

Developing an Engineering Design Lesson

The Skyline Design Activity starts by considering what we wanted children to know and be able to do using *Understanding by Design* as a guide. In this case we were interested in surface area and volume of three-dimensional figures, which are key concepts in 6th grade mathematics. In thinking about multi-faceted assessment, the design portfolio scaffolds and allows for assessment of student work in demonstrating their understanding through the use of Knowledge and Skill Builders (KSBs), as well as with the design and construction of a skyscraper that meets geometric specifications. The specifications require students to have a knowledge of surface area and volume, and be able to use that knowledge in the design process. There are two levels of assessment opportunity, the KSBs and the final design. The Teacher Resource Guide contains sample rubrics for design assessment for students and teachers. In addition, the extension questions at the end of the design seek to probe student understanding by asking them to apply their knowledge to new situations. This transfer of knowledge is another important element that can be assessed.

The Design Portfolio also allows teachers to assess understanding of key ideas in engineering, e.g. understanding of specifications and constraints, trade-offs and optimization, modeling, in this case representational modeling. The use of digital tools in performing the task, e.g. ModelMaker and the digital fabrication, aligns with important ideas from ISTE standards. Both are included in the forthcoming NAEP standards and probable assessments.

This design activity uses a formative design process, rather than a summative design process. In the summative design process, a design challenge occurs at the end of a unit as a culminating activity. In the formative design process, there are several designs of increasing complexity, applying new knowledge. The formative design activity is pedagogically more powerful, but takes more time. In the Skyline Activity, the initial design activity just specifies three geometric shapes for the skyscraper. Then, the student is asked to revise the design as the scenario changes and developer has volume and area specifications to add. The students must revisit the prior knowledge and add to it. This could be extended, of course. However, the number of redesigns needs to be limited, perhaps to two, three at the most, or students may lose interest in the topic.