Designing a Bridge:

Time and cost factors.

OBJECTIVES

Students will:

1. Design and build a model bridge to meet a series of criteria.
2. Calculate the costs of the materials they need for their bridge.
3. Compete with other teams to meet the design specification at the lowest cost and within the allotted time frame.

MATERIALS

Each team of 4–6 students will need:

- 1 or 2 K'NEX Introduction to Structures: Bridges sets
- String or cord
- 8½" x 11" Paper
- Pencils
- Scissors
- Paper clips
- Pipe cleaners
- Drinking straws
- Tape
- Student Journals

PROCEDURE

Introduction

- Having completed their survey of different types of bridges, students should understand that while engineers must consider the location and the function of the bridges they design, this is not all they have to take into account. The cost of the bridge and the timetable for its construction are also important factors. Although they cannot skimp on materials because of a potential loss of safety, they must keep within budget. They may also have to keep in mind that only certain materials may be available for the bridge and this may affect how the bridge is designed and built. Keeping to a schedule is important too – missing the deadlines means that the bridge will cost more and traffic will be congested for a longer period of time.

- Explain to the students that they will work as "company" design teams of 4-6 students to design a bridge that can carry a specific load. Each team should decide on their "company" name.

The design task

- To design and make a bridge that can span a 14" (40cm) gap and be able to support a 50g load in the middle. The bridge must have a roadway that allows vehicles to travel along it.

Competition conditions

- The activity will be a competition in which they will be asked to make their bridge from materials including 8½" x 11" paper, paper clips, tape, pipe cleaners, straws and string. Companies decide which materials are best for their designs.

- Companies cannot use K'NEX construction set parts in their designs, but they can use the sets to try out and test their ideas.

- The companies will be allowed 45 minutes **design time**, during which they will need to estimate and purchase the materials they will need for their bridge. A further 45 minutes will be allowed for the construction of the bridge.

- The materials can be purchased from the "Teacher's Store" at the following prices:

8 ½" x 11" paper	$5 per sheet
Tape	$1 per 10cm strip
Paper Clips	$0.50 each
Straws	$1 each
Pipe cleaners	$2 each
String/cord	$1 per 10cm strip

- Those best able to plan will have no materials left at the end. Any surplus materials will be bought back by the "Teacher's Store" at half the original cost. If any additional materials are needed after the initial purchase, they will cost twice the original price.

- Companies must create a name for their bridge design.

The Winner

- The winning company will be the one whose bridge meets the design specification at the lowest cost and within the allotted time frame.

Design and Build Activity

- Remind students that pre-planning and testing may be the key to a successful entry in the bridge competition. Students should be encouraged to use materials not found on the official materials list for testing purposes.

- Suggest that the companies record all of their design ideas on paper, along with their reasons for rejecting or accepting them. They should make notes and comments about any modifications made to their design during the design process.

- Encourage the members of the companies to make joint decisions and to assist one another as they work toward deadlines. Tell the companies that you will be monitoring for cooperative teamwork – everyone should have a chance to contribute to the bridge design and construction. They may decide to allocate a role for everyone on their design and construction team.

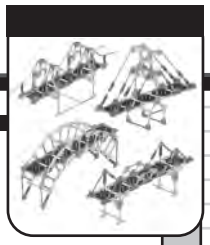
- Remind the companies to use their journals as log books to keep track of materials and costs. They may want to organize their information in chart form, listing the materials they used, the unit cost for each type of material, the amount used and the total cost for the bridge. They should check their calculations to make sure that they have tallied their costs correctly.

- When evaluating their design they should ask questions such as:

  - How can we make it stable?
  - How can we make it stronger?
  - What are the weak points in the design?
  - How can we reinforce it?

- Allow each company to test its bridge to make sure that it can support the 50g weight.

- Check the costs and the finish times for each group and award the bridge building contract to the firm that meets all the requirements for budget, time, bridge strength, and working together effectively as a team. (You may want to prepare an official-looking document to use for the "contract".)



Applying The Idea (Assessment Opportunities)

On completion of the competition ask the students to:

- Share any problems they had and describe the ways in which they overcame them.
- Describe how they might improve their design – what were the weak points and how they might strengthen them.
- Explain how they might make their bridge stronger, using fewer materials.

NOTES: