

About This Book

Principles and Standards for School Mathematics (National Council of Teachers of Mathematics [NCTM] 2000) outlines much of what has traditionally been algebra 1 in secondary schools as expected content for the middle grades. It is imperative then that a broadening and deepening of mathematics content take place in high school. New topics—not frequently before found in algebra—such as recursion, classes of functions, and using technology on symbolic expressions, are emerging in the high school curriculum.

As the mathematics broadens, deepens, and emerges, we must not only tie the new learning to what has been learned before but also do so in a way that helps students generalize what they have previously learned in a more specific way. Only in this manner can we approach algebra as a language of process for all students that adds a structural framework to the mathematics begun as arithmetic in the lower grades.

Algebra is an extremely effective tool for investigating all areas of school mathematics. As students deepen their understanding of number, operation, measurement, geometry, statistics, and probability, algebraic ideas constantly emerge. These emerging ideas give teachers many opportunities for focusing, reinforcing, and developing algebraic processes. The basic elements of algebraic processes are variables, operations, and relations, including functions. This book addresses algebra as a language of process in chapter 1 and expands the notion of variable in chapter 2. Chapter 3 develops the notion of the representation of functions, and chapter 4 extends students' understandings of algebraic equivalence. Chapter 5 helps expand students' understanding of change.

Each chapter is built around a set of activities that can be used either with students or for the professional development of teachers. The activities include lists of prerequisites and the materials to be used, including the blackline masters, which are signaled by an icon and can be found at the back of this book and on the accompanying CD-ROM. In addition, the CD, also signaled by an icon, contains readings for professional development, along with several tools, listed as applets on the contents page. The authors originally intended to include assessments for each activity in the book but decided against it. Instead of developing an assessment rubric unique to each student activity, we believe that teachers need to develop simple, more general rubrics that they can use on a regular basis, rubrics that translate into habits of mind for their students. For example, in promoting constructive discourse during an algebra activity, teachers can assess the quality of the dialogue by using the rubric “Explain, build, or go beyond,” described in “Talking about Math Talk” (Sherin, Mendez, and Louis 2000, pp. 188–96). With this simple rubric, teachers can encourage students to justify or explain their procedures and results. Students are asked to build on one another's ideas and thereby, for example, contribute alternative procedures and ways of validating results. Finally, the rubric encourages students to engage routinely in generalizing beyond the specifics of the problem or process under study.

In activities in which building an understanding of an algebraic

Key to Icons



Principles and Standards



CD-ROM



Blackline Master

Three different icons appear in the book, as shown in the key. One alerts readers to material quoted from *Principles and Standards for School Mathematics*, another points them to supplementary materials on the CD-ROM that accompanies the book, and a third signals the blackline masters and indicates their locations in the appendix.

process is the goal, another simple rubric such as “Estimate, carry out, check, think back” might be used. Using this rubric, teachers routinely ask such questions as What would be a good estimate? Why do you think your method works? What are some ways you could check your answer? How could you have done that another way? What other problems would your method help in solving? It is important that students occasionally write down their responses to these questions so they can be used in assessing their understanding. These and other such questions are important in environments where students are making regular use of technology to carry out algebraic procedures. However, they are also helpful in environments where a computer algebra system (CAS)—which enables the user to work with variables on a calculator—is not available.

In *Navigating through Algebra in Grades 9–12*, the authors have tried to produce a book that will cause mathematics teachers to think. Collectively, we believe that mathematics education in the United States will reflect the notions in *Principles and Standards for School Mathematics* (NCTM 2000) only when teachers’ beliefs are both validated and challenged. In the past, *algebra* evoked in almost everyone a similar image—that of a traditional ninth-grade course from the 1960s, 1970s, or 1980s. The educational mindset reflected in that image began to change with the publication of *Curriculum and Evaluation Standards for School Mathematics* (NCTM 1989). *Principles and Standards* is again challenging that mindset with recommendations for algebraic thinking reaching from prekindergarten to grade 12. With a challenged mindset come new topics and old topics thought of in different ways. With the emphasis on algebraic thinking from the prekindergarten years on, concepts and expectations in algebra have changed and will continue to change. The use of technology is now expected, not to the exclusion of algebraic computation by hand, but in ways that enhance how students learn and understand computation. As you read and work through this book, consider how your classroom must change to implement the Algebra Standard.