Chapter 7
Tower Design, Build and Test as a STEAM Project: Tower Design, Build, and Test

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EXECUTIVE SUMMARY

The next generation science standards promote the teaching of engineering skills including the designing, testing, and building of models. Tower building can yield real world experience that not only provides the student with physics and mathematics through motion and stability but also through the explanation of the use of models and the engineering practice of design, redesign, and testing of these models. Tia Pliskow used the project of building a tower with her middle school students in order to provide a cooperative team long-term project. She focused first on the design, using background information on existing towers. She required each team to design their tower first using graph paper and scale. This process stressed the need for science, technology, engineering, art, and mathematics. The case included in this article expands her process by including a cost analysis attempting to promote real world engineering, links to more content, and final project photos. In addition, by building a shake platform, a test for the tower is added.

INTRODUCTION

Designing and building a tower project requires that students utilize and explore each component of STEAM (science, technology, engineering, art, and mathematics). The physics of force and motion combine with the effects of earth movement, wind,

and other geological factors. Also, the mathematical calculations affect the design and structural integrity of the tower. The history of towers including the newest and largest structure may motivate students to embark on a fascinating journey that perhaps winds back to the pyramids and ends at the Burj Khalifa. This journey also provides students with historical and modern engineering role models with information concerning their interests and their passion for this art form. Also suggested is research on disasters such as the collapse of the bridge in Minneapolis, Minnesota in 1961 with information on whether the collapses are caused by design flaws, material problems, and/or lack of maintenance.

Researching past and present structures accompanied by foundational scientific and mathematical research before students design and carry out the activity is the basis for the STEAM approach to learning. All disciplines combine to develop the problem and to form a new solution. The building, testing, and redesigning not only strengthens the process but emphasizes the importance of the research process.

This approach varies from past practice because it embraces the research process and the STEAM philosophy. This chapter provides the practitioner with a sampling of the history of a number of towers with suggestions for further research. The history intertwined with science, mathematics, and engineering provides the foundation needed to proceed to design and redesign. The activity itself leads students into the building and testing which naturally leads them back to the design. The students will:

- Practice structural design, model development, and engineering to be assessed by their designs, models, model tests, and redesigns.
- Focus on motion and stability, assessed by observation questions and applied design.
- Use mathematics and computational thinking, assessed by observation questions and applied design.
- Explain the use of models in writing, assessed by observation questions.
- Research towers globally, assessed by observation questions.
- Interact in teams, assessed by teacher informally and by observation questions.
- Research structural disasters.

STANDARDS

Next Generation Science Standards

Dimension I: Scientific and Engineering Practices (1,2,3,4,5,6,7,8) including asking questions and defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics