

Mathematical Modeling as a Tool for Empowerment

Ear to the Ground features voices from several corners of the mathematics education world.

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What are your long-term goals for your students? As teachers, when we think about this question, we tend to move away from specific topics and toward the ways big mathematical ideas relate to students' lives. We think about how students might use mathematics in their future careers, their mathematical habits of mind and ability to work through complex problems, their interactions with other human beings, and their sense of belonging in STEM-related (science, technology, engineering, and mathematics) fields. Mathematical modeling has a unique role in the school curriculum because it broadens students' understanding of what mathematics is, whom it is for, and how it applies in the world. Mathematical modeling in classrooms affirms students' dignity as creative—and mathematical—human beings. Mathematical modeling empowers students as learners and doers of mathematics and engages them in empathetic critical thinking skills.

Modeling is the process of using mathematics to understand and make decisions about the world. The modeling process in classrooms begins when students encounter an authentic problem that is important to them or their communities, which happens often! For example, we have worked with students who ask questions such as, “What is the best way to share snacks?”, “Do we have enough pencils to last the school year?”, “Where should the mobile library bus park each week?”, “How should the cross-country coach choose runners for the state meet?”, or “Is the SAT a fair criterion for college admissions?”

When engaged in modeling, students consider a problem from a mathematical perspective to understand if and how mathematics can be used to understand the situation. As they develop a model, they make assumptions, assign variables, and begin to craft

a solution to the problem. Along the way, they check in with classmates and the teacher to revise and refine their thinking, considering the benefits and limitations of different approaches and how their models capture the perspectives of different human beings.

Mathematical modeling is a powerful classroom practice that increases students' capacity to use mathematics as a tool to address complex problems that they encounter in their day-to-day experiences. Students can bring multiple facets of their identity and their experiences to understand a problem and inform their solution strategies. We have found it useful to phrase three “I can see” statements that encapsulate the perspective that modeling nurtures in students about themselves, mathematics, and their communities.

I can see mathematics in the world. Modeling gives students

the opportunity to find mathematics in the world around them. Mathematics is one tool, of many, that students can draw on to become more powerful and informed decision makers.

I can see how and why my decisions matter. Modeling affirms the resources our students bring to the classroom and connects to issues they care about. It allows them to see that their solutions matter and empowers them to act on their findings.

I can see that different approaches to a problem have merit. Modeling allows students to see mathematics as a creative endeavor in which multiple solutions exist. Modeling also allows for community building, as students learn from one another to revise and refine their thinking.

If any of these ideas resonate with you and you are inspired to learn more about mathematical modeling, we encourage you to explore these new books recently published by the National Council of Teachers

of Mathematics: *Becoming a Teacher of Mathematical Modeling, Grades K–5* (Arnold et al. 2021a) and *Becoming a Teacher of Mathematical Modeling, Grades 6–12* (Arnold et al. 2021b).

These books will help you learn more about the process of modeling and conceptualize what modeling could look like in your classroom. We also invite you to watch two webinars related to modeling: Grades K–5 (link online) (Fulton and Wickstrom 2022) and Grades 6–12 (link online) (Arnold 2022). —

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