Bridges Demonstration

Lesson Source(s)	▪ Douglas R. Carroll, Department of Basic Engineering, University of Missouri-Rolla ▪ Museum of Science, *Engineering is Elementary*, To Get To The Other Side: Designing Bridges
Grade Level	Suggested grades K-8 , high school wizard available upon request
Abstract	This lesson introduces students to engineering through the creation of a six-foot long structurally sound bridge that they can crawl across. A pictorial presentation helps the students identify many different types of bridges: truss, stone arch, steel arch, concrete girder, cable-stayed, and suspension. The fundamental engineering concepts of tension and compression are introduced.
Objectives	▪ Students will discuss some of the problems, criteria, constraints, and solutions associated with designing bridges. ▪ Students will recognize the role of civil engineers in designing structures. ▪ Students will identify forces that act on structures. ▪ Students will understand that pushes and pulls (tension and compression) must be balanced, or a structure will move or collapse/fail. ▪ Students will observe different types of bridges with different kinds of supports. ▪ Students will recognize that the shape of a bridge affects how well it can distribute forces and support weight. ▪ Students will build and test their own bridge.
Pre-Visit	_____ Complete the *W.O.W! Photo Release* Form _____ Make sure there is ample floor space for construction _____ Review Engineering and Technology
Photos/Video	**Kit Photo(s):**
Post-Visit	_____ Complete the brief post-visit survey http://www.surveymonkey.com/s/WOWDemoSurvey
Best Teaching Practices	▪ Learning Cycle ▪ Hands-on/Minds-on Learning ▪ Discussion ▪ Probing Questions
Standard Alignment	As a result of the demonstration, students should develop an understanding of

	▪ Properties of objects and materials ▪ Position and motion of objects ▪ Motion and forces ▪ Balance and Weight ▪ Transfer of energy ▪ Abilities of technological design ▪ Understanding about science and technology ▪ Abilities to distinguish between natural objects and objects made by humans ▪ Abilities necessary to do scientific inquiry ▪ Understandings about scientific inquiry
Content Knowledge	Civil engineering is the branch of engineering concerned with the design and construction of public structures. From houses and roads, to bridges and tunnels, civil engineers help to design all of the essential structures of the modern world. The origin of civil engineering dates back thousands of years. One of the greatest challenges for civil engineers is designing structures appropriate to the environmental conditions in a particular region. Civil engineers must ensure that the structures they design will be sturdy and safe. Bridges are designed to balance and diffuse the forces acting on them, including tension, compression, and gravity. If a bridge is not properly designed to withstand the forces acting upon it, it will fail. The most basic force acting on a bridge is gravity. Gravity pulls down on the parts of the bridge and on people or vehicles crossing it. Weight is actually a measurement of the force of gravity acting downwards on an object (load). For every force acting on the bridge, such as gravity, there must be a reaction equal in force and opposite in direction (according to Newton's Thrid Law of Motion), which means that the bridge must, in turn, push upwards to overcome the downward force of gravity and support the people and vehicles on it. The forces stressing the materials of the bridge are another part of the reaction. Tension is the force pulling a material apart. Compression is the force squashing a material together. Engineers need to know what forces will be acting upon each part of the bridge, so they can choose the right materials to withstand those forces. A wooden post is good for withstanding compression because it keeps its shape when squashed. A steel cable is good for withstanding tension because it keeps its shape when pulled. The beam in a beam bridge is a classsic example of a structure that needs to withstand both compression and tension. The top of thebeam is under compression, while the bottom of the beam is under tension. For this reason, deeper beams are necessary for holding greater weights and for spanning longer distances. A deeper beam has more materials to withstand both the tension and the compression acting upon it. The Bridge Wizard will provide numerous pictures illustratrating various bridge types and discuss in detail the forces that act upon each type.
Safety	Constructed Bridge easily holds one student, 200 lbs. maxium weight
Applications	Civil Engineering, Design Process, Modeling and Simulation
Assessment	Observe student participation in the activity Observe student participation in discussion
Other Considerations	**Additional Materials/Resources:**

	▪ *Javier Builds a Bridge* – A Civil Engineering Story (lower grades) ▪ *Engineering is Elementary*– Museum of Science supplimental materials ▪ http://www.mos.org/EiE ▪ American Society of Civil Engineers http://www.asce.org ▪ American Society of Engineering Education http://www.engineeringk12.org All materials available from the W.O.W! Lending Library upon request
Skillsheet(s)	n/a