BRIDGE BUILDING COMPETITION

A group design, build and test competition using Expedition Workshed

think up

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Facilitator notes

Introduction

In this exciting group work activity, teams of students compete to build and test to destruction a bridge built from paper and string.

The student brief is to design and build a 1:100 scale model of a footbridge designed to span 120m. Teams must test their bridge by hanging weights from the centre of the span: the team that builds the bridge that can support the greatest weight for the least use of materials is the winner.

Putting students in a structural engineer's boots, this workshop gives students the opportunity to:

- Respond creatively to a brief.
- Understand forces and their effects.
- Consider appropriate use of materials.
- Experiment with design and adapt their designs according to observations.

The Bridge Building Competition requires a minimum of 1.5 hours to complete in a single session, but the workshop can be extended or broken up in order to build in additional tasks, as described in the 'Other activities' section below.

Setting up the space

This workshop is ideally carried out in a large classroom or hall. The students are asked to build a bridge that spans 1.2m. Building the bridge between two desks separated by 1.2m is a good way to simulate this gap.

Students will need desk space in order to assemble the components of their bridge. The final testing of their bridge could either take place at their work station, or at a specially designated testing space at the front of the class.

Material requirements

A4 paper, sticky tape, scissors and string. If you limit the quantity of materials that students have access to from the start then it is easier to measure material usage, and to encourage them to think more creatively about material use. You will require a set of weights for bridge testing (ideally at 100g increments).

Briefing the students

You can brief the students by providing them with a copy of the student briefing sheet. They can access the Bridges Fact File and Materials Fact File in Staffroom which provide links to online interactive resources.

Testing and judging

The aim of the testing process is to test the students' structures to destruction, adding to the excitement of the activity. Test the bridges by adding increasing numbers of weights to the middle of the span.

The students are told that their bridges will be tested according to four criteria:

1. Maximum weight supported before collapse.
2. Efficient use of materials.
3. Elegance of design.
4. Their ability to describe how the materials are transferring the forces in the bridge.

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It is up to you to decide how to weight each of these factors. You could simply rank the each bridge for each factor (higher rank, greater score), and add up the scores to determine the winner.

Other activities

In addition to the basic requirements of the student brief, there are many ways to add to this activity to meet particular curriculum needs. Below are some suggestions.

Producing a drawing

Ask students to produce an accurate drawing of their final bridge structure, showing the dimensions at full scale in order for students to practice converting from one scale to another.
Ask students to produce an artist's impression of the bridge that could be used as part of the planning approval process with the local council.

Experiment

Ask students to predict how their bridge will fail, and then to design and run an experiment to monitor the failure of their bridge. They could for example measure the vertical displacement of the central span or the horizontal displacement of any supporting towers as they add weight to the structure. Students can plot their results and try to explain their findings.

Design and test

Given more time, teams of students would have the opportunity to test a number of different bridge designs before deciding on and building their final model. As part of this process, students could set themselves a design specification and evaluate each design according to this specification, and then evaluate how their final design performed under final testing.

Communicate

Ask students to make a presentation about their bridge to their peers. You could ask them to describe why they chose the design they did, and to explain how the bridge ultimately failed.

Ask students to produce a multi-media presentation about their bridge (for example, a photo montage or short video). See the 'Bridge Case Study Multi-media Competition' for additional guidance on shooting video and taking photos.

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Student brief

Intro

Bridge building is one of the clearest and most eye-catching examples of the work that engineers do. The development of bridge design maps closely to technological, economic and social development and the development of interconnected societies; yet even as long ago as Roman times, engineers have been capable of building bridges at awe-inspiring scales.

The aim of this competition is to put you into a structural engineer's boots and to work in a team to develop and test a design for a bridge to span 120m.

In addition to the brief outlined here, you supervisor may ask you to carry out additional activities along the way.

Brief

Work in teams to design a bridge that spans 120 metres at 1:100 scale. In the time available you must build the lightest, strongest bridge you can, using only A4 paper, sticky tape and string.

The bridge must have a single span of 1.2 metres, with no additional supports in the middle.

The bridge may be attached to the supports, and to the 'ground' anywhere behind the supports (if for example you are building a suspension or cable-stayed bridge).

The bridge must be built from the sides – i.e: no one standing in the water!

Testing and judging

Your bridge will be tested to destruction by hanging more and more weights from the centre of the span until it collapses.

The winning bridge will be decided according to four criteria:

1. Maximum weight supported before collapse
2. Efficient use of materials
3. Elegance of design
4. Your ability to describe how the materials are transferring the forces in the bridge

Starting points

- What type of bridge? Use the Bridges Fact File.
- What materials do you have at your disposal?
- How will you build the bridge, given that you are not allowed to 'stand in the water'.
- Organise your team.
- One part of your team could research bridge types whilst the other could research materials.
- Once you have a design for your bridge, you may need to form your own production line in order to construct all the elements necessary for the bridge.
- Who in the team is going to assemble the final structure?

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