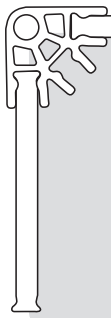
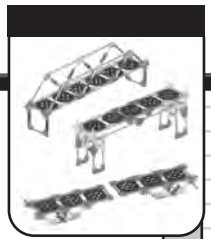


# Introduction to Bridges:

## Preparatory Activities.



### OBJECTIVES

#### Students will:

1. Identify the forces that act on structures.
2. Demonstrate the ways in which selected materials respond to forces acting on them.
3. Explore the ways in which selected shapes respond to forces acting on them.

### MATERIALS

#### Each student group will need:

- Sheets of 8½" x 11" paper
- Rubber bands
- Long K'NEX rods
- Selection of K'NEX corner connectors

#### You will need:

- A piece of solid foam rubber approx. 12 x 2 x 2 inches (30 x 6 x 6 cm)
- Marker

**NOTE:** The activities referenced below are intended for students with no prior knowledge of structures. Your judgment will determine which of these activities are appropriate for your students.

## PROCEDURE

### Introduction

- Begin by asking the class what we mean when we talk about STRUCTURES. Write their responses on the board.

*Answers may include the following: Buildings including skyscrapers, stadiums, domes; roads/highways; bridges; tunnels; dams; harbors; breakwaters; jetties; cooling towers for power stations; transmission towers; pipelines; oil rigs and oil platforms; pyramids; amusement park rides.*

- Encourage the students to describe the largest structure in which they have been. Ask them to describe their feelings while in the structure.

*Possible answers: excited, anxious, amazed.*

Probe to discover why they had the feelings they described.

- Ask the students if they can tell you the name given to the specialists who design structures such as buildings, roads, and bridges.

*Engineers: civil engineers/ structural engineers.*

- Ask the students: "If you were an engineer designing a large building, bridge, etc., what would you need to take into consideration as you planned the structure?" (Strength, beauty, safety, etc.) Use probing, questioning strategies to help students with this brainstorming activity. List responses on the board and use a mapping or webbing diagram to help students realize how many of their ideas are related.

## Inquiry Activities

### NOTE to the Teacher:

Information and suggested classroom activities for **FORCES**, **MATERIALS** and **SHAPES** are provided in the Key Concepts section on Pages 5-17 of this Guide. An activity focusing on bridge **LOADS** can be found in the lesson entitled, "Are All Bridges the Same?" on Page 25-28 of this Guide.

The [www.pbs.org/wgbh/buildingbig/bridge/](http://www.pbs.org/wgbh/buildingbig/bridge/) web site provides a '**Forces Lab**' that demonstrates the effects of **FORCES** on different shapes, as well as addressing building **MATERIALS**, **SHAPES** and **LOADS**. It uses simple, clear graphics and animations. We highly recommend that you and your students explore the resources offered at this site.

☉ You may want to discuss, for example, the **forces** that act on structures:

- ☉ Squeezing/compression
- ☉ Stretching/tension
- ☉ Twisting/torsion
- ☉ Sliding/shear

☉ You may also want to explore the following with the students:

- ☉ some of the characteristic features of different types of **building materials**
- ☉ the ways in which different **shapes** respond to different forces
- ☉ the **loads** that structures are required to bear

*All of these concepts are clearly and simply demonstrated at the web site we have referenced above.*

### SUGGESTED STEPS

Explain to the class that they will explore some of the factors that engineers must consider as they develop their designs.

1. If they appeared as responses in the earlier discussion, highlight the factors identified below. If they were not mentioned earlier, use questioning techniques to elicit them from the children and add them to the list/map:

- ☉ **FORCES** acting on the structure
- ☉ **MATERIALS** used for the structure
- ☉ **SHAPES** used in the structure
- ☉ **LOADS** to be carried by the structure

2. To introduce your students to these concepts **please refer to the activities described in the Quick Guide section on Page 5-11 of this Guide**. Resource materials for these activities are listed above on Page 22. The activities you may want them to undertake could include:

- ☉ Demonstrating the effects of forces using a piece of foam rubber or visiting the Forces Lab at [www.pbs.org/wgbh/buildingbig/bridge/](http://www.pbs.org/wgbh/buildingbig/bridge/)
- ☉ Activities demonstrating the ways in which the properties of materials can be changed, using sheets of 8.5" x 11" paper.
- ☉ Investigating the strength of various shapes using K'NEX Rods and Connectors.
- ☉ Using the Forces Lab at [www.pbs.org/wgbh/buildingbig/bridge/](http://www.pbs.org/wgbh/buildingbig/bridge/) to investigate ways to strengthen shapes used in structures.

