Bridge Builder - Building Math Skills

This module addresses comprehensive aspects of the design and building of bridge structures. Numerous concepts are introduced independently and then they are synthesized through a series of experimental demonstrations, hands-on projects, and computer-based simulations.

One Bridge Builder Module will supply hands-on experience for 1 group of 20 students.

	Estimated Classroom Time	Module Contents
Activity 1	10 minutes reading 30 minutes class time	Teachers Guide Manual Balsa Wood S-Hook Wood Glue Ruler U-Bolt Bracket Painter's Bucket Long Pins Wax Paper Measuring Cup Drafting Paper Model Smart 3D Software Microstation V8i Software Xacto Knives
Activity 2a, 2b, 2c	10 minutes reading per activity 20 minute lab prep per activity 30 minutes class time	
Activity 3	40 minute teacher prep 30 minutes class time	
Activity 4	30 minute teacher prep 90 minutes class time	
Activity 5	30 minute prep time 3 hours class time	

Activity 1 is an interactive computer-based introduction to the basic concepts employed by the structural engineer when designing and building bridges. The students will first examine the main challenge facing a bridge designer, which is the identification of the different types of loads that a bridge must be capable of withstanding. Specifically, they will be taught the following concepts:

- Dead Load (weight of the structure itself)
- Live Load (weight of anything on the bridge, including cars, people, and snow)
- Other Loads (including earthquake forces and stresses due to temperature fluctuations)

Then, the module will address the types of forces that bridge elements must withstand (tension, compression, and bending) and ways different materials (concrete, wood, and steel) are suited to withstand each type of force.

After this introduction has been presented, students will begin to study the different types of bridges (suspension, girder, arch, and truss) and the factors that go into deciding the most suitable type of structure for a given location. Then, they will look at the individual building blocks (connections, cables, columns, beams, arches and struts) that make up each type of bridge. Specifically, each of these elements will be discussed in terms of the forces to which they will be subjected and appropriate materials for their construction. Online demonstrations illustrate these points.

Activity 2 involves in-class demonstrations that illustrate some of the key structural concepts that are essential to understanding how basic bridges behave. Students can see how the efficiency of a simple structure is affected by its basic geometry.

Activity 3 gives the students an introduction to computer-based design. The Model Smart program allows them to design computational bridge models that can be used to predict overall structure strength and weight. This program allows the students to define the bridge geometry, choose the material properties, and apply different loading situations. After designing the bridge, a computational analysis can be performed that shows the students how their models deformed and failed under the given loading state.

Activities 4 and 5 allow the students to take part in hands-on activities that guide them through the process of building their own bridges, which they will test in class as part of a design competition. The judging of each student-built structure will be based upon the overall weight of the structure and its performance, which will be measured by applying incremental loads to the structure until it fails.

NOTE: Class visits by NDDOT TRAC volunteers are available for this module. These visits include a presentation on bridge construction and engineering.