

# Preface

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## OVERVIEW

With mandates from No Child Left Behind and other state-driven assessment initiatives, substantial amounts of educator time and energy are being spent on developing, implementing, scoring, and analyzing summative assessments of students' mathematical knowledge. Although the importance of summative assessment is recognized, findings point to formative assessment as an important strategy in improving student achievement in mathematics.

Formative assessment informs instruction through various methods and strategies, the purposes of which are to determine students' prior knowledge of a learning target and to use the information to drive instruction, moving each student toward understanding of the targeted concepts and procedures. Questioning, observation, and student self-assessment are examples of instructional strategies that educators can incorporate to gain insight into student understanding. These instructional strategies become formative assessment if the results are used to plan and implement learning activities designed specifically to address the specific needs of the students.

This book focuses on using diagnostic questions, called Mathematics Assessment Probes, to elicit prior understandings and commonly held misconceptions. This elicitation allows the educator to make sound instructional choices based on the specific needs of a particular group of students.

Diagnostic assessment is as important to teaching as a physical exam is to prescribing an appropriate medical regimen. At the outset of any unit of study, certain students are likely to have already mastered some of the skills that the teacher is about to introduce, and others may already understand key concepts. Some students are likely to be deficient in prerequisite skills or harbor misconceptions. Armed with this diagnostic information, a teacher gains greater insight into what to teach. (McTighe & O'Connor, 2005)

The Mathematics Assessment Probes provided in this resource are tools for middle and high school teachers to gather these important insights.

## AUDIENCE

The first collection of Mathematics Assessment Probes and the accompanying Teachers' Notes was designed for the busy K–12 classroom teacher who understands there is a growing body of research on students' learning difficulties and that thoughtful use of this research in developing and selecting diagnostic

assessments promises to enhance the efficiency and effectiveness of mathematics instruction. Since the publication of the collection, *Uncovering Student Thinking in Mathematics: 25 Formative Assessment Probes* (Rose, Minton, & Arline, 2006), we have received continuous requests for additional probes. Both teachers and education leaders have communicated the need for a collection of research-based probes that focuses on a narrower grade span. Due to these requests, we set to work writing, piloting, and field testing a more extensive set of probes for middle and high school teachers.

## BACKGROUND

The probes are designed to uncover student understandings and misunderstandings based on research findings, and have been piloted and field tested with teachers and students.

Because the probes are based on cognitive research, examples of such probes exist in multiple resources but not as a collection and not for the specific purpose of action research in the classroom. In addition, the questions are spread throughout various research materials and are not ready for classroom use. The probes in this book were developed using the process described in *Mathematics Curriculum Topic Study: Bridging the Gap Between Standards and Practice* (Keeley & Rose, 2007) and were originally piloted with the Maine teachers participating in the State Mathematics and Science Partnership Project: Mathematics: Access and Teaching in High School (MATHS). The use of the probes was expanded to include past participants in the other mathematics projects, including the National Science Foundation (NSF)-funded Northern New England Co-Mentoring Network, Maine Governor's Academy for Mathematics and Science Education Leadership, a State Mathematics and Science Partnership Project: Building Administrators' and Leaders' Abilities and the Numeracy Capacity of Educators (BALANCE), and various other mathematics professional development programs offered through the Maine Mathematics and Science Alliance. In addition, the probes were field tested nationally through a network of leaders involved with the Curriculum Topic Study Project.

## ORGANIZATION

This book is organized to provide readers with the purpose, structure, and development of the Mathematics Assessment Probes, as well as to support the use of applicable research and instructional strategies in mathematics classrooms.

Chapter 1 provides in-depth information about the process and design of the Mathematics Assessment Probes along with the development of an action research structure we refer to as a QUEST cycle. Chapter 2 highlights instructional implications and images from practice to illuminate how easily and in how many varied ways the probes can be used in mathematics classrooms. Chapters 3–5 are the collections of probes categorized by content strands, within grade spans, with accompanying Teachers' Notes that provide the specific research and instructional strategies designed to directly address students' challenges with mathematics.