STEM Connections

Toothpick Bridges

Below are ideas for connecting the Toothpick Bridge activity to STEM concepts and principles. For more ideas and detailed STEM lessons, consult the *Toothpick Bridges Teacher's Guide*.

ACTIVITY OVERVIEW

Students design, build, and test bridges constructed from toothpicks. Students can come up with their own designs, or they can model a bridge they see in a book or in their area.

SCIENCE

Stability and Change

Have students design a toothpick bridge that they think will be able to support a great amount of weight and will be a stable structure.

When this is completed, have students begin testing their bridges with the Pitsco Toothpick Bridge Tester or a similar device. Students will gradually add mass to the tester and observe and record any visual or auditory changes from their bridges. They should make notations each time mass is added, and the notations should include the amount of mass added.

Students continue to add mass until the bridge breaks.

If available, students can record this procedure, adding notes to the video or providing videos or pictures in addition to their written observations.

When this is completed, have a class discussion about stability and change – have students reflect on their experience with their bridges. Have students compare and contrast their bridge stability (did it twist, bend, break individual members, and so on) and what changes occurred as they added weight to their bridges.

One variation to this activity is for some students to use square toothpicks, round toothpicks, or flat toothpicks. As a class they can compare and contrast any differences.

ENGINEERING

Gusset Construction

In this activity, students will evaluate the effectiveness of the use of gussets in bridge design.

Have students design a toothpick bridge that they think will support the greatest amount of weight. They should do two or three sketches of bridge designs and then choose one for their construction.

Students should construct two identical bridges, being careful to make each bridge the same. Have students add paper gussets to one of the bridges, gluing a gusset (radius = about 1/2") onto each joint on the bridge sides. The gussets can be made from ordinary copy paper.

After construction is complete and the glue has dried, students test the two bridges to destruction using the Pitsco Toothpick Bridge Tester. Have students record their results, and have them contrast and compare the results (both observations and total load data) between their two bridges.

Students can also research the use of gussets in bridges and other structures and include that research in a report about their two bridges.

TECHNOLOGY

Construction Technologies

In this activity, students will determine the relative strength of various adhesives.

Have students design a toothpick bridge that they think will support the greatest amount of weight. They should do two or three sketches of bridge designs and then choose one for their construction.

Students should construct three identical bridges, being careful to make each bridge the same – with the exception of the type of adhesive that they use. Provide several options for adhesives, and options could even include various concentrations of water-soluble glues. Some options include (use age-appropriate discretion):

- CA adhesive (superglue-type adhesive) – several options within this class are available as well
- White glue (typical Elmer's variety glue)
- Wood glue (aliphatic glue – carpenter's glue)
- HD Bond II (secret formula, quick bonding)

Have students complete their bridges and test them to destruction using the Pitsco Toothpick Bridge Tester. Have students record their results, and have them contrast and compare the adhesives they used in either a written or oral report.

MATH

Modeling Cost Analysis

Many real-world math problems include those involved with costing. How much cost is involved with the production of a product?

With the toothpick bridge activity, costs are designated for each material needed for bridge construction. These costs can be set arbitrarily, but effort should be made to keep the relative ratio of material costs comparable to real-world costs of similar materials.

Labor and time costs can also be built into the activity; again, these can be completely arbitrary.

When the costs are known, students are provided a listing of those costs. Their goal is to build a toothpick bridge that will be both cost efficient and structurally efficient.

If desired, students can use play money to pay for materials and labor, or they could write checks and maintain bank balances within the process as well.

A rubric can be set up for scoring/grading, with about 50 percent of the score being from a cost standpoint and 50 percent being from a load-bearing standpoint. Bridges are tested with the Pitsco Toothpick Bridge Tester to determine the amount of load-bearing capacity they have.

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