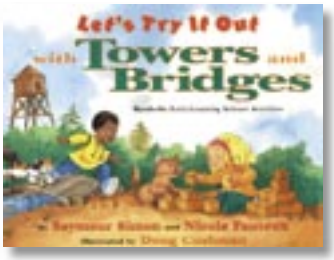
If You Build It…

By Christine Anne Royce

From the youngest ages children construct buildings, bridges, towers, and anything else that comes to mind using a variety of materials. This month's books and activities take this interest in construction and build on it by allowing students to experiment with structures, their design, and how they withstand forces. Through building activities young students start to develop science concepts associated with engineering and technology, while older students are able to put their knowledge of structures to the test in the design process.

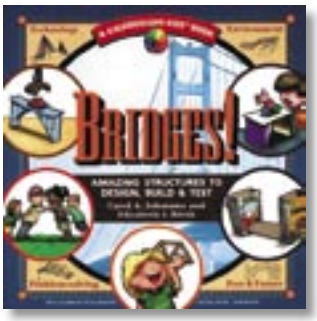
This Month's Trade Books



Let's Try It Out With Towers and Bridges
By Seymour Simon and Nicole Fauteux.
Simon and Schuster Books for Young People. 2003.
ISBN 068982923X.
Grades K–3

Synopsis

This picture book engages children in basic principles of science, technology, and engineering through the topic of bridges and towers using play activities where the children are encouraged to "try this out." Through play they discover the aspects of construction that help to make a structure sturdy. The materials use readily available household materials.



Bridges: Amazing Structures to Design, Build, and Test
By Carol A. Johmann and Elizabeth Rieth.
Williamson Publishing Company. 1999.
ISBN 1885593309.
Grades 4–6

Synopsis

This book combines the subjects of science, history, and technology while presenting activities that will help students examine the design and construction of bridges. It introduces key vocabulary and provides both real pictures and illustrations to help convey the concepts. This book provides a large amount of information and references on the topic of bridges.

Curricular Connections

The idea of building structures is one that starts early in a child's development. *Let's Try It Out With Towers and Bridges* and *Bridges: Amazing Structures to Design, Build, and Test* allow students to use this creativity and curiosity to engage in the development of several basic science concepts associated with structures and forces.

This intrigue with building allows students to investigate the intersection of Science and Technology as described in the *National Science Education Standards* (NSES) where students "establish connections between the natural and designed worlds [and are provided] with opportunities to develop decision-making abilities" (NRC 1996, p. 106). The NSES are quick to point out that at this intersection, "science as inquiry is parallel to technology as design. Both standards emphasize student development of abilities and understanding" (NRC 1996, p. 107). Students will make decisions about the best design of their structures through the trial-and-error process—a large part of inquiry. By allowing students to use common, familiar objects such as building materials, they are put in a safe environment that allows them to explore.

Let's Try It Out With Towers and Bridges presents young children asking a question and then trying it out—this process of questioning and experimentation is modeled in the activities below. As children get older, they are better able to examine the design process. They will be able to think about what they already know and apply it to their designs before they build and test it, as described in *Bridges: Amazing Structures to Design, Build, and Test*.

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For Grades K–3: Let's Try It Out

Purpose:

To experiment with different structures and forces through play

Materials:

Wooden building blocks or other stackable blocks of varying size (6–10 per group), straws, paper, clay, corrugated cardboard, tape, and plastic blocks

Procedure:

Before introducing *Let's Try It Out With Towers and Bridges*, have students find pictures of towers and bridges in magazines or on the internet and create a large mural of these structures. Ask students to generate a list of ideas about how the different structures are built: *What do you notice about the base or bottom of the structure? What are the different shapes you see in the structure?* The construction process relies heavily on the use of forces and balance.

When reading the book, allow the students to pose possible solutions to the challenges. For example, page 3 of the book poses the challenge to "make a building in the shape of a mountain" (Note for teachers: cover the pictures in the book at this point until the students have a chance to try the challenge) and then asks, "How strong is your building? Can it survive a windstorm?" Allow the students to try building a structure similar to a mountain (or pyramid as shown) using blocks and test its strength by blowing at it.

Return to the pictures they found and see if they have a match for a structure. Ask the students to speculate about why this structure design is sturdy; ideas may include "There is a larger base than top," "The buildings are more square or rectangular rather than circular." If you allow students to construct a "human pyramid," as suggested in the book, enlist the help of the physical education teacher for safety.

Continue to construct or act out the activities described on the next several pages—standing like a tree, balancing tubes or straws using a base, etc. Ask, "What observations can you make when a structure is stable?" Student answers may include "the bottom is bigger" or "it is not as high as one that falls down."

Beginning on page 13, a challenge is posed "to build a bridge that will span a certain distance." As the pages progress, different possibilities are posed and the students are asked to try each out. The teacher can read these pages and allow students to try each option or refer back to the student mural and ask the students to attempt different ideas on their own. Some bridges have supports that hold it up at points all the way across, whereas other bridges have cables on top (suspension bridges) that help to support the "road." Either way, the students will be engaged in trying to design a bridge that will span a distance and support weight.

The final challenge in the book is for students to construct a building using beams made out of straws and clay and paper. This activity could serve as a final assessment for student learning. Students at this age will be able to apply simple ideas about construction of structures, such as the need for a strong base, the weight (actually the load) needing to be distributed evenly, and the ability to think through the process of trial and error in their design.

For Grades 4–6: Build a Bridge

Purpose:

To construct a bridge using common materials and determine how much of a load it will hold

Materials:

Each group will need 26 pieces of white copy paper (20 for the initial planning activity/ six for the final bridge), paper for recording ideas and designs, a roll of tape, scissors, and 50–100 pennies.

Procedure:

Pose the following challenge to the students: *Can you design a bridge that will cover a 22.5 cm (9 in) span that will support a load using only copy paper?* Break students into teams of two or three and allow them to find a place to work.

Provide each team with supplies and explain that these materials are only for the planning part of the project. They will be given additional paper to construct their actual bridge at a later point. Explain that students must construct a bridge to span 22.5 cm using ONLY six sheets of paper. They may use tape to assemble the bridge but may not secure the bridge to any surface. The bridge will be suspended across the distance using two stacks of textbooks of the same height. The goal is for the bridge to hold the largest load of pennies.

Students can use *Bridges: Amazing Structures to Design, Build, and Test* to examine illustrations and individual aspects of bridge design and to learn vocabulary.

The students should make, test, and explain the reasoning behind at least three bridge designs. They should record their ideas (the design phase) before they actually assemble the bridge; draw or sketch their bridge and keep it for demonstration purposes (the build phase); and record their data for how much weight the bridge held as well as observations they made about where the bridge failed (the test phrase).

Finally, after allowing students to experiment with their designs, have the students choose their final design and build the bridge using the specifications outlined above. When all groups have constructed their bridge, have each group describe their trials, explain what they learned from each attempt, and present their final design. Then have a competition to determine which bridge design can hold the largest load of pennies.

When a bridge winner has been determined, ask the students to discuss what they learned from the different designs—focus on construction techniques, shape, strength of the bridge, etc. When the paper is folded in certain ways it makes the bridge stronger; the bridge needs to be supported somehow or it will sag in the middle. A bridge building competition always excites students and engages them in the design process.

A familiar movie phrase states, "If you build it…they will come." A slightly modified phrase fits the purpose and use of these activities in the classroom—"Students will come to understand important science concepts. . . if you let them build."

Resources

National Research Council (NRC). 1996. National science education standards. Washington, DC: National Academy Press.

Connecting to the Standards

This article addresses the following *National Science Education Standards* (NRC 1996):

Content Standards

Unifying concepts and processes in science

Standard B: Physical Science

- Position and motion of objects (K–4)

Standard E: Science and Technology

- Abilities of technological design (K–4)
- Understandings about science and technology (5–8)