

Points of Emphasis in M103

Often, the study of quadratic functions is drawn together with solving quadratic equations, factoring quadratic expressions, and even polynomial operations more generally. The result is often an unfocused experience that prioritizes factoring quadratics with integer coefficients. Most important, not enough emphasis is paid to the power of quadratic functions as modeling tools.

The focus of M103 reverses this trend, focusing student understanding on using quadratic functions for modeling purposes. Key characteristics of M103 include the following:

- A distinct shift towards using functions, represented algebraically, in tables, and in graphs, to examine real-world situations, including projectile motion, business profits and losses, design problems involving area, and more (LP 1).
- Real-world tasks should be at the center of all work with quadratic functions in this badge. Students should be given tasks that require engagement with multiple parts of the modeling cycle and should name their own assumptions and variables as much as possible (LP 1).
- Students should also be given choice of representation (table, equation, graph, or others) in creating models (LP 4).
- Students can engage socially by collaborating with each other and sharing and discussing their solution methods (LP 2).
- Tasks can be organized around topics, allowing students to have agency by choosing what they are interested in (LP 4).

Sometimes, in the study of quadratics, significant time can be spent computing with functions or graphing by hand. To aid understanding and allow for students to maximally engage in modeling, students should have access to computer graphing tools.

Students should also be given frequent opportunities to use spreadsheets to model quadratic phenomena, especially as a tool to understand first and second differences (LP 7). The use of technology allows for a focus on model creation and conceptual understanding, as opposed to computation.

Further, students should engage with tasks that do not require any computation, but instead focus on understanding and reasoning with models. As examples, students should:

- explain the real-world meaning of a quadratic model.
- compare two different quadratic models.
- explain the relationship between parameters in a quadratic model and features of its graph.
- use a quadratic model to justify a claim about a real-world context.
- justify the selection of a quadratic model, based either on characteristics of the quantities (e.g., projectile motion) or analysis of the rate of change (e.g., that it is changing at a constant rate) (LP 3).

Many of these reasoning-based activities can be done with partners or groups of any size, allowing for social interaction as part of the learning process (LP 2). The history of mathematics also presents fertile ground for the study of quadratic functions (LP 5).

Instead of focusing only on the applications typically thought of as associated with quadratic functions (e.g., projectile motion), students should also be given opportunities to understand and reflect on the ways that quadratic modeling can use mathematics in authentic situations (LP 6). For example, students can use quadratic functions to examine innovations in recyclables and profits analysis.