Introduction for Educators

The Maryland Department of Transportation State Highway Administration (SHA) has prepared the Bridging Maryland, Becoming Engineers Lesson Plan for free use to aid educators in guiding students in learning about basic bridge engineering and the Engineering Design Process through a combination of information presented about historic bridges and through hands-on problem solving.

Grade Levels

The target grade levels for this Lesson Plan are Grades K-3.

Class Time

It is expected that each lesson and the associated activities will require class time of approximately one hour, for a total of two hours, spread over two days.

Preparation Needed

The educator leading the Lesson should schedule time to review the presentations in advance to allow time to gather the needed materials for the bridge model activity.

Materials needed for the K–1st Grade bridge model activity include:

- Two (2) Toilet tissue rolls
- Three (3) 4-inch by 10-inch strips of cardboard
- Blue paper cut to represent a stream
- Toy car
- Tape

Materials needed for the 2nd–3rd Grade bridge model activity include:

- Two (2) Identical tissue boxes
- Cardstock paper for the bridge deck
- toy car
- bag of 100 pennies
- Notepad and pencil
- Tape
- Narrow slip of plain paper with a road drawn on it.

Standards

A list of Next Generation Science Standards (NGSS) Science and Engineering Goals met by this Plan is included as an appendix.

Lesson Plan Components

- *Bridging Maryland, Becoming Engineers (Grades K-3)*, Part 1, a PowerPoint providing a general introduction to bridge purposes and materials, as well as an introduction to the Engineering Design Process (60 minutes).
- *Bridging Maryland, Becoming Engineers (Grades K-3)*, Part 2, a PowerPoint that presents reviews the Engineering Design Process and parts of a bridge. It provides instructions for building a prototype of a basic bridge deck unit. The students, working individually or in teams, are invited to build this prototype. Students will test, optimize, and share their designs (50 minutes).
- An Exit Ticket that provides students an opportunity to document their design and optimization and answer the essential question (7 minutes to answer question, 3 minutes to collect and end the day).

Suggested Extensions

Minnesota also offers lesson plans on bridge engineering. It can provide additional information and activities for bridge engineering units.

- *Bridge Up!* Curriculum from Minnesota Department of Transportation (Lessons for all grade levels) http://www.dot.state.mn.us/stem/curriculum.html

Additional Maryland-related Bridge Resources:

- Book: *Historic Bridges of Maryland* by Dixie Legler and Carol M. Highsmith. 2002. Available in local libraries and can be ordered from the Maryland Historical Trust: https://www.roads.maryland.gov/mdotsha/pages/Index.aspx?PageId=235 or online: https://archive.org/details/historicbridgeso0000guer
- Brochure: *Maryland's Historic Highway Bridges* (classroom sets may be available): https://www.roads.maryland.gov/OPPEN/MD_Historic_Highway_Bridges.pdf
- GIS: *Maryland Bridges in Black and White, Maryland Department of Transportation State Highway Administration*: https://roads.maryland.gov/mdotsha/pages/Index.aspx?PageId=359

- Story Map: *Maryland's Historic Highway Bridges*: https://maryland.maps.arcgis.com/apps/Cascade/index.html?appid=6e47ce93010642a3a65cc9309ecd9e4a

Appendix 1.

The Building Bridges, Becoming Engineers Lesson Plan also meets the following Next Generation Science Standards (NGSS) Science and Engineering Practices for Grades K-3:

1.A.1. Constructing Knowledge: Raise questions about the world around them and be willing to seek answers to some of them by making careful observations and trying things out.

1.D.1. Technology: Design and make things with simple tools and a variety of materials.

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.