TEACHER ACTIVITY

# BUILD-A-BRIDGE

It's not merely by luck that there are still some structures standing that date back as far as 8000 BC. Do you think you have the know-how to build infrastructure that doesn't come crumbling down?

In this activity, you and a teammate will build a bridge that can hold as much weight as possible while taking both material and space constraints into account!

## STEP 1: CONNECT

Stability can be defined as a measure of how likely it is for an object to topple over or collapse when pressure is exerted upon it.

What are some things in your community that rely on stability in order to function?

## STEP 2: INVESTIGATE

Vehicles, equipment, and infrastructure are three examples where stability is of the utmost importance. It would be unsafe if anything in these categories was *not* stable!

Today, you're going to take a closer look at bridges—an infrastructure that dates back as far as history goes, and one that can have devastating effects if its stability is lost.

First, visit tinyurl.com/stablebridges and take a look at six of the most common types of bridges.

Then open a new tab in your browser. Visit google.com/maps, find your town or city, type "bridge" in the search box, and click *search*. A list of local bridges should appear under the search box, and their locations should be highlighted throughout the map. Click through the pictures provided, and toggle back and forth between your two open tabs to compare and contrast the bridges in your community with the different bridge designs.

## STEP 3: DISCUSS

Placing a log across a stream is maybe the simplest type of bridge that exists. Based on the six different bridge designs (tinyurl.com/stablebridges), which type of a bridge would this be?

### ENGINEERING MISTAKES

Sometimes bridge designs don't go as planned! Millennium Bridge is a steel suspension bridge for pedestrians in London. When it opened in 2000, it was quicky nicknamed "Wobbly Bridge" when the public realized that pedestrians crossing the bridge caused noticeable shaking and swaying. The bridge was shut down just two days after it opened, and remained closed for two years until adequate changes were made to stop its swaying! Want to learn more? Visit tinyurl.com/wobblylondonbridge.

Now take a closer look at the design elements that make each of these bridge designs similar *and* unique. What shapes and design features likely contribute to each one's stability?

Which of these bridge design(s) can be found around your own community? Why do you think this type(s) of bridge design was selected? Could another design have been equally stable? Why or why not?

## STEP 4: MATERIALS

Now let's experiment with bridge stability by building your very own bridge! You'll need:

- uncooked spaghetti
- hot glue gun and glue (or tape)
- weights: blocks, toy cars hand weights, books, sand-filled containers, etc.
- string
- ruler or measuring tape
- bucket, optional

## STEP 5: THE CHALLENGE

With your teammate, your challenge is to design and construct your own bridge out of *only* spaghetti and hot glue (or tape, if hot glue is not available).

In addition, your bridge must:

- Be more than 50 centimeters long
- Be wide enough for at least one lane of traffic (4 centimeters)
- Be ready to hold as much as weight as possible

First, select the location for your bridge. It may connect two chairs, two tables, or two sides of a long container.

Then sketch out several possible designs, keeping your constraints *and* what you have learned about bridge design in mind.

Once you have a design you think may work, begin building! Don't hesitate to change your design ideas after you get started.

### THINK ABOUT THIS!

Bridges that maintain an equilibrium are stable—which means they don't move. In order for this to occur, the bridge must have an upward force that equals its downward force. The total downward force on the bridge is equal to the mass of the bridge plus any additional weight, multiplied by the acceleration of gravity.

When your bridge is built, begin to test how well it copes with added weight. To test this, you may either add weight directly to your bridge or use the string. You can use the string to add weight in one of two ways:

1. Drape the string over the middle of your bridge and tie weights to it that dangle above the ground.
2. Drape the string over the middle of your bridge, tie the string to a bucket that dangles above the ground, and then fill the bucket with weight!

No matter what you decide, observe how your bridge reacts to the weight and brainstorm how to make it stronger if it seems to struggle. You'll be creating a video of your bridge in the next step, so don't let it break! Instead, focus on making changes so that it is as strong and stable as can be.

## STEP 6: SHARE

Now that you've built a stable bridge that not only meets tricky constraints but can also bear weight, create a short video that shows off just how stable your bridge actually is. In your video, be sure to:

1. Explain the engineering design decisions behind your bridge.
2. Add as much weight as possible… until it breaks!

Use the hashtags #InnovationAtPlay and #BridgeDesign to help others find your video.

### NGSS STANDARDS

- HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
- HS-PS1-6 Matter and its Interactions: Cross-Cutting Concept: Stability and Change: Much of science deals with constructing explanations of how things change and how they remain stable.

### COMMON CORE ELA STANDARDS

- CCSS.ELA-LITERACY.CCRA.SL.4: Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.