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## Preface

*Rigor, Relevance, and Relationships: Making Mathematics Come Alive with Project-Based Learning* is divided into four sections. In section I, we introduce a teaching methodology called *project-based learning* (PBL). We describe the nuts and bolts of designing an effective PBL unit (chapter 1), outline the importance of college and career readiness and how PBL instruction can play a key role in preparing students for these future challenges (chapter 2), and present a literature review on the effectiveness of PBL (chapter 3). Sections II and III showcase PBL units that have been designed and implemented by high school mathematics teachers in their classrooms. The final section includes tips and resources from mathematics teachers and educators who have taught and researched in PBL settings.

Each unit includes tips on how to sustain **rigor**, engage learners in **relevant** learning, and foster students' **relationships** with their peers and with members of the community. The essential elements of PBL and the connections to the Common Core State Standards for Mathematics (CCSSM) are discussed in detail. Units include a variety of supplemental materials, for example:

- A Project Planning Form and Project Calendar containing details about the project
- Rubrics used throughout the project
- Written and digital examples of critical points in the PBL process, such as the launch of the project, establishment of effective small-group norms, and project presentations
- Examples of student work and student learning
- Other resources that help make PBL effective in math classrooms



Supplementary digital resources for both detailed and brief PBL units can be found on the National Council of Teachers of Mathematics (NCTM) website ([www.nctm.org/more4u](http://www.nctm.org/more4u)).

The detailed PBL units presented in section II are as follows:

- In *Solar Cooking with Conics* (chapter 4), students are challenged to build a solar cooker that uses the sun's rays as the only means of heating a pot of soup. Learners are engaged in becoming more globally aware as they use a number of digital tools to meet this mathematical challenge.
- *Interest in Interest* (chapter 5) uses the idea of shopping for a new car as a framework for students' learning about exponential growth, decay, and logarithms. Students learn about financial literacy—a real-life skill they will need in the near future.
- The *Polyhedron Tiling Artwork Project* (chapter 6) incorporates art into students' work in geometry. It is a great example of how to scaffold non-PBL learners' experiences by implementing some PBL practices in a mathematics classroom.
- *I'm Hair to Help* (chapter 7) is a service learning project in which students are introduced to the Locks of Love organization; in addition to math skills, students learn about and practice empathy.

The brief PBL units presented in section III are as follows:

- *To Netbook or Not to Netbook?* (chapter 8) is based on an actual situation: investigating whether the one-to-one Netbooks provided by a school were being used effectively. The unit empowered learners to gather data to help the school administration.
- *“Worth”-Quake Insurance* (chapter 9) focuses on a recent series of earthquakes that alarmed a community. Learners use exponential growth graphs to make a compelling argument for purchasing earthquake insurance, in the process developing a relationship with a popular local insurance agency.
- *Super Baugh I: Flacco vs. Kaepernick* (chapter 10) draws on learners’ interest in the Super Bowl and engages them in exploring and modeling phenomena to predict the outcome of athletes’ performances.
- In *Don’t Sweat It!* (chapter 11), students learn about data analysis and mathematical modeling through research on healthy eating habits and exercise routines.

Readers are encouraged to adapt these units and use them in their own instructional settings. We also encourage readers to design and implement new PBL units for their own use and to share them with the broader community of mathematics educators. The templates in chapter 1 (Project Planning Form, Scaffolding NTKs [Need-to-Knows], Project Calendar, Six Problem-Solving Phases Planning Worksheet) are provided to aid teachers in designing or adapting PBL units for their own classrooms.