

Points of Emphasis in M104

Whereas a typical instructional unit on exponential functions might begin with a focus on students independently performing computations or manipulating exponential expressions disconnected from real-world contexts, in M104, students should:

- regularly encounter real-world tasks involving constant percent change (growth or decay) that require them to employ models and predict values. Common settings for this type of growth include population growth, “viral” memes or internet videos, infectious diseases, finance, and radioactive decay (LP 1).
- engage with multiple parts of the modeling cycle (see above), especially naming their own assumptions and variables and defending their choice of model as much as possible (LP 1).
- be able to choose tasks that are organized around different scientific, social, or other topics, allowing students to have agency in their learning (LP 4).
- frequently collaborate and share their solution methods (LP 2).

Spending time computing or manually completing tables with exponential expressions should not be a focus of this badge. In fact, the opposite is true. In M104, students should:

- regularly engage with tasks that do not require any computation, but instead focus on understanding and reasoning with models. For example, students should:
 - explain the real-world meaning of an exponential model.
 - compare two different exponential models.
 - explain the relationship between parameters in an exponential model and features of its graph.
 - use an exponential model to justify a claim about a real-world context.
 - reason about the differences between exponential and linear models (LP 3).
- have frequent opportunities to use reasoning to relate the algebraic form of an exponential function to its graph (LP 3).
- have opportunities to share their reasoning with partners or in groups, allowing for practice sharing, critiquing, and revising their arguments and including social interaction as part of the learning process (LP 2).

Instead of focusing only on the applications typically thought of as associated with exponential functions (e.g., bacterial growth), students should also be given opportunities to understand and reflect on the ways that exponential modeling can authentically involve real-world situations (LP 6). Some contexts to consider include:

- changes in revenue over time.
- the disproportionate impact of COVID-19 on people living in different zip codes.
- the human impact on the environment.

Often, coursework with exponential functions is focused on performing computations by hand. Instead, students should be given frequent opportunities to use spreadsheets and graphing software to allow for

focus on understanding, rather than computation or symbolic manipulation. Students should write spreadsheet formulas to model phenomena that exhibit exponential growth or decay (LP 7).