Madison Public Schools

Grade 7 - Unit 6 - Engineering Bridges PBL (Extension Unit)

Unit Focus

After observing different types of bridges around the world, students will make predictions about how bridge structure relates to function as they prepare to build their own bridge. Students will investigate their predictions with computer simulations of the various forces that act on bridges and through practice builds. Ultimately, student will use the Engineering Design Process to create a bridge that can withstand a variety of applied forces.

Stage 1: Desired Results - Key Understandings

Established Goals

Next Generation Science

Middle School Engineering Design: 6 - 8

- Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. *MS-ETS1-1*
- Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. *MS-ETS1-2*

Next Generation Science Standards (DCI)

Science: 7

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. *ETS1.6.B1*
- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process-that is, some of those characteristics may be incorporated into the new design. *ETS1.6.C1*
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. *ETS1.6.B4*
- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. *ETS1.6.C2*

Transfer

T1 Create models to explore complex systems, show mastery of key science concepts, and/or develop solutions through creation of a product open to testing and redesign.

Meaning

Understandings	Essential Questions
U1 Established knowledge provides the foundation for future scientific and engineering advances.	**Q1** How does structure relate to function? **Q2** Based on current information, how do I develop a testable design? 3-12 **Q3** How do I use tools and materials to carry out my test? How do I collect and record quality data?

Acquisition of Knowledge and Skill

Knowledge	Skills
K1 The Engineering Design Process is a systemic process for planning, testing, and redesigning. **K2** Bridges and structures can be designed in different ways to withstand certain loads and potentially destructive forces. **K3** Engineers and scientists build models of bridges, conduct controlled experiments to learn how they will withstand various stresses, and consider the trade-offs of various design alternatives. **K4** Bridges can fail because they have faulty parts, are	**S1** Effective application of the Engineering Design Process to develop a structure that functions as intended. **S2** Conduct experiments to discover how different types of bridges are able to support a load based on the interplay of tension and compression forces that result in a net force of zero (no movement). **S3** Use technology and other tools to simulate how engineers plan, test and revise designs of bridges give parameters including cost, time, safety, and aesthetics.

Stage 1: Desired Results - Key Understandings		
Student Growth and Development 21st Century Capacities Matrix *Creative Thinking* • Design: Students will be able to engage in an appropriate process to refine their product. *MM.2.3* *Self-Direction* • Perseverance: Students will be able to identify problem(s) and use appropriate strategies to continue toward a desired goal. *MM.4.2*	used in ways that exceed what was intended by the design, or were poorly designed to begin with.	