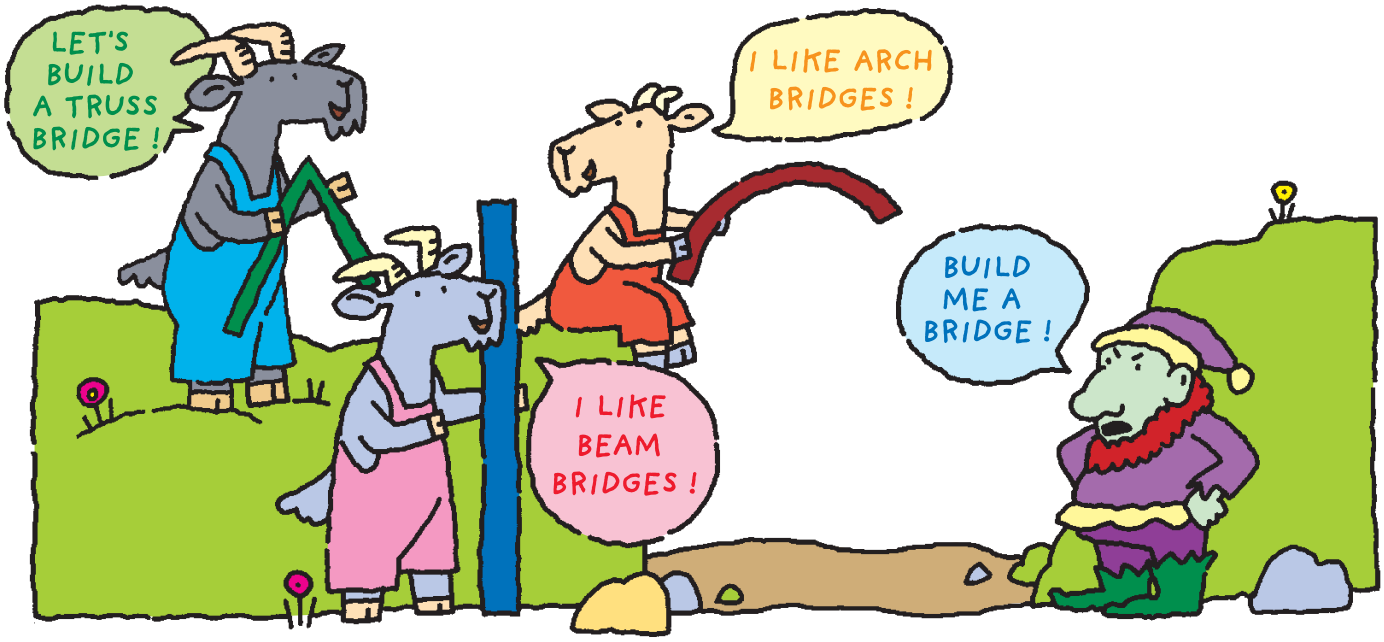


illustrations by Shirley Beckes

Getting from Here to There...

Beautiful Bridges

Bridges are a sight to behold! But have you ever stopped to wonder why a particular bridge was built or even how bridges are constructed? Come along on an enlightening journey and learn about many different kinds of bridges.

Bridge Background

The very first bridges were simple structures that people built out of logs, stones, or vines. Later, as new construction methods and better building materials were discovered, bridge designs became increasingly complex. The first major advance in bridge design was the stone arch. Perfected by the Romans, the stone arch remained the main bridge design until the introduction of steam locomotives in the early 1800s.

As the use of railroads expanded, bridges evolved. In order to carry these massive vehicles over valleys, rivers, and other such obstacles, designers began experimenting with a variety of bridge types and materials to build bridges that were higher, wider, and stronger. It was during this period that trusses—sophisticated scaffolding that reinforces a structure—were invented. Soon iron trusses became the preferred design for large bridges.

In 1855, Sir Henry Bessemer, a British inventor, revolutionized a process for changing cast iron into steel. This process made steel readily available at a reasonable cost. The stability and relative lightness of steel forever changed bridge building. During this time, many steel suspension bridges were built over major waterways, and in the late 20th century, engineers experimented with concrete reinforced with steel bars that would render it stronger still. In the mid to late 20th century, the steel-and-concrete-bridge became one of the most frequently used bridge designs. Today, engineers use computers as well as many new materials to design and construct bigger and better bridges!

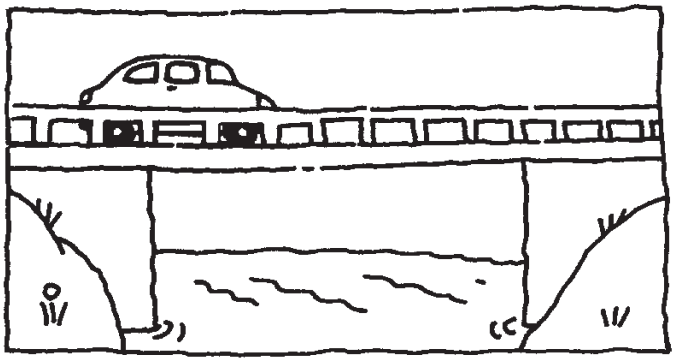
Bountiful Bridges

If you're looking for a picture-perfect way to introduce kids to the varied designs of bridges, read ***Bridges*** by Susan Canizares and Daniel Moreton (Scholastic). After sharing this easy-to-read picture book with students, ask children to describe some of the differences between the bridges featured in the book. Help kids realize that some of the bridges are flat, some are rounded, and some look simple in design while others are quite complex. Conclude

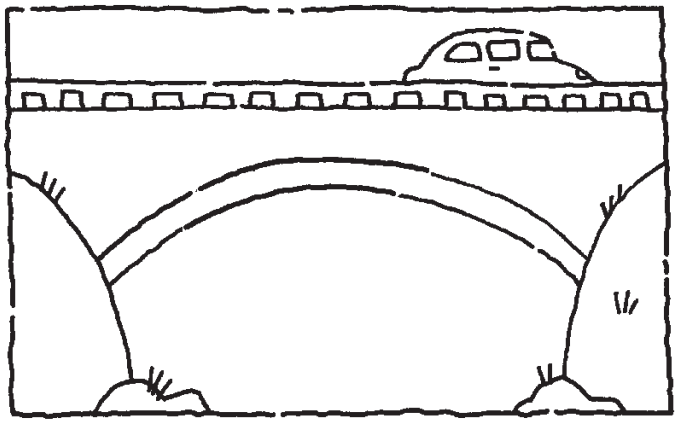
the lesson by reminding students that although there are differences in appearance between most bridges, the one thing that all bridges have in common is that they connect two places and afford people the opportunity to get from one place to another.

Bridge Basics

While bridge designs may differ in the way that they support loads, there are really only eight different kinds of bridges...beam or girder bridges, cantilever bridges, arch bridges, truss bridges, suspension bridges, cable-stayed bridges, movable bridges, and floating bridges. Use an overhead projector to enlarge the four most common bridge shapes and help children become familiar with the designs by explaining the characteristics and the benefits of each, as well as where each bridge is used.

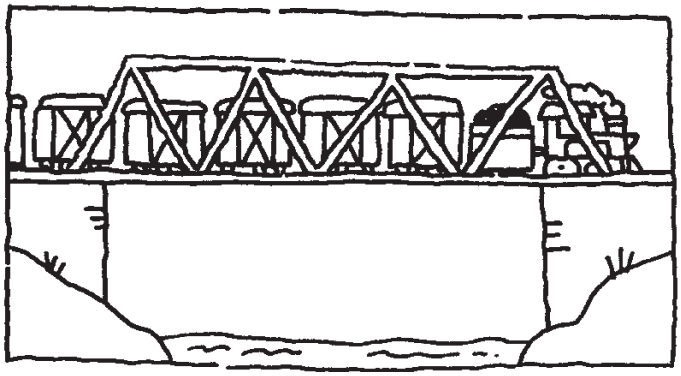


BEAM bridges are the simplest of all bridges. A beam bridge is made by supporting a beam at both ends. The supports may be the banks of a river or they can be special posts called piers. Beam bridges are used most often in highway construction.

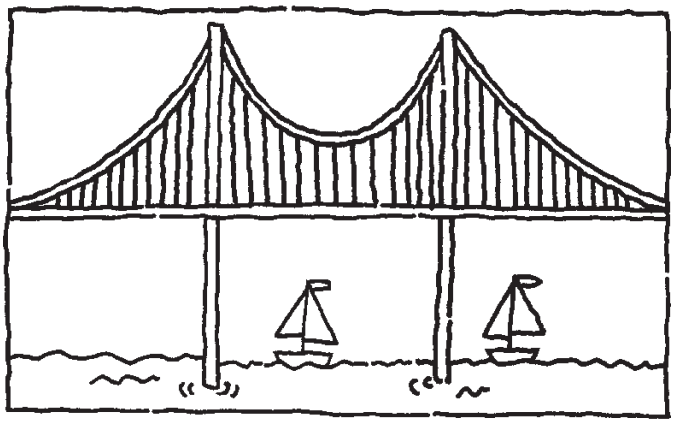


ARCH bridges are very stable. The weight of the load is carried from the top of the arch to the ends of the arch! Abutments keep the ends of the arch from spreading apart. Arch bridges are often used when a bridge is needed over something like a canyon that has steep walls.

TRUSS bridges, although they do not weigh a lot, can carry heavy loads. And truss bridges are cheaper to build than most bridges. Trusses are made by joining beams together to make a triangular shape. The truss distributes the weight of the bridge so that each beam shares part of the load.



SUSPENSION bridges are made by hanging two large cables from towers. The ends of the cables are buried in concrete blocks, and a road is then hung from smaller cables. The main cables hold the weight of the bridge and help shift the load to other parts of the bridge. Suspension bridges are often built when a very long bridge is needed.



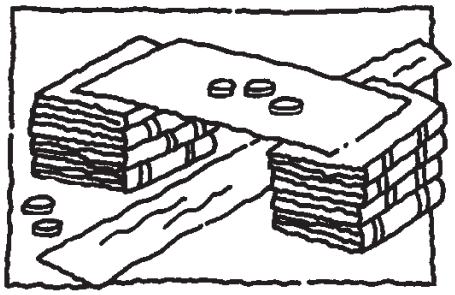
Experiment with Bridge Designs

Try these hands-on activities to help students learn more about bridges. To make it more understandable, you may want to use the experiments while introducing the four main bridge designs with your overhead presentation.

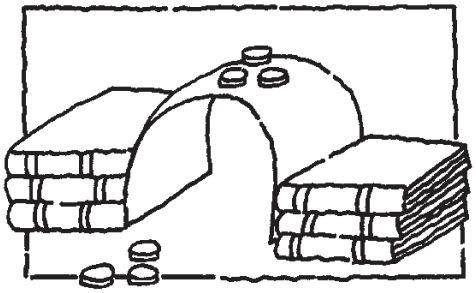
To complete the activities, children will need:

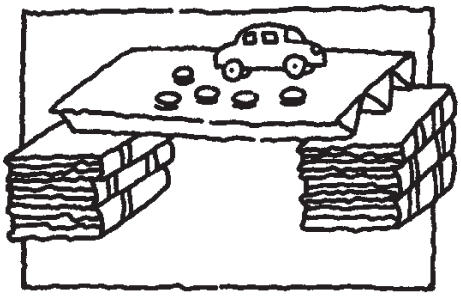
a length of blue crepe paper
(to represent a river)
several books for stacking
2 half-sheets of paper
a supply of pennies
toy cars (optional)

To simulate a beam or girder bridge, have students position the crepe paper between two stacks of books. Then direct kids to place one half-sheet of paper on top of the books to join the two stacks. (If the bridge does not collapse, have kids move the stacks slightly apart.) Next, ask children to place pennies, one at a time, on the mock bridge to see how much weight it will hold. Have students record how many pennies this bridge will hold.

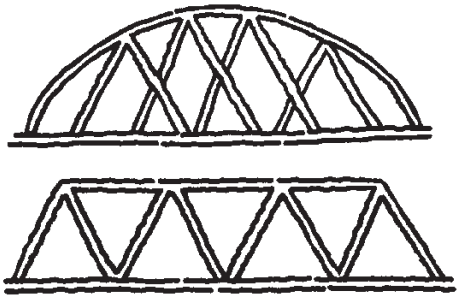


Next, have children make an arch bridge using the same materials. This time ask children to bend or arch the half-sheet of paper and place it between the stacks of books. Have students predict whether changing the bridge's shape will have an effect on its strength. Then have kids place pennies on top of the arch bridge, one at a time. Direct students to record how many pennies the arch bridge holds and discuss any differences they note. Guide kids to understand that the arch bridge is stronger than the flat (beam) bridge. Then challenge kids to think about what they would do if a strong, flat bridge was needed. Provide time for students to reflect on this and brainstorm solutions to the problem.





After discussion, have children fold one sheet of paper accordion-style and place it on top of the stacks of books. Position the paper so the folds run horizontally between the stacks. Adjust the width of the stacks as necessary and place a second sheet of paper over the first to provide a smooth surface for laying pennies. Have kids place the pennies on top of this bridge and record how many it can hold. If desired, invite kids to place toy cars on the bridge to discover how many vehicles the bridge can support. Finally, have students share their data and help everyone come to the conclusion that the accordion-folded paper is strongest and can support the most weight.

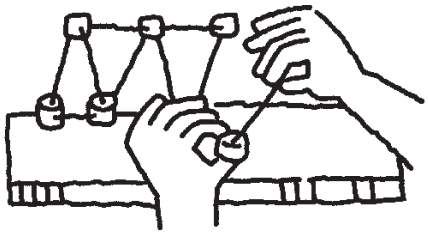


Strong Shapes

After completing the folded-paper activity, have children observe the end of the bridge (the part that is resting on the stack of books) and ask them to identify the shape that they see. Kids should be able to identify that triangles are formed. Explain that the triangle, rather than a square, a circle, or a rectangle is the strongest shape that can be used for a bridge part. Challenge students to remember the bridge design you talked about that contained triangle shapes. Remind kids that such bridges are called truss bridges.

Terrific Trusses

Explain to children that when truss bridges were first being built, they were very simple. By the 1700s, however, American bridge builders started to experiment with this design and even began competing in contests to see who could design the strongest, easiest, and least expensive truss. Draw some examples of different kinds of truss bridges on the chalkboard to show students some of the many trusses that are used.



Then invite kids to use miniature marshmallows and toothpicks to make a model of a truss design by gently pressing a toothpick into a marshmallow. Have children continue in this manner, using marshmallows to hold the toothpicks together, to replicate some truss designs.

Order...Please

Each bridge that is constructed is built for a specific reason. Engineers must consider the distance that must be crossed (is the river wide or narrow), think about the kind of traffic that will be traveling on the bridge, and consider the amount of weight the bridge will need to support. They even take environmental conditions into consideration when making this important decision. Many things are analyzed before it can be determined which type of bridge will be built. Turn your kids

into "bridge consultants" and challenge them to suggest an appropriate bridge to be built when presented with different scenarios..."I need a bridge that can carry a heavy load. I need a bridge that does not cost a lot of money to build." Ask students to use the expertise they acquired while learning about the different kinds of bridges to make good decisions.

Who's That on My Bridge?

No doubt your kids are familiar with the story of the *Three Billy Goats Gruff*. Chances are, they'll delight in this new twist on an old favorite. Begin by reading the story aloud and then have kids form small groups of at least five members. Give each group a sheet of poster board and ask them to either draw (using rulers and markers or crayons) or replicate (gluing pieces of spaghetti and/or pieces of yarn to the poster board) a side-view of a bridge of their choosing. Then have kids write a script that will educate the audience about their chosen bridge and assume the roles of goats, the troll, or narrator. Require that the troll call the bridge by name ("Who is trip-trapping on my arch bridge?) and also have each goat, in his quest to cross the bridge, provide the audience with a fact about the bridge type. ("Why, it's just me, Baby Goat. I'm crossing your lovely arch bridge that is oh, so stable, to get to the nice green grass on the other side.") Fun!

Design A Bridge

A popular activity for older students or groups of students is to build bridges using balsa wood, toothpicks, or even various kinds of pasta. When completed, students' designs can be tested to see how much weight they will hold. Kids may like to get bridge-building ideas by searching the Internet for information on such a project or checking the book ***Building Toothpick Bridges*** by Jeanne Pollard (Dale Seymour Publications).

Bridges of Your County

Encourage students to become more aware of bridges in your area by having them take photographs or make drawings of some local bridges. Ask kids to bring the photograph or drawing to school and consider awarding any child participating with a special "Bridge Watcher" certificate.

After you have a collection of bridges, ask students to classify them according to their characteristics. Are most bridges in your area covered bridges, arch bridges, or truss bridges? Investigate and find out!

Where in the World Is...

Expand your study of bridges by taking a look at bridges around the world... where on Earth is the Sydney Harbor Bridge? Share the book ***Bridges Are To Cross*** by Philemon Sturges and illustrated by Giles Laroche (Puffin Books) to find a uniquely illustrated book featuring many different bridges. As you read the story, enlist students' help in locating the country or state where the bridge is found.

Sing a Song of Bridges

Younger students will enjoy these songs and fingerplays with a bridge theme.

BUILDING BRIDGES

(sing to the tune of "Here We Go 'Round the Mulberry Bush")

This is the way we build a bridge, build a bridge, build a bridge.
This is the way we build a bridge over long and winding rivers.

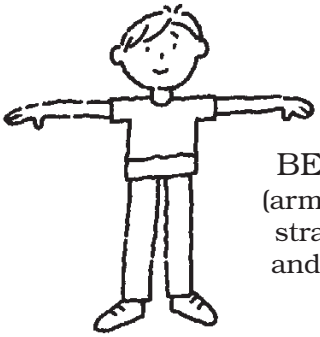
Change the underlined portion to note what bridges connect (for example, through the cold and craggy mountains).

CROSS THE BRIDGE

(sing to the tune of "Row, Row, Row Your Boat")

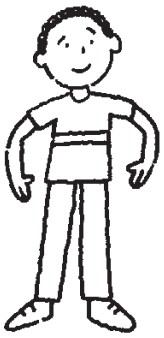
Cross, cross, cross the bridge,
Be sure to look around.
Is the bridge a beam or truss?
Or does it make a frown?

Teach students the following arm motions to accompany this song:



BEAM
(arms out straight and flat)

TRUSS
(arms in front and crossed)



ARCH
(arms bent in "frown" position)