Grades 3–5

15 minutes

STRONGEST SHAPES

DESIGN CHALLENGE

Using index cards and only one shape in your design, build a bridge that can support the weight of one die-cast toy car across an 8-inch span.

SUPPLIES AND EQUIPMENT

Per team

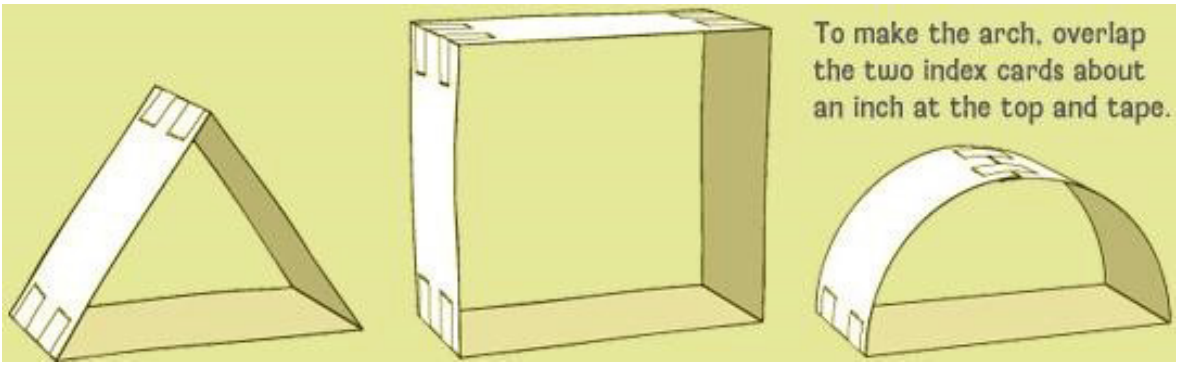
- ☐ 1 toy car (1:64 scale size, such as Hot Wheels or Matchbox)
- ☐ 10 or more 3" x 5" index cards
- ☐ 1 roll of tape

GETTING READY

Build one triangle, one square, and one arch in advance as visual aids.

INTRODUCTION

Do you know what the strongest shape is? Engineers design structures using shapes that support a lot of weight without collapsing. Think about bridges you have seen. Did you notice any shapes that are repeated? Today you can experiment with shapes and think like an engineer to build a bridge.



Examples of a triangle, a square, and an arch made of index cards and tape.
Credit: American Society of Civil Engineers.

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INSTRUCTIONS

Show the participants examples of a triangle, an arch, and a square made of index cards and tape.

1. Encourage them to build their own index card shapes. Find out which is strongest by pushing down on them and rocking them side to side. Make sure to stand the shapes upright!
2. Make observations about the strength of each shape. Notice that the square was easy to collapse while the triangle and arch held up better under pressure.
3. Instruct teams to choose one shape to use in building a bridge. The shapes can be taped together, but not taped to the table. Use index cards to create a roadway, if necessary.
4. While it is resting flat on the table, test the bridge with toy cars to see how it holds up under a load. Can it support one car without collapsing?
5. Rest the bridge on two piles of books 8 inches apart. Now see if it can hold one car without collapsing. How about two?

ACTIVITY VARIATIONS

Have a contest to see whose bridge can hold the most weight.

RELEVANT TERMINOLOGY

Load: The weight that something must support. A bridge has to support the weight of cars driving across it.

Span: The distance from one side of something to the other side, like the length of a bridge.

The Dragon Bridge in Vietnam uses arches that look like a dragon. Credit: Bùi Thụy Đào Nguyên/Wikimedia Commons.

GUIDANCE FOR PARTICIPANTS

QUESTIONS TO ASK AFTER THE ACTIVITY

- What shapes did you try out in your bridge? Which one was the strongest?
- How can tape make your bridge stronger?
- What would happen if you doubled up the index cards—would the bridge be stronger?
- How can you make your bridge look really good? Do you think that engineers care how a bridge looks? (Check out the Dragon Bridge in Vietnam.)

ENGINEERING CONNECTIONS

Building a bridge is an example of a hard problem that engineers know how to solve. They have the knowledge to plan one, design one, and build it, so that we don't have to worry about whether a bridge is strong enough for us to cross. To make a safe bridge that will last a long time, engineers often look at other bridges that are already built and try to imagine ways that they can improve on that existing design. In other words, they learn from mistakes made in the past and make old designs even better!

SCIENCE CONNECTIONS

If you push hard on one side of a square, pentagon, or other straight-edged shape, it will fold in on itself...except for one shape: the triangle. It is impossible to collapse a triangle without breaking one of its sides, which makes it the strongest straight-edge shape. For this reason, you will see triangles in lots of bridges. Triangle shapes in a bridge direct the weight of the bridge and the cars crossing it downward without bending. What about arches? They act like triangles, directing the weight of cars on the bridge without bending.

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ACKNOWLEDGMENTS

Activity adapted from American Society of Civil Engineers.

http://www.asceville.org/lessons-bridges.html

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