

What Gives?

Activity 4

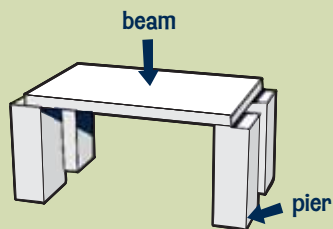
Kids learn about bridges and how they support weight. After seeing a demonstration of a simple beam bridge, kids are challenged to build one that's much stronger. Their goal is to design and build a suspension bridge that won't collapse under the weight of a pile of books.

Prepare Ahead

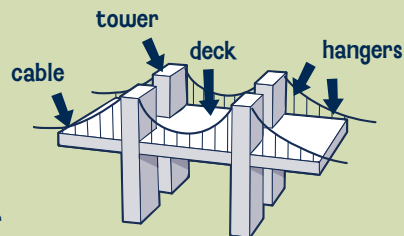
- Use recycled corrugated cardboard or buy new cardboard at an office supply store (or online).
- Collect images of bridges from books or the Internet to display. Photos should show different types (the most common are beam, arch, truss, and suspension bridges) as well as famous ones (e.g., the Golden Gate Bridge and the Brooklyn Bridge).
- You'll be demonstrating how two different bridges work. Tape together 3 pieces of cardboard and cut 2 lengths of string 3 yards long for your demonstrations.
- For kids' convenience, tear off pieces of duct tape, and stick them along the edges of a table or other surface that's accessible.
- Set up work areas. Each should have 2 chairs, 3 pieces of cardboard, duct tape, string, hole punchers, scissors, a yard or meter stick, and paper and pencils.

Lead the Activity

- 1 Introduce Ruff's challenge.** (5 minutes)
Hand out the activity sheets. Tell kids that today's challenge is to build a sturdy bridge. Ask them what kinds of bridges they know about, and show them pictures of different types. Ask them if they know the names of some famous bridges.
- 2 Demonstrate the strength of a beam bridge.** (5 minutes) Put 3 cardboard pieces taped together over two chairs.
 - Tell kids this is a beam bridge, the simplest type of bridge. It has a horizontal beam supported by two piers at each end.
 - Then tell kids you're going to test how much weight this bridge can hold. Put one book on it. Ask kids what's supporting the weight of the book. (*The weight of the book pushes down on the piers and the beam.*) Ask kids how many books they think the beam bridge will hold. Add books until it collapses.
 - Explain that beam bridges aren't the strongest bridges. They are used to span short distances and are relatively simple and cheap to build. But to span large rivers, lakes, or canyons, more complex—and more expensive—bridges are needed. Tell kids they are now going to build a bridge that's much stronger—a suspension bridge. Ask kids how they will know if their bridge is stronger than the beam bridge. (*It will support more books.*)



Beam Bridge. The weight is supported from below by the piers and by the beam itself.



Suspension bridge. The weight is supported from above by the towers, cables, and hangers.

Materials

- Activity sheet for each kid
- 2 chairs with backs for each group of four kids
- 3 11" x 17" sheets of corrugated cardboard per group
- Roll of duct tape per group
- Roll of string per group
- Hole punchers, 2 per group
- Scissors, 2 per group
- 1 yard or meter stick per group
- Paper and pencil for each kid (to sketch bridge designs)
- 15 books, of equal weight, about 1 lb. each
- Images of different types of bridges from books or the Internet

National Science Education Standards

Grades K-4

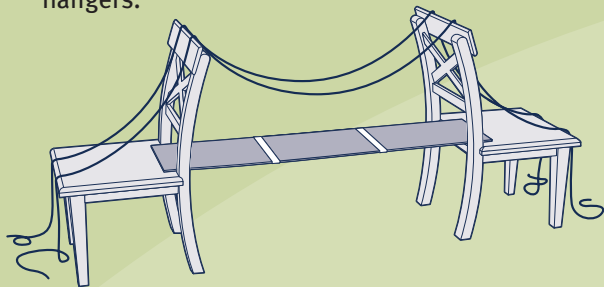
Science and Technology: abilities of technological design

Grades 5-8

Science and Technology: abilities of technological design

3 Demonstrate how to set up a suspension bridge. (5 minutes)

- Place the cardboard between the chairs again (flip it over if it's bent from the beam bridge demonstration). Then drape two strings (cables) over the bridge and have two kids hold the ends.
- Tell kids that unlike a beam bridge, a suspension bridge's support system comes from the cables, hangers, and towers above the deck.
- Compare the diagram of the suspension bridge on their activity sheet to the bridge you're demonstrating. Review the names of the parts of the bridge and point out the corresponding materials they'll be using: the deck (cardboard), the towers (chairs), cables (string draped over the chairs), and anchors (kids holding the cables/strings at each end). Ask kids what's still missing from the bridge (*the hangers*). Tell them their job is to figure out how to attach the cables to the deck using hangers.



4 Brainstorm, design, and build. (30 minutes)

Break into groups of four and discuss the remaining steps on the activity sheet. Note: kids may want to tape the cable strings down rather than hold them. Explain that tape isn't strong enough to serve as anchors when weight is added to the deck—kids will need to grip the cables.

5 Testing. (5 minutes)

As groups finish building, have kids test their bridges by piling books, one at a time, in the middle of the deck—until their bridges either hold the entire stack or collapse.

- Most bridges will hold at least three times as many books as the beam bridge did.
- Switch anchors so all kids experience the tension on the cables. Support the deck with your hands while the kids switch places.
- Ask kids what would happen if the anchors let go of the cables. (*The bridge would collapse.*)

6 Discuss what happened. (5 minutes)

- Ask kids: How many books did your suspension bridge hold? Was it stronger than a beam bridge? What did it feel like when you were an anchor? (*The more books added to the deck, the more you felt the pull of the weight on the cables.*)
- Ask kids to identify the parts of a suspension bridge, and explain the purpose of each:
 - **Deck:** The deck bears the weight of traffic going over the bridge.
 - **Hangers:** Hangers connect the deck to the cables.
 - **Cables:** The cables (along with the hangers) hold up the weight of the deck. They transfer the weight up to the two towers, and are attached to the ground on both ends of the bridge by the anchors.
 - **Towers:** The towers support the weight of the bridge.
 - **Anchors:** The anchors secure the cables on both ends of the bridge, fastening them with huge blocks of concrete or solid rock.

7 Award Points. (5 minutes)

Time to rack up some points! Review the activity's key ideas by asking the following questions, worth 50 points each:

- Each of the two bridges we've talked about supports weight in a different way. How does a beam bridge support weight? (*The weight pushes down on the piers and the beam.*) What about a suspension bridge? (*The towers support the weight, with help from the cables, hangers, and anchors.*)
- Name three parts of a suspension bridge. (*Deck, towers, cables, anchors, hangers*)
- Which bridge is stronger? Why? (*The suspension bridge is stronger. It held more books. A suspension bridge has towers, cables, hangers, and anchors that work together to transfer and distribute weight, so a suspension bridge is much stronger than a beam bridge.*)
- When did you brainstorm during this challenge? How did brainstorming help you? (*Answers will vary.*)
- When would you use a suspension bridge? Why? When might a beam bridge be the best choice? (*A suspension bridge is used to span long distances and bear lots of weight—heavy traffic, for example. A beam bridge is used for shorter distances—it's cheaper and less complex to build.*)

