

XQ Guidance for Designing: Learning Principles

Each badge framework is grounded in a set of Learning Principles that serve as a foundation for designing student learning activities that help them meet the Content and Practice Expectations for the badge. These Learning Principles should guide the creation—or alignment and adaptation—of instructional materials for badges. All badge-related content engages students in experiences that reflect and are supported by these seven core Learning Principles (LPs):

Engage with cognitively demanding tasks in heterogeneous settings (LP 1). Students should be given opportunities to grapple with multistep, non-routine tasks that promote mathematical rigor. These experiences should be differentiated so that all students engage in appropriate challenges, for example, through tasks with multiple entry points and solution pathways. For many badges, these experiences should continue to integrate knowledge and skills developed in grades 6-8 at the level of sophistication of high school mathematics.

Engage in social activities (LP 2). Students should have opportunities to work independently and communicate with one another about mathematics by engaging in collective and collaborative learning activities. Explaining, receiving feedback, and having opportunities to revise one's thinking has excellent value for solidifying one's knowledge.

Build conceptual understanding through reasoning (LP 3). Students should be given the opportunity to reason, justify, and problem solve with critical thinking, reading, writing, speaking, and listening. By reasoning and working with multiple representations, students learn why procedures work and build conceptual understanding of key mathematical ideas.

Have agency in their learning (LP 4). Students should be able to choose tasks and learning activities that align with their interests and aspirations. All students have rich and varied experiences and home lives. Learning mathematics should bring students' experiences and interests to the fore and build on the strengths that they bring to the learning space.

View mathematics as a human endeavor across centuries (LP 5). Students should understand that mathematical ideas emanated over time from civilizations around the world and have opportunities to explore these contributions to mathematics. Students should develop an appreciation of mathematics as a human endeavor: one in which they feel a sense of belonging, where they see themselves as mathematicians, and one that offers opportunities to broaden their ideas about what mathematics is, how it is used, and who it is for.

See mathematics as relevant (LP 6). Students should engage with mathematics in ways that authentically involve real-world situations. Problem-solving contexts should allow them to see mathematics as a tool for addressing the questions that arise in everyday life, as well as the ways it can model our world and address complex global challenges. Students should also engage with mathematics in ways that connect both to academic disciplines and future careers by doing mathematics used by artists, designers, engineers, and other professionals.

Employ technology as a tool for problem-solving and understanding (LP 7). Research indicates that technology is a powerful tool for learning deeper mathematics by improving calculation efficiency and enabling more sophisticated analyses. Students should learn to use technology, with emphasis put on widely used tools and software, such as calculators, spreadsheets, and data visualization tools, to make sense of models. Technology use should not be limited to supporting “doing mathematics,” but should also be used as a tool for critically reasoning about, displaying, and communicating results to appropriate audiences.

To illustrate how the Learning Principles intersect with the frameworks, each framework describes the **Points of Emphasis** for the badge and has **Annotated Examples** of learning activities that can be used to support students’ engagement with the Content and Practice Expectations. These examples do not provide comprehensive coverage of those expectations but rather elevate some of the learning principles less likely to be part of published curricular materials for mathematics instruction.