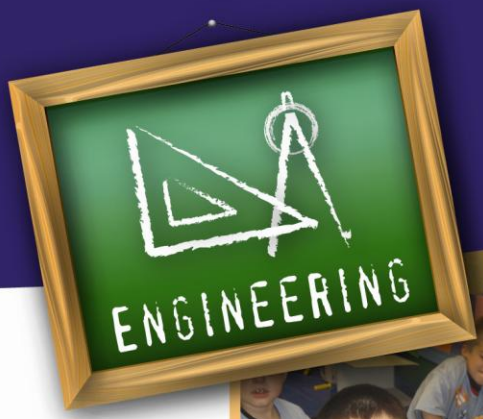
techathalon

BRIDGE BUILDERS



Overview

Using environmentally responsible materials, participants will build a bridge. The bridge will demonstrate creative use of engineering principles and must support a given weight, span a specific distance, sustain changes in the environment (e.g. wind, waves, etc.) and, perhaps, float! Materials may be required to meet real-world budgetary constraints.

Learning Objectives

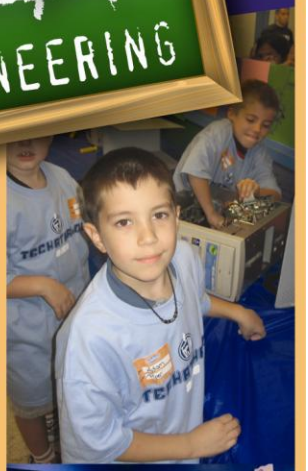
Bridges are structures that span and provide passage over natural or man-made barriers, such as rivers or freeways. There are many different types of bridges (arch, girder, truss, cantilever, suspension, etc.). Although no two bridges are alike, all bridges have some common elements. **Abutments** are structures that support the ends of a bridge or anchor it cables. **Piers** are vertical structures that provide additional support to the bridge. A **span** is the section of a bridge between abutments and/or piers.

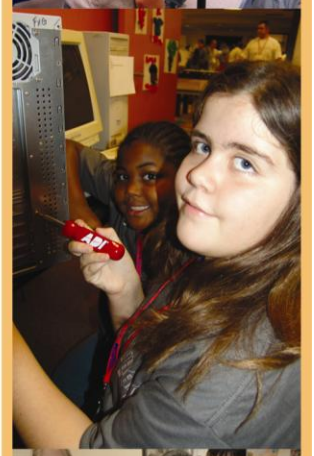
Most bridges work by balancing the forces of **compression** and **tension**. **Engineers** use their knowledge of these forces to design bridges best suited to their environment and purpose. Based on the distance to be spanned, the type and **volume** of traffic as well as forces of natures, engineers may choose different types of materials and principles of design. In addition, engineers may also be **constrained** by **budgetary** requirements. For example, steel may be the best material for a specific bridge, but it may be too expensive to ship to the location.

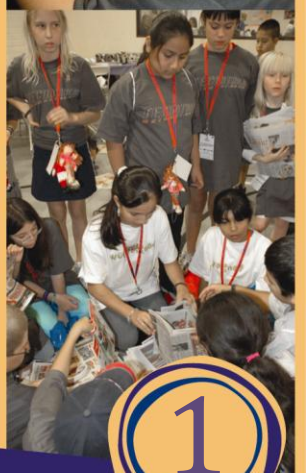
The successful design, construction and testing of a bridge requires the collaboration of team of professionals with unique skills and talents. Engineers, architects, city planners, construction workers, accountants and many others contribute to the final product.

Upon completing this challenge participants will have…

1. Used principles of engineering to design and build a scale model of a bridge.
2. Understood the effects of the environment on structures and the effect of structures on their environment.
3. Practiced basic budgeting skills.







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ENGINEERING

The Challenge

In order to successfully complete this challenge, teams must adhere to the following guidelines:

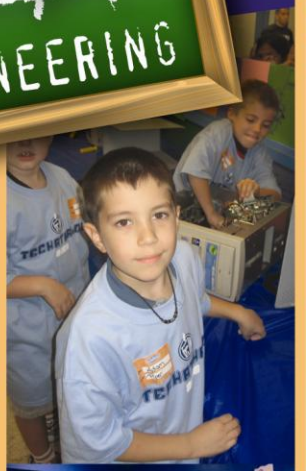
1. Each team will have 10 minutes to brainstorm and prepare rough sketches (blueprints) of their bridge design. Rough sketches should be displayed next to final bridge design and should include the team name as well as the Club name.

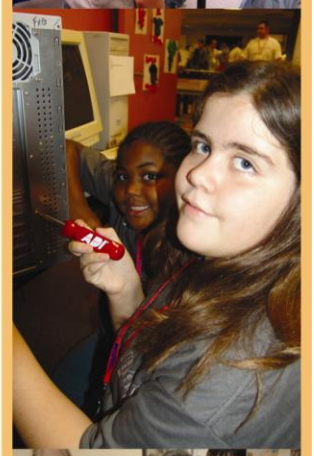
2. Using any combination of the materials (**MATERIALS:** popsicle sticks, tape, string, straws, cardboard, scissors, foam, clay) provided, teams must build a bridge designed to the specifications provided by the challenge facilitator. Facilitator may provide the same specifications to each age division may elect to provide different specifications to each age division. All teams will be required to build a bridge that spans a minimum of 12 inches and sustains a minimum weight of one pound (16 ozs) while floating. Bridges built by teams ages 10 and above must also build bridge that can withstand wind speeds between 2- 8 mph.

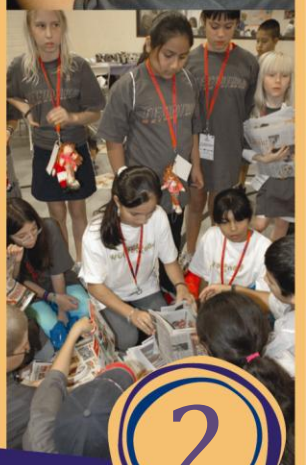
3. Upon completion of the bridge, teams ages 10 and above must complete an *expense report,* detailing all of the items used during creation of the bridge, the cost of each item, and total construction costs of the bridge. Cost of materials will be provided by the challenge facilitator (Ex. Straws - $0.25ea.) Teams ages 13 and above must account for waste produced during construction of the bridge. For example, if the teams damage a straw during the construction process and have to replace it with a new one, they must account for the cost of 2 straws.

4. Upon completion of the bridge, teams must test the bridge and write the following information on their bridge blueprint: maximum load, maximum distance spanned, floatability and wind resistance (where applicable).

5. Finally, all teams will be asked to write a 1-2 sentence reflection on how the bridge they built might impact the surrounding environment.







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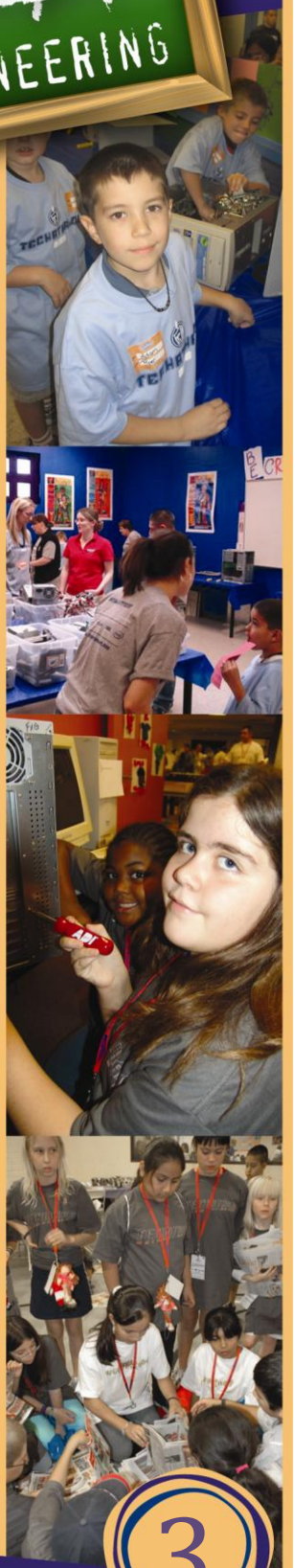
Constructive Response

All bridge designs will be evaluated by a group of trained community volunteers. Volunteers use their professional expertise and education to evaluate and provide constructive criticism on each design. Evaluation rubrics are tabulated and made available to each team after the challenge. Evaluation scores may qualify teams for Techathalon honors during the awards ceremony.

PROJECT SCORING RUBRIC

	4	3	2	1
Blueprint	All parts are drawn to scale and are clearly labeled.	More than half of the parts are drawn to scale and are clearly identified.	Less than half of the parts are drawn to scale and clearly identified.	Parts are not drawn to scale. Labels are unclear and difficult to read.
Troubleshooting	Clear evidence of troubleshooting, testing, and refinements based on data or scientific principles.	Clear evidence of troubleshooting, testing and refinements.	Some evidence of troubleshooting, testing and refinements.	Little evidence of troubleshooting, testing or refinement.
Engineering Knowledge	Explanations by all group members indicate a clear and accurate understanding of scientific principles underlying the construction and modifications.	Explanations by all group members indicate a relatively accurate understanding of scientific principles underlying the construction and modifications.	Explanations by most group members indicate relatively accurate understanding of scientific principles underlying the construction and modifications.	Explanations by several members of the group do not illustrate much understanding of scientific principles underlying the construction and modifications.
Expense Reports	Expense report is neatly done, contains all materials used and totals correctly.	Expense report contains most of the materials used and totals correctly. Report shows attempts at neatness.	Expense report contains most of the materials used but does not totals correctly. Report shows attempts at neatness.	Expense report is missing most of the materials used and totals incorrectly.
TOTAL PROJECT POINTS (OUT OF 16):				



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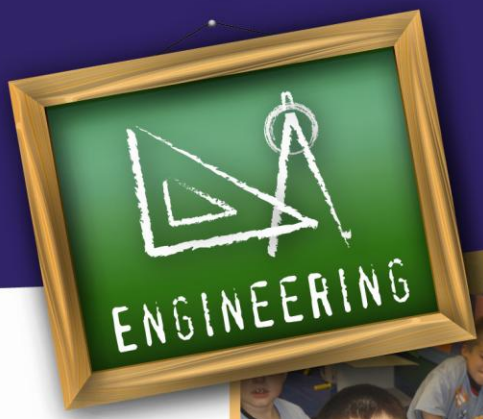
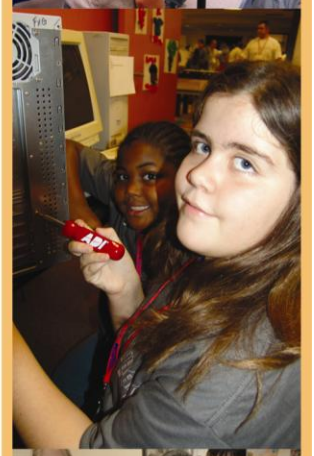


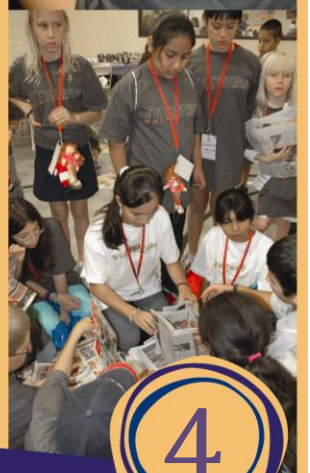
TEAMWORK SCORING RUBRIC

	4	3	2	1
Cooperation/ Collaboration	Team members almost always listen to, share with, and support the efforts of others. Try to keep people working well together.	Team members usually listen to, share with, and support the efforts of others. Do not cause "waves" in the group.	Team members often listen to, share with, and support the efforts of others, but sometimes are not good team members.	Team members rarely listen to, share with, and support the efforts of others. Often are not good team players.
Attitude	Team members are never publicly critical of the project or the work of others. Always have a positive attitude about the task(s).	Team members are rarely publicly critical of the project or the work of others. Often have a positive attitude about the task(s).	Team members are occasionally publicly critical of the project or the work of other members of the group. Usually have a positive attitude about the task(s).	Team members are often publicly critical of the project or the work of other members of the group. Often have a negative attitude about the task(s).
Effort	Project represents the team's best effort.	Project represents a strong effort from the team.	Project represents some effort from the team.	Project represents very little effort from the team.

TOTAL TEAMWORK POINTS (OUT OF 24): _____

(Take total points attained and multiply by 2 for the final score.)





STANDARDS ALIGNMENT

National Academies of Science National Science Education Standards

NS.5-12.2: As a result of their grade level activities, all students should develop an understanding of motions and forces.***NS.K-12.7***: As a result of their grade level activities, all students should develop an understanding of science as human endeavor.

NS.K-12.6: As a result of their grade level activities, all students should develop an understanding of populations, resources and environments.

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