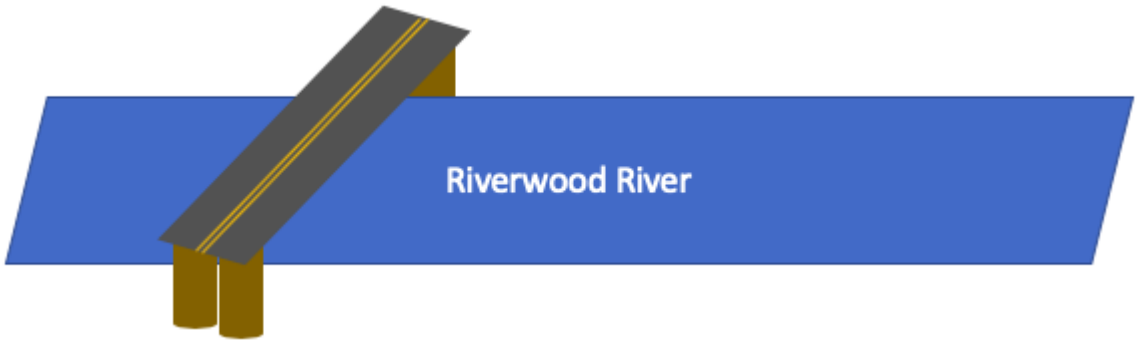
Bridge-Building from Recycled Materials

Bridge-Building:

Paper, cardboard, and many other materials found around the house may seem flimsy, but you can use them to make a bridge that is quite sturdy! In this activity, you'll be able to build a bridge that can hold a book, or two, or maybe even more! The setting of the challenge is Riverwood, a town that has opened a competition for bridge-builders. You will run your own construction and design company that is competing for the contract to build a bridge for the town of Riverwood.



Your project:

The town of Riverwood has decided to replace its old bridge. In the recent referendum that was passed, the people of Riverwood decided to set aside $1,000,000 for a new bridge. They want the bridge to have a pedestrian walkway, two lanes for cars, two bike lanes, and to be tall enough for sailboats to pass beneath. Your design and construction company has decided to enter the competition to design and build the bridge for Riverwood and its people. The bridge that meets the specifications on the next page and that holds the most weight (in books) will win!

This activity is courtesy of ICE, the Institute for Chemical Education at UW-Madison's Chemistry Department. It is adapted from an Engineering Challenge Activity at a hands-on Fun with Chemistry Camp program.

Specifications:

- The bridge must span a distance of at least 8 inches.
- The bridge must be free-standing. It cannot be attached to a surface.
- The bridge supports can only rest on the riverbanks and not in the river.
- The maximum amount spent on materials can be $1,000,000; use ten bottle caps, can tabs, marbles, pebbles, pencil eraser caps, or something else found around the house to represent $100,000 each. (Choose something that can be reused or recycled)
- The bridge surface must be flat. A double-striped line should divide the two sets of lanes for cars.
- There must be a marked pedestrian walkway.
- There must be two marked bike lanes, one for going each direction across the bridge.
- The bridge must be at minimum 4 inches above the surface of the river so that boats can pass beneath the bridge.
- The bridge must be able to support the weight of the cars and trucks that will drive on it.

Suggested Materials List:

The bridge can be made primarily with materials found around the house that would be recycled.

- 12 inches of tape ($100,000)
- 4 sheets of standard-sized paper (8.5 x 11.0 in), sold only in a set of 4 ($100,000)
- 10 rubber bands ($100,000)
- 10 popsicle sticks ($100,000)
- 1 stick of hot glue** ($100,000)
- 50 toothpicks ($100,000)
- 10 old pencils ($100,000)
- 1 cardboard box ($500,000)
- 12 inches of yarn/string ($100,000)
- Anything else in the recycling that is safe to use that is going to be recycled! (Cost can be determined by those running the challenge!)
- Scissors**, a ruler, markers for drawing the lines, drafting paper, pencils ($100,000 to “rent” for the entirety of the building challenge)

****Note:** *It is strongly recommended that young children be supervised when handling scissors and that parents/guardians handle the hot glue to prevent injuries.*

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Diagram of the Setup with Measurements

Bridge-Building Competition:

- Each bridge should be tested one at a time.
- Place the books on the bridge one by one, in the same order for each bridge to maintain consistency.
- If the bridge tips over, the number of books that the bridge was able to support is one fewer than the number of books placed on the bridge during the trial.
- If the bridge collapses, the number of books that the bridge was able to support is one fewer than the number of books placed on the bridge during the trial.

Materials Provided:

- On the next page we have provided a drawing of the Riverwood River that measures 6 inches across. This can be printed so contestants can build the bridge across it.

Learning Objectives:

- Introduction to design—if a sketch is made before the bridge is built, this activity can be a fabulous introduction to design by incorporating explanations for various features found in the design of the bridge.
- Introduction to budgeting—budgeting is an important life skill. Making a budget and sticking to it has applications in both industrial settings and in daily life. In this exercise, paying for the use of scissors, measuring tools, and drawing utensils, substitutes for the cost of running the machines used to build bridges and bottle caps, marbles, etc. substitute for money.
- Environmental Impact—adding a support pillar for a bridge that goes directly into the river may be the only option for some longer bridges, but putting a support in

a small river can be highly disruptive for aquatic life and the construction projects that involve digging in the river can dramatically increase turbidity downstream during the project.

Modifications:

- *If only one person is participating in the engineering activity…*

Guess how many books the bridge will support and see if your bridge meets or exceeds your expectations! If the bridge does not, consider how you would re-design the bridge or modify the bridge to hold more books and test your theory!

- *If the budget is too low and/or the prices of the materials are too high…*

The budget in this activity and the cost of the materials for the activity listed above are suggestions. It is possible to complete the engineering challenge with a modification to the budget or modifications to the cost of materials. It is encouraged that the participants discuss and come to an agreement about the budget and the cost of the materials prior to beginning the competition.

- *If the dimensions of the bridge are too large or too small…*

The dimensions of the bridge in this activity are suggestions. It is encouraged that the participants discuss and come to an agreement about the dimensions of the bridge prior to beginning the competition.

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