

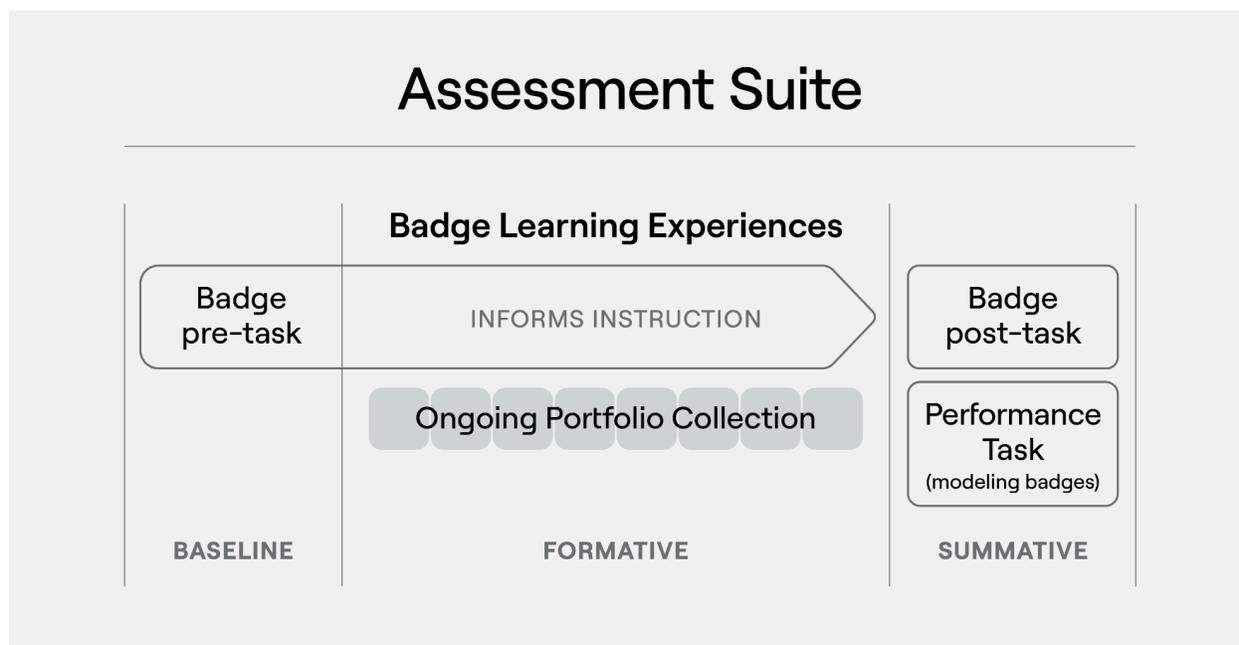
Evidence of Learning

The goal of the badging system is for each student who attempts a badge to earn it. This is in stark contrast to how the current mathematics education system is set up: mostly as a filtering and sorting mechanism that presents obstacles and provides little opportunity for students to exercise autonomy in the ways that they demonstrate evidence of their learning. It is important to state this upfront because a more humanizing mathematics experience means that we must think differently about how we provide opportunities for students to earn a badge and how we ensure their success along the way.

Each badge framework describes the forms of evidence of student learning that can be used to award the badge credit. Teachers are encouraged to flexibly integrate evidence from multiple sources to determine whether students have demonstrated their understanding of the knowledge and skills required by the content and practice demands of the badge.

Forms of Evidence

Students earn badges by providing evidence that demonstrates mastery of the badge Content and Practice Expectations in a multiple-measures system. An example of how this evidence may be collected and evaluated throughout badge learning is shown in the diagram below.



These different forms of evidence of student learning are described in more detail in the sections that follow.

Portfolios of Evidence

A Portfolio of Evidence consists of a set of student-produced artifacts aligned to the Content and Practice Expectations. These artifacts are collected from student work through the badging educators' chosen curricular and learning activities, aligned to each badge. Students should be given agency to

choose artifacts that make them proud and allow them to demonstrate their learning through multiple modalities. This provides students with an opportunity to use their voice and reflects the mindsets and habits of professionals who use mathematics in their work. Students are given the opportunity to showcase evidence of their own learning through the work they have done.

Performance Tasks

For badges with a stronger emphasis on mathematical modeling, at least one performance assessment will be included in a student's portfolio to demonstrate successful engagement with the full modeling cycle (Sackstein, 2019).

Performance assessments provide students with the opportunities to show evidence of their learning related to mathematical modeling and application, allowing them authentic ways to demonstrate their ability to apply transferable, real-world skills. For badges that emphasize mathematical modeling, students will have the opportunity to engage in the full modeling cycle through these tasks that feature meaningful context(s.) Students will have the opportunity to report their conclusions using modes and means that are well suited to the overall purpose of the task and that allow for some agency. The following criteria are offered for designing high-quality performance assessments (Safir & Dugan, 2021):

1. Elicits evidence of skills and knowledge matter.
2. Is tight on quality criteria while open to different approaches.
3. Is authentic.
4. Offers a learning activity in and of itself.

For modeling badges and other badges strongly grounded in the application of mathematics, performance assessments are a required component of the badge-earning process. The level of cognitive complexity targeted by the performance tasks is Application Level 3, which is described in the following section.

Pre-Post Badge Tasks

During the 2024-25 school year, there will be Pre-/Post-Badge Tasks available for Badges M101, M102, M103, and M104. These tasks should be administered to students before launching instruction on a new badge and again once badge instruction is coming to a close. These tasks are designed to support students' understanding of what they have learned from the beginning to the end of each badge and to support teachers in making relevant, timely decisions about how they support student learning. Additional development for other badges will be determined based on feedback and interest from educators during the 2024-25 school year.

Badge Mastery Determinations

While there is no single, scientifically “correct” way of making this decision, it can be made in systematic ways supported by evaluation rubrics, student work examples, and evaluation protocols to avoid unnecessary errors and inconsistencies. These evaluation mechanisms need to be documented, refined over time, and empirically evaluated. In this way, developing best practice locally in alignment with professional practices is a valuable professional development opportunity for teachers, school leaders, and district leaders.

The following principles should be kept in mind when designing, implementing, and monitoring local evaluation processes for awarding badges:

- Evaluation decisions should be made in ways that integrate insight from multiple sources. Evidence about the mastery of specific Content and Practice Expectations (CPEs) can typically be found across multiple badge assessments or even multiple components of a single assessment (e.g., Portfolio entries, Performance Task work products). Similarly, a single component within a badge assessment may provide evidence about multiple CPEs.
- Evaluation decisions should not lead to an unproductive dissection of work products that undermines valuable holistic evaluations. For example, XQ advises against developing Portfolios or Performance Tasks with artificially fragmented components or work products because it is believed that each one has to be mapped against one and only one CPE. These assessments should be used to gather rich evidence about multiple CPEs in ways that are authentic, generative, and engaging.

Cognitive Complexity Framework

Cognitive complexity is a measure of the depth of thinking required by a mathematical task or other learning activity. While the Content and Practice Expectations for the badges generally have a range of expected cognitive complexity, it is worth noting that college- and career-ready standards for high school generally demand that students spend a lot of time engaged with deep conceptual understanding and rich applications. The framework for cognitive complexity that is best used for understanding these varied demands is Achieve’s tool for evaluating cognitive complexity in mathematics assessments, which builds on earlier work on depth of knowledge, but provides more specific guidance for varying complexity along the dimensions of procedural skill and fluency, conceptual understanding, and application as required by states’ standards. Table 6 provides an overview of the levels of complexity along these three dimensions (Achieve, 2019).

Table 6. Framework for Evaluating the Cognitive Complexity in Mathematics Assessments

	Level 1	Level 2	Level 3
Procedural Complexity: ¹³	Solving the problem entails little procedural ¹⁴ demand or procedural demand is below grade level.	Solving the problem entails common or grade-level procedure(s) with friendly numbers.	Solving the problem requires common or grade-level procedure(s) with unfriendly numbers, ¹⁵ an unconventional combination of procedures, or requires unusual perseverance or organizational skills in the execution of the procedure(s).
Conceptual Complexity: ¹⁶	Solving the problem requires students to recall or recognize a grade-level concept. The student does not need to relate concepts or demonstrate a line of reasoning.	Students may need to relate multiple grade-level concepts of different types, create multiple representations or solutions, or connect concepts with procedures or strategies. The student must do some reasoning, but may not need to demonstrate a line of reasoning.	Solving the problem requires students to relate multiple grade-level concepts and to evidence reasoning, planning, analysis, judgment, and/or creative thought OR work with a sophisticated (nontypical) line of reasoning.
Application Complexity:	Solving the problem entails an application of mathematics, but the required mathematics is either directly indicated or obvious.	Solving the problem entails an application of mathematics and requires an interpretation of the context to determine the procedure or concept (may include extraneous information). The mathematics is not immediately obvious. Solving the problem requires students to decide what to do.	In addition to an interpretation of the context, solving the problem requires recognizing important features, and formulating, computing, and interpreting results as part of a modeling process.

13. This is based on the NAEP States Item to Item Comparison Study, NAEP Validity Studies Panel; Philip Daro, Gerunda Hughes, Sami Kamito, Fran Stancavage, Natalie Tucker-Bradway; American Institutes for Research, 2018.

14. A procedure is a step-by-step sequence that can be memorized and executed without understanding or attending to the meaning of the quantities; a procedure is useful for a class of problems or situations. Computations that are likely to be known from memory are considered procedural.

15. Unfriendly numbers: The student is likely to get the problem wrong not because of the targeted procedure but because of the numbers involved.

16. This is based on the conceptual aspects of the Mathematics Framework for the 2015 National Assessment of Educational Progress; National Assessment Governing Board, 2014.