# Cable-Stayed Bridge Activity Guidelines

**Design Goal:** Design and build a cable-stayed bridge.

Supplies:

- Foam core (for the bridge shown here we used a piece ~60 cm x 45 cm; the amount you use with depend on bridge size you design); alternatively, you could use cardboard or wood
- X Acto-knife, box cutters, scissors, or utility knife
- Twine or string (3-5 meters)
- Tape and/or hot glue [optional]
- Paper clip or big sewing needle [optional]
- A few nuts or washers or plastic beads [optional]

**Question:** How will you design your cable-stayed bridge? How tall will the towers be? How far will the deck span? How wide will you make the deck? How many cables will you use? Will you use a fan design or a harp design? Will the towers be on just one side of the deck or on both sides? Do you want multiple towers or just one? Will your cables thread through the center of the road or along the outsides? How does the spacing of your towers affect how you will thread your cables, and how can you design your cables to evenly distribute forces throughout the system?

**Brainstorm**: It can be helpful to do some research and look up different cable-stayed bridges online. Sketch ideas for different bridges and then choose your favorite to build.

**Design and Prototype:** Sketch all the forms required for your design onto the foam core. Think about how your towers will be supported. Look at the tips and tricks section if you need some ideas. When you're ready, cut the form for your tower or towers and the form for your road/walkway. Our cable-stayed bridge, shown below, is based on the Zakim Bridge in Boston, having two towers with some cables attached to the middle of the roadway and some connected to the outside of the roadway.

Sketch where you will cut holes through these forms to thread your twine/string. If you have more than one tower, think about how far apart you want to place them. Where you place the towers will inform how you will thread your cables.

When you've thought about how you will thread the twine, make small holes in your tower(s) and road. Before threading your cables, it is very important to secure your road to your supports because the tension in the cables will lift the road or deck

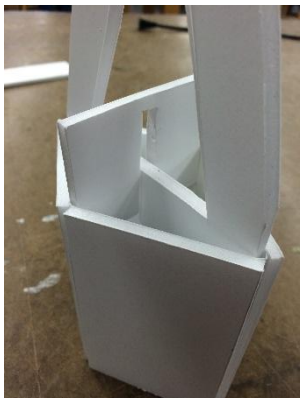
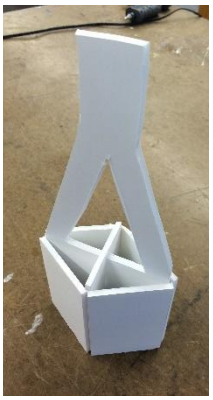
upward. Use tape, hot glue, or string to secure your road to your towers and then thread your cables to finish your bridge. Sometimes it can be helpful to recruit a friend to help you secure the cables.

Have fun and be creative! The way you thread your cables will greatly impact the look of your bridge and how the forces are distributed along the deck.

**Test and Reflect:** Are the cables in tension and do forces seem to be pretty evenly distributed along the road? Are there any areas on your bridge that seem to be particularly stressed? How much load does your bridge support? What would you do differently next time?

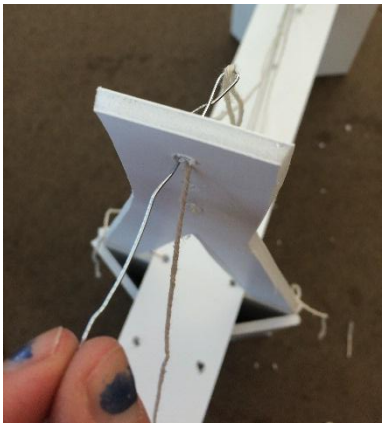
**Tips and Tricks:**

- Building sturdy towers is important. A good way to make your base is shown below. First, cut the form for the tower. Then, to make a support for your tower, cut a rectangle that is ~2.5 times longer than the width of your tower and the same height as the base of your tower; make 3 evenly spaced vertical score marks on this piece of foamcore. Scoring means that you do not cut all the way through the material but instead cut only through one layer. Scoring will allow you to easily create a bend without having 4 separate pieces. Be sure when you score the foam core (or cardboard) that the size of two of the pieces is slightly greater than the width of the tower. Then, tape or glue the seam together. Now your tower should sit within the support. If you want to make it even sturdier, cut a square brace as shown below to keep everything

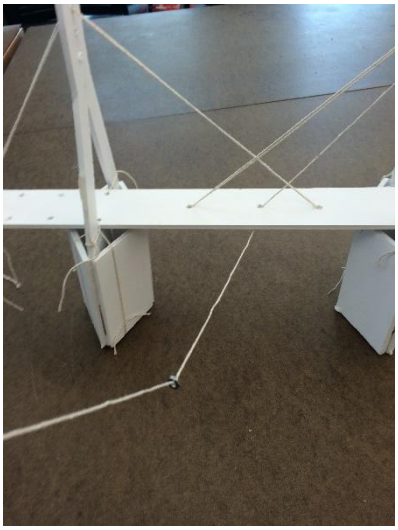




in place.

- Once you start threading your cables, use a big sewing needle or unfold a paper clip and use that to help you thread the string through the holes. It will make threading your cables much easier!



- If you want to thread a cable down and back through the same hole, you can use a nut, washer, or some sort of spacer (made of rubber bands, cardboard or foam core cut in the shape of a washer… anything you can think of) as seen below.



- In order to avoid having to tie a lot of knots and waste excess string, think about how you will thread your cables beforehand. It will be easier to tension your cables appropriately if you can reduce the number of separate pieces of

string you use. In the example below, the cables were threaded with only three separate pieces of string.

- The example shown here is a relatively simple design. Feel free to try something completely different—experiment with curved towers, using only one tower, or designing a cantilevered road… have fun with it!