frequency of Primes
Palindromic Differences	Number Chains
Palindromic Decimals	Integer Differences
Consecutive Numbers	Standard Deviations
Differences of Squares	Dice Roll Simulations
Repeating Decimals	Coin Toss Simulation

ACTIVITY BOOK

(ISBN 0-07-253307-2) *Mathematics for Elementary Teachers: An Activity Approach*, Sixth Edition, contains an activity set corresponding to each section of the text. Each activity set is a sequence of inductive activities and experiments that enable the student to build an understanding of mathematical ideas through the use of models and the discovery of patterns. The activity sets augment the ideas presented in the corresponding sections of the text. Over 50 Material Cards, some with colored manipulatives are packaged with *Mathematics for Elementary Teachers: An Activity Approach*. A section on *Ideas for the Elementary Classroom* at the end of each chapter includes a suggested elementary school activity and a list of selected sources. There are puzzles throughout the book and the activity sets are followed by *Just for Fun* enrichment activities. The text, *Mathematics for Elementary Teachers: A Conceptual Approach*, may be packaged with the activity book, *Mathematics for Elementary Teachers: An Activity Approach*, and the Manipulative Kit (ISBN 0-07-287392-2).

Acknowledgments

We thank the many students and instructors who have used the first five editions of this book and have supported our efforts by contributing comments and

suggestions. In particular, significant improvements were suggested by Professors Judy Carlson at Indiana University/Purdue and Danny Breidenbach of Purdue University. Portland State University Teaching Assistants Steve Blair, Dan Canada, and Matt Ciancetta also contributed valuable suggestions. The following students in the Geometry for Teachers class at the University of New Hampshire used the fifth edition of the text and merit special thanks for their suggestions: Karen Astell, Alicia Briggs, Megan Haldemen, Lauren Magner, Amy Schmidt, and Tayna Welsh.

We especially acknowledge the following reviewers who contributed excellent advice and suggestions for the sixth edition.

Danny Breidenbach, *Purdue University*
 Laurie Burton, *Western Oregon University*
 Judy Carlson, *Indiana University-Purdue University, Indianapolis*
 John Drury, *Indiana University-Purdue University, Indianapolis*
 Fe Evangelista, *University of Wisconsin, Whitewater*
 Kim Hagens, *Louisiana State University, Baton Rouge*
 Jean Marie Grant, *Bradley University*
 Elizabeth Gray, *Southeastern Louisiana University*
 Joyce Griffin, *Auburn University*
 Joan Cohen Jones, *Eastern Michigan University*
 Janet Melancon, *Loyola University*
 Kathleen Miller, *California State University, Long Beach*
 Carole Phillips-Bey, *Cleveland State University*
 Virginia Powell, *University of Louisiana, Monroe*
 Fary F. Sami, *Harford Community College*
 Susan Schibel, *New Mexico State University, Las Cruces*

Special thanks go to Jane Bennett for devoting many hours to reading various stages of the manuscript and the galleys. We are grateful to Joe Ediger for his valuable suggestions and his writing and revising the Student's Solution Manual, and to Albert B. Bennett, III, for the initial programming of the *Mathematics Investigator* software. We also wish to acknowledge the following University of New Hampshire reference librarians for providing assistance on so many occasions: Louise Buckley, Peter R. Crosby, Valerie Harper, David Severn, Deborah E. Watson, and Dianna Wood. We wish to express our gratitude to the following members of McGraw-Hill Higher Education: Senior Sponsoring Editor David Dietz for his vision and leadership; Developmental Editor Christien Shangraw and Senior Project Manager Vicki Krug for their many excellent decisions in guiding this book through the revision and production process; Marketing Manager Mary Kittell for her professional judgment; Designer Rick Noel for imaginative and interesting interior text and cover designs; and Media Producer Jeff Huettman for recognizing the potential of the *Digital Manipulative Kit* and for overseeing the development of this kit, the Interactive Mathematics applets, and the revised *Mathematics Investigator* software. Finally we thank copyeditor Pat Steele for her meticulous attention to detail in this and the previous edition.