About This Book

Secondary school geometry has long served as a vehicle for teaching logical reasoning and the deductive method. In colleges and universities, geometry has commonly been approached as a branch of algebra or analysis. However, *Principles and Standards for School Mathematics* (National Council of Teachers of Mathematics [NCTM] 2000) sees geometry as affording slightly different and richer opportunities: "Geometry offers a means of describing, analyzing, and understanding the world and seeing beauty in its structures. Geometric ideas can be useful both in other areas of mathematics and in applied settings" (p. 309). Furthermore, "high school students should develop facility with a broad range of ways of representing geometric ideas—including coordinates, networks, transformations, vectors, and matrices—that allow multiple approaches to geometric problems that connect geometric interpretations to other contexts" (p. 309). Thus, *Principles and Standards* neither excludes from high school geometry the teaching of logical reasoning and the deductive method nor implies that geometry could not be taught as a branch of algebra or analysis, but it does expand the roles of geometric ideas beyond the traditional ones.

In a book as brief as this one, it is impossible to include all geometric topics and contexts that the authors or others deem important. We have had to choose carefully among topics in order to concentrate on overarching ideas from *Principles and Standards* that extend to other mathematical contexts. These include transformations, coordinates, and matrices, as well as the use of geometry to describe, analyze, and understand location in the world by means of the Global Positioning System (GPS). We also consider such traditional topics as congruence and similarity in the context of twenty-first-century developments, and we explore applications in which geometry is a tool for investigating the infinite.

A transformation is a one-to-one correspondence that maps the plane to itself.

We approach geometry through a transformational lens. Transformations provide the study of geometry with a functional basis that lends itself to extensions to algebra, statistics, and calculus. Transformations equip students for future explorations of computer science through the use of matrices and mappings. In applying transformations, we do not neglect the rich traditional geometry of past centuries but focus instead on an application from the centuries-old tradition of map making.

In this book, we assume that middle school students have "explored and discovered relationships among geometric shapes, often using dynamic geometry software" (NCTM 2000, p. 309). Moreover, we expect that middle school students will have begun to develop logical arguments that will underpin more formal reasoning and proof. We expect students to continue that development, calling on them to present justified arguments to support geometric claims.

Each chapter features a group of activities that take students through related geometry tasks. For each activity, we include goals, materials and equipment, and a "Discussion of the Activity" that briefly explains what students will be doing and learning. The activities themselves appear in reproducible blackline masters in the appendix, which also

Key to Icons

Principles and Standards

CD-ROM

Blackline Master

includes solutions. The activity pages move students step by step through a variety of concrete tasks, and "Discussion and Extension" questions call on them to reflect on what they have just done, often urging them to generalize from their results. The blackline masters of the activities also appear on the CD-ROM that accompanies this book.

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

As you and your students work through the activities, you will sometimes need access to Dynamic Geometry® software or a calculator or computer with software that handles data and allows you to produce geometric images and graphs. The authors believe that all teachers need to adopt the Technology Principle from *Principles and Standards:* "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (NCTM 2000, p. 24). The activities that use technology make note of this requirement in their lists of materials. Some of them could be approached without the technology, but we believe that other approaches would not be likely to be as effective.

As you read, think about what a geometry course for students in today's world could and should be if it were built around the Principles and Standards. We have tried to provide you with food for thought as well as to give you activities to challenge your students and enhance your own professional development.

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