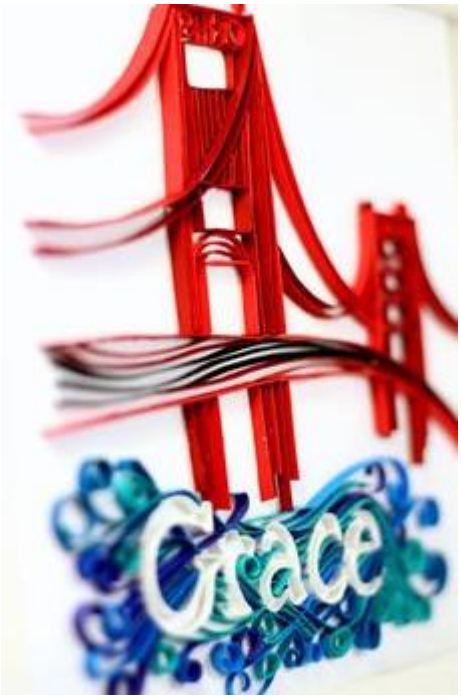
Bridging the Gap

Day 9 & 10: Paper Bridges



Quilling, also known as *paper filigree*, is an art form that involves rolling and gluing thin strips of paper into various shapes and arranging them to form designs. Quilled paper designs can be very simple or as complex as you have the dexterity and patience for!

The art of quilling dates back to the Renaissance when French and Italian monks and nuns would use quills (the shaft of a feather) to roll thin strips of paper into ornate designs. They would then use these to decorate book covers and other items, often imitating designs they saw in ironwork. Quilling later became popular in America during Colonial times.

Quilling has become popular worldwide, thanks to the common, inexpensive materials used to do it. All you need is paper, glue, and something to roll the paper around. Even though quilled designs are made from humble materials, there's no limit when it comes to the elaborate designs you can create!

Quilling is traditionally done with 1/8" paper strips which can be purchased precut and ready to use. You can also make your own 1/4" strips using a *paper shredder*. Beginning artists will have an easier time with wider strips, so I it's best to start younger students out with 1/2" strips (which you can cut on a paper trimmer) until they get the hang of it. Note: Wide strips from a heavy paper can be easily rolled with fingers, without the need to use a tool.

You will need:

- Paper strips (ex. Black & Red—for the bridge, Yellow—lights or stars?, Blue, Green, Purple,--water; Grey, White—Clouds/Fog)
- Q-tip, with the ends cut off (*You can purchase a special tool with a slit at the end for rolling your paper strips, but it really isn't* necessary.)
- scissors (or simply tear the strips to the lengths you want)
- Glue (***YES! Paste*** works well, but any white craft glue will work)
- toothpick for applying small amounts of glue
- for inspiration, have students check out the included images of the Golden Gate Bridge

Quilling Basics from TeachKidsArt:

*Have students follow these simple steps to learn the **basic shapes** for quilling… then **combine them to create a gorgeous bridge design**! Children's quilling doesn't have to be perfect :) Encourage your students to do quilling no matter how messy it turns out.*

1. Cut the ends off your Q-tip and use it to roll one of your paper strips into a ***tight coil***. *(Some artists find that rolling towards themselves is easiest, but that's just personal preference, see what works for you..)*

2. Apply a small amount of glue to the end and press it down for a few seconds (Using ***YES! Paste*** or Craft Glue here).

3. Now pull out your Q-tip "quill" — you have just completed your first ***tight coil***.

4. Roll another coil the same way, but when you get to the end, pull out your quill and release your grip just a little so your coil begins to expand. You can let it expand a lot or just a little…it's up to you. A small amount of glue will hold it in place at the size you want. We'll call this a ***loose coil***.

5. Now make two more ***loose coils***. Pinch one of them on one side to form a ***teardrop shape***. Pinch the other one on two opposing sides to form an ***eye shape***.

6. To make a graceful ***"S" curve***, roll a strip halfway and release it. Then roll the other end of the strip halfway in the opposite direction and release again.

7. A ***heart shape*** is made by first folding your paper strip in half. Then roll each end in toward the middle, releasing when you get to the size you want your ***heart shape*** to be.

8. After making each of these basic shapes, it's easy to make ***triangles***, ***squares,*** and more.

9. Finally, use small amounts of glue to assemble your shapes into a suspension bridge/Golden Gate Bridge/Brooklyn Bridge scene! Don't be afraid of spilling the glue: spread it over the base, not the quilling shapes as usual. Another method is to pour some glue onto a sheet of paper or cardboard, or into a small plate and let children dip their quilling shapes in it. Older children can apply the glue directly onto the shapes.

Remember: *Building a complicated design with quilling can take some patience! Younger students can/should keep it simple!*

Option: Don't limit your kids to quilling in their projects. Let them combine different media and techniques, you'll be surprised what wonderful little pieces of art they come up with.

Days Nine & Ten K-8 Standard Alignment

K

- 3.1.3 Select and apply subject matter, symbols, and ideas in the student's own art.
- 1.1.3 Demonstrate precision in the use of teacher selected tools and media in a safe manner.

These standards will be met and reinforced as students learn about quilling and practice techniques and then implement them in order to make their own suspension bridge art incorporating the symbolism of the Golden Gate Bridge (or Brooklyn Bridge) as modeled by the teacher.

1

- 1.1.3 Demonstrate a precision in and explore the use of teacher selected tools and media in a safe manner.
- 3.1.3 Select and apply subject matter, symbols, and ideas in the student's own art.

These standards will be met and reinforced as students learn about quilling and practice techniques and then implement them in order to make their own suspension bridge art incorporating the symbolism of the Golden Gate Bridge (or Brooklyn Bridge) as modeled by the teacher.

2

- 3.1.3 Implement chosen subject matter, symbols, and ideas in the student's own art.
- 1.1.2 Demonstrate a precision in and explore the use of teacher selected tools and media in a safe manner.

These standards will be met and reinforced as students learn about quilling and practice techniques and then implement them in order to make their own suspension bridge art incorporating the symbolism of the Golden Gate Bridge (or Brooklyn Bridge) as modeled by the teacher.

3

- 3.1.3 Produce subject matter, symbols, and ideas in one's own artwork as guided by the teacher.
- 1.2.1 Demonstrate media in the intended manner as modeled by the teacher.

These standards will be met and reinforced as students learn about quilling and practice techniques and then implement them in order to make their own suspension bridge art incorporating the symbolism of the Golden Gate Bridge (or Brooklyn Bridge) as modeled by the teacher.

4

- 3.1.3 Produce subject matter, symbols, and ideas in one's own artwork as modeled by the teacher.
- 1.2.1 Execute a variety of media in the intended manner as modeled by the teacher.

These standards will be met and reinforced as students learn about quilling and practice techniques and then implement them in order to make their own suspension bridge art incorporating the symbolism of the Golden Gate Bridge (or Brooklyn Bridge) as modeled by the teacher.

5

- 3.1.3 Produce subject matter, symbols, and ideas in one's own artwork as coached by the teacher.
- 1.2.1 Execute a variety of media in the intended manner as coached by the teacher.

These standards will be met and reinforced as students learn about quilling and practice techniques and then implement them in order to make their own suspension bridge art incorporating the symbolism of the Golden Gate Bridge (or Brooklyn Bridge) as modeled by the teacher.

6

- 3.1.3 Apply subjects, themes, and symbols in works of art in an effective manner.
- 1.1.2 Develop and demonstrate control of different types of media, techniques, and processes.

These standards will be met and reinforced as students learn about quilling and practice techniques and then implement them in order to make their own suspension bridge art incorporating the symbolism of the Golden Gate Bridge (or Brooklyn Bridge) as modeled by the teacher.

7

- 3.1.3 Apply subjects, themes, and symbols in works of art in an effective manner.
- 1.1.2 Develop and demonstrate control of different types of media, techniques, and processes.

These standards will be met and reinforced as students learn about quilling and practice techniques and then implement them in order to make their own suspension bridge art incorporating the symbolism of the Golden Gate Bridge (or Brooklyn Bridge) as modeled by the teacher.

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Day 1: The Force(s) are with you!

To introduce the lesson activities and access students' prior knowledge have them watch and analyze this **short animated film** from Vimeo user Ting entitled "Bridge".

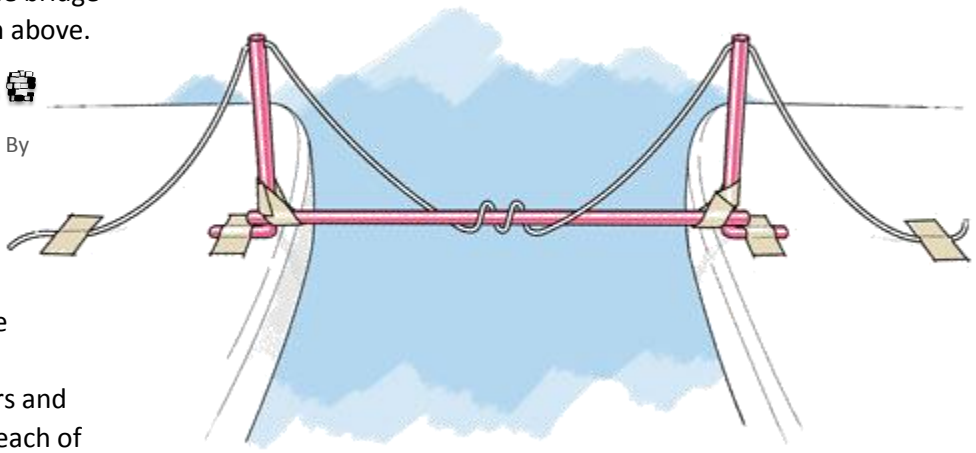
Have you ever wondered how bridges stand tall in the face of gravity, weather and the heavy traffic crossing over them? Building them might seem complicated, but they are based on some surprisingly simple forces that you have probably experienced yourself. Have you ever stomped on an empty can? Or played tug-of-war? Then you might know more about engineering suspension bridges than you think!

"Compression" and "tension" are two forces that we can feel and see in the world around us. Where can you find examples of compression (hint: think of the empty can) and tension (hint: try a game of tug of war). Using lots of math, civil engineers position the parts of a suspension bridge so compression and tension work together to hold up some of the world's longest spans.

In the U.S. the two most famous suspension spans are probably San Francisco's Golden Gate and New York City's Brooklyn bridges, which we've learned about!

The main parts of a suspension bridge are its towers, cables, decking and anchorages. As you might guess, the long cables are the unique part of a suspension bridge. Anchored on land at each end, the cables are strung over the top of tall towers and gently slope back down to support the bridge deck (the road and/or walkway) from above.

Feel the Force



Materials

- A partner (someone of similar size works best)
- Three straws: one to use as towers and two to use as bridge decks—one for each of the two bridges to be built
- Scissors
- Piece of string, four feet long, to use as a suspension cable

- Masking tape
- Large paper clip
- Load bucket (paper box takeout containers work well)
- Heavy nuts, bolts or anything else small but heavy to serve as weights
- Ruler

Preparation

- Move two chairs of equal height seven inches apart.
- Carefully cut one straw in half to make two towers.
- Cut a small slit on the top end of each tower for the string to rest in.
- Cut one four-inch piece of string.
- Have the masking tape handy.

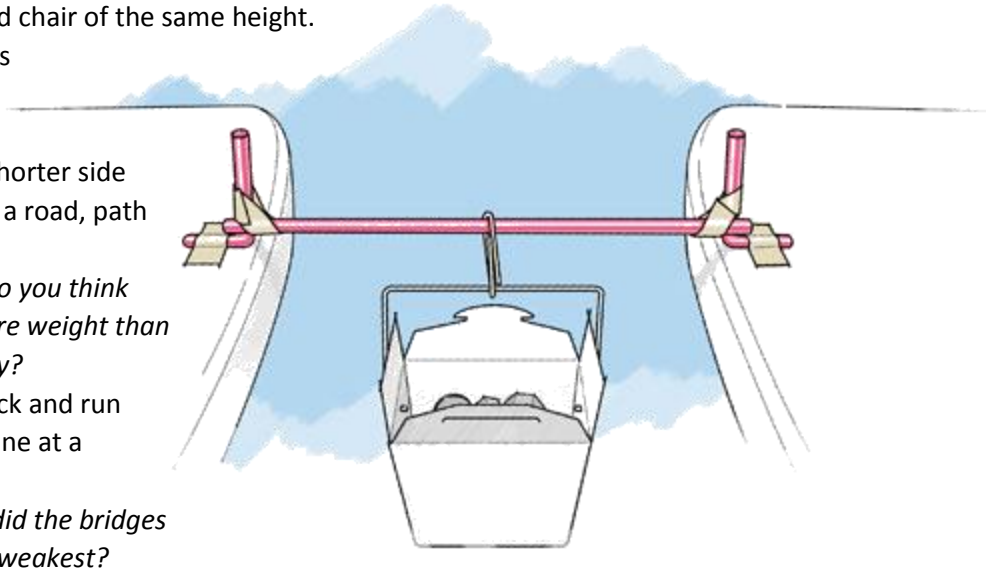
Procedure

1. To learn about the forces that keep suspension bridges standing, you can experience them yourself. To start, face your partner.
   Join hands, and slowly, carefully lean backward. Don't let go! *Do you feel a tug? What is the force associated with pulling?* This is tension, which suspension bridge cables use.
   Facing your partner again, place your palms against your partner's. Now slowly, carefully lean toward each other. *What kind of pressure do you feel now?* This is compression, which is found in bridge towers.
2. Now that we know what the forces of compression and tension feel like, we can build two types of bridges and compare their strength. We'll start by building a model suspension bridge.
3. Tape one half of the cut (tower) straw to the top of one of the chairs so that the slit is on the top, pointing to the other chair.
4. Now tape the other half of the straw to the other chair in the same manner. The two slits should be in a line, and the straws should be seven inches apart.
5. Wrap the middle of the four-foot string twice around a whole straw. This will serve as the deck—where a road or walkway would go.
6. Tape each end of this straw to a base of a tower straw so that it spans the distance between them.
7. Thread each end of the string through the slit in each straw down the other side. To anchor the bridge, tape each side of the string to the chair. You've just built a suspension bridge!
8. Loop a large paper clip around the deck straw and hang your empty load bucket from it. Begin to put your weights into the bucket, recording the number until the bridge breaks (by the straw bending or giving way).

You're Beaming!

Now we'll build a beam bridge. Remove the string and carefully cut the two side-tower straws in half.

1. Tape one straw "tower" to the edge of a chair.
2. Tape the second tower to a second chair of the same height.
3. Position these towers seven inches apart.
4. Now tape each end of another straw to the bottoms of the two shorter side straws. This is your beam—where a road, path or railroad tracks would go.
5. You've just built a beam bridge! *Do you think this bridge will be able to hold more weight than the suspension bridge or less? Why?*
   Hang the load bucket from the deck and run the test again by adding weights one at a time.
   Which bridge is stronger? Where did the bridges collapse? Where was each bridge weakest?



Observations and result:
Which bridge was able to hold more weight? Why do you think that is?

When all the materials and circumstances are the same, suspension bridges can span longer distances than simple beam bridges. This is because the bridge deck, or roadway, is supported from above using tension in the cables and compression in the towers rather than just from bases. Suspension bridges are also less rigid, so they can better withstand outside forces, such as earthquakes. Have you crossed beam bridges or suspension bridges?

Extra: Design and build a longer span. See if you can make a bridge twice as long (14 inches) that supports the same amount of weight. *What parts of the bridge will you need to change?* (Tip: You might need to reinforce the tape situating the towers, wrap the string around the deck more times or tape the anchorages farther back.)

Day Eleven K-8 Standard Alignment

K

- 7.9.1 Observe, identify, and compare the properties and characteristics of various objects.
- 7.T/E.1 Explain how simple tools are used to extend the senses, make life easier, and solve everyday problems.
- 7.T/E.3 Use tools to measure materials and construct simple products.

These standards will be met and reinforced as students learn about, build models of, and compare and contrast the characteristics of suspension and beam bridges. Ex. Which bridge is stronger? Where did the bridges collapse? Where was each bridge weakest?

1

- 7.9.1 Classify objects according to their physical properties.
- 7.T/E.1 Explain how simple tools are used to extend the senses, make life easier, and solve everyday problems.
- 7.T/E.3 Use tools to measure materials and construct simple products.

These standards will be met and reinforced as students learn about, build models of, and compare and contrast the characteristics of suspension and beam bridges. Ex. Which bridge is stronger? Where did the bridges collapse? Where was each bridge weakest?

- 7.12.2 Realize that things fall toward the ground unless something holds them up.
- 7.T/E.1 Explain how simple tools are used to extend the senses, make life easier, and solve everyday problems.
- 7.T/E.3 Use tools to measure materials and construct simple products.

These standards will be met and reinforced as students learn about, build models of, and compare and contrast the characteristics of and uses for suspension and beam bridges. Ex. Which bridge is stronger? Where did the bridges collapse? Where was each bridge weakest?

- 7.9.1 Use physical properties to compare and contrast objects.
- 7.T/E.1 Explain how different inventions and technologies impact people and other living organisms.
- 7.T/E.3 Determine criteria to evaluate the effectiveness of a solution to a specified problem.

These standards will be met and reinforced as students learn about, build models of, and compare and contrast the characteristics of and uses for suspension and beam bridges. Ex. Which bridge is stronger? Where did the bridges collapse? Where was each bridge weakest? Students will apply what they've learned from the original models and try to expand on them, ex. Building a longer bridge that will hold the same amount of weight. They will determine what will show whether they were successful or not, ex. Did the bridge hold the weight? Did it collapse? Etc.

- 7.9.1 Choose an appropriate tool for measuring a specific physical property of an object.
- 7.T/E.1 Explain how different inventions and technologies impact people and other living organisms.
- 7.T/E.3 Determine criteria to evaluate the effectiveness of a solution to a specified problem.

These standards will be met and reinforced as students learn about, build models of, and compare and contrast the characteristics of and uses for suspension and beam bridges. Ex. Which bridge is stronger? Where did the bridges collapse? Where was each bridge weakest? Students will apply what they've learned from the original models and try to expand on them, ex. Building a longer bridge that will hold the same amount of weight. They will determine what will show whether they were successful or not, ex. Did the bridge hold the weight? Did it collapse? Etc.

5

- 7.12.2 Identify the force that causes objects to fall to the earth.
- 7.T/E.1 Explain how different inventions and technologies impact people and other living organisms.
- 7.T/E.3 Determine criteria to evaluate the effectiveness of a solution to a specified problem.

These standards will be met and reinforced as students learn about, build models of, and compare and contrast the characteristics of and uses for suspension and beam bridges. Ex. Which bridge is stronger? Where did the bridges collapse? Where was each bridge weakest? Students will apply what they've learned from the original models and try to expand on them, ex. Building a longer bridge that will hold the same amount of weight. They will determine what will show whether they were successful or not, ex. Did the bridge hold the weight? Did it collapse? Etc.

6

- 7.T/E.1 Use appropriate tools to test for strength, hardness, and flexibility of materials.
- 7.T/E.2 Apply the engineering design process to construct a prototype that meets certain specifications.

These standards will be met and reinforced as students learn about, build models of, and compare and contrast the characteristics of and uses for suspension and beam bridges. Ex. Which bridge is stronger? Where did the bridges collapse? Where was each bridge weakest? Students will apply what they've learned from the original models and try to expand on them, ex. Building a longer bridge that will hold the same amount of weight. They will determine what will show whether they were successful or not, ex. Did the bridge hold the weight? Did it collapse? Etc.

7

- 7.T/E.1 Use appropriate tools to test for strength, hardness, and flexibility of materials.
- 7.T/E.2 Apply the engineering design process to construct a prototype that meets certain specifications.

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8

- 7.T/E.1 Use appropriate tools to test for strength, hardness, and flexibility of materials.
- 7.T/E.2 Apply the engineering design process to construct a prototype that meets certain specifications.

These standards will be met and reinforced as students learn about, build models of, and compare and contrast the characteristics of and uses for suspension and beam bridges. Ex. Which bridge is stronger?

Where did the bridges collapse? Where was each bridge weakest? Students will apply what they've learned from the original models and try to expand on them, ex. Building a longer bridge that will hold the same amount of weight. They will determine what will show whether they were successful or not, ex. Did the bridge hold the weight? Did it collapse? Etc.

Days 12[&13]: Simply Suspenseful

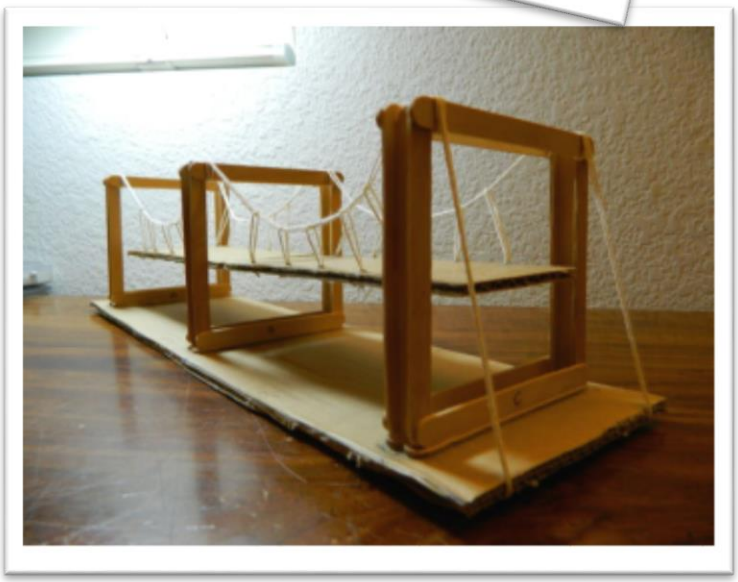
Students have been hired as bridge engineers! Your local city is in desperate need of a new suspension bridge to cross the river that will save commute time, but won't interfere with boat and river traffic…and it's up to you to build it! *This guide details the highlights of the process in making your very own suspension bridge out of simple, cheap materials. To make the suspension bridge in the sample, the builder/creator (jamesabt007) used the following materials and tools:*

Materials

- Cardboard
- Popsicle Sticks (24 for a bridge with 1 deck, 36 for 2 decks, etc.)
- String
- Scotch Tape

Tools

- Large Nail, Hobby Knife or Box cutter
- Scissors
- Ruler
- Pen/Pencil
- Sand Paper
- Elmer's Glue or Craft Glue



First, We'll Make the Pylons

For each pylon (Picture 1-Upper Left), you will need 12 Popsicle sticks. Make two I beams, two L beams (Picture 2-Upper Right). And then combine them with each other **and** two separate Popsicle sticks.

Use the following series of images for reference as you complete the previous steps and make a pylon.

Make at least three pylons.

Image Notes
1. Your goal.

Image Notes
1. Your second goal

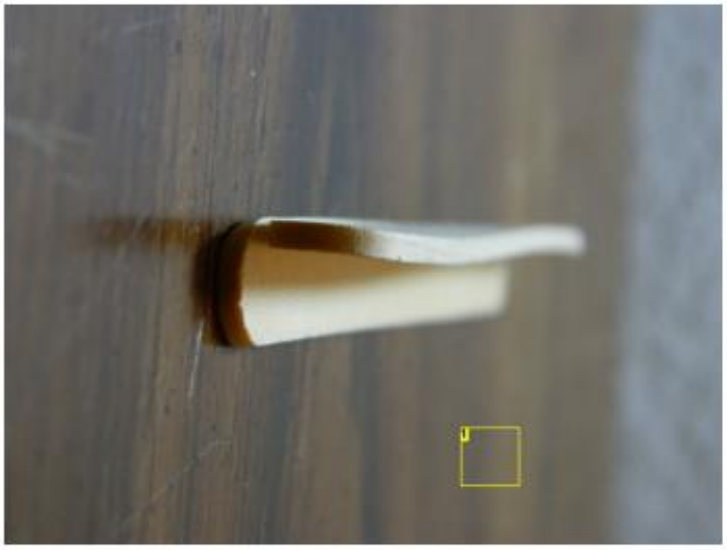


Image Notes
1. This sidewayness really bothers me, sorry if it also bother you.

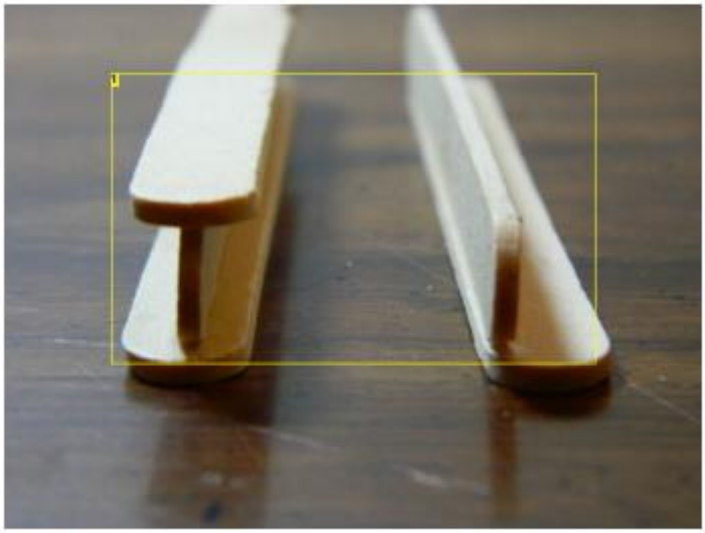


Image Notes
1. Your end result.

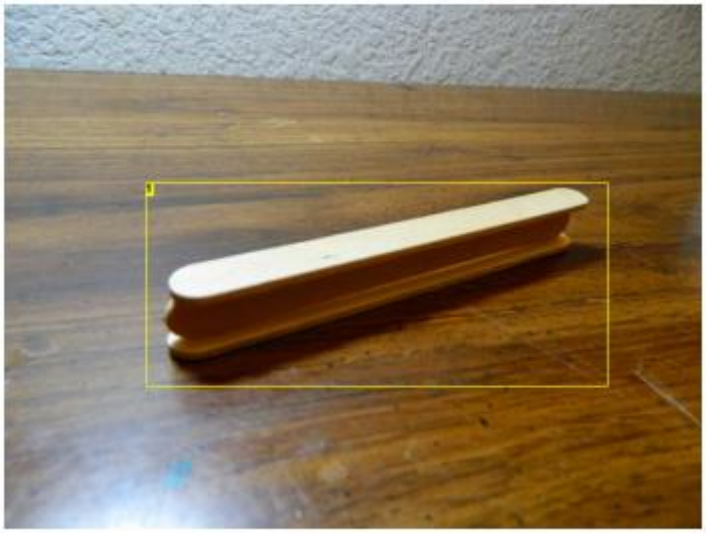
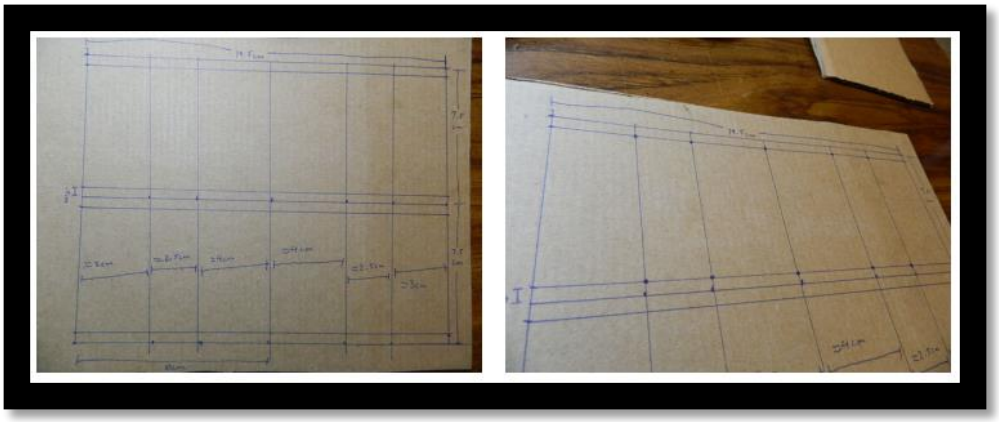


Image Notes
1. Your I-beam, sort of looks like a hot-dog if you ask me...

Making the Deck(s)

To make the deck for the bridge, start out with a relatively medium sized cardboard. The piece in the following images was large enough to fit two decks.

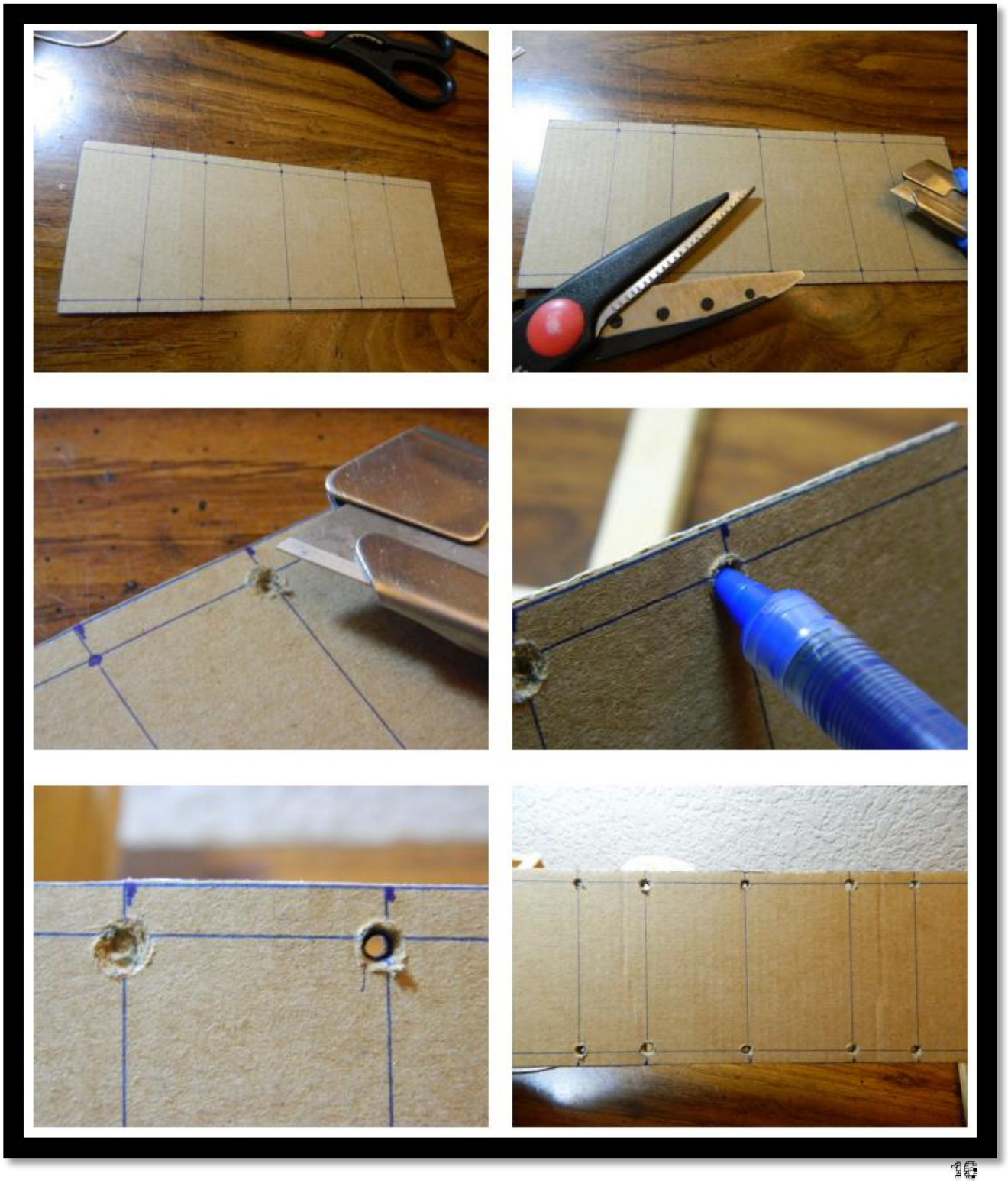


Depending on how many decks you want your bridge to have, you can make more or less.

Measure out the deck, mark the holes from the intersections to where

you will punch holes for the suspension cables to go through, cut the piece.

Tip: if you are using a knife to punch the holes for students, be sure to have students clean them by either making them larger than needed or by forcing the material aside such that there is a distinct hole with a pen or pencil or large nail. This is to ensure that the string can easily be threaded through the holes and will make the process a lot easier to make the decks.



String

Your lengths of string can vary depending on the distance from pylon to pylon, your total span of the bridge, and your height you want the decks to be above the ground. Use a ruler and explore with different lengths to see which bridge looks nicer or more realistic.

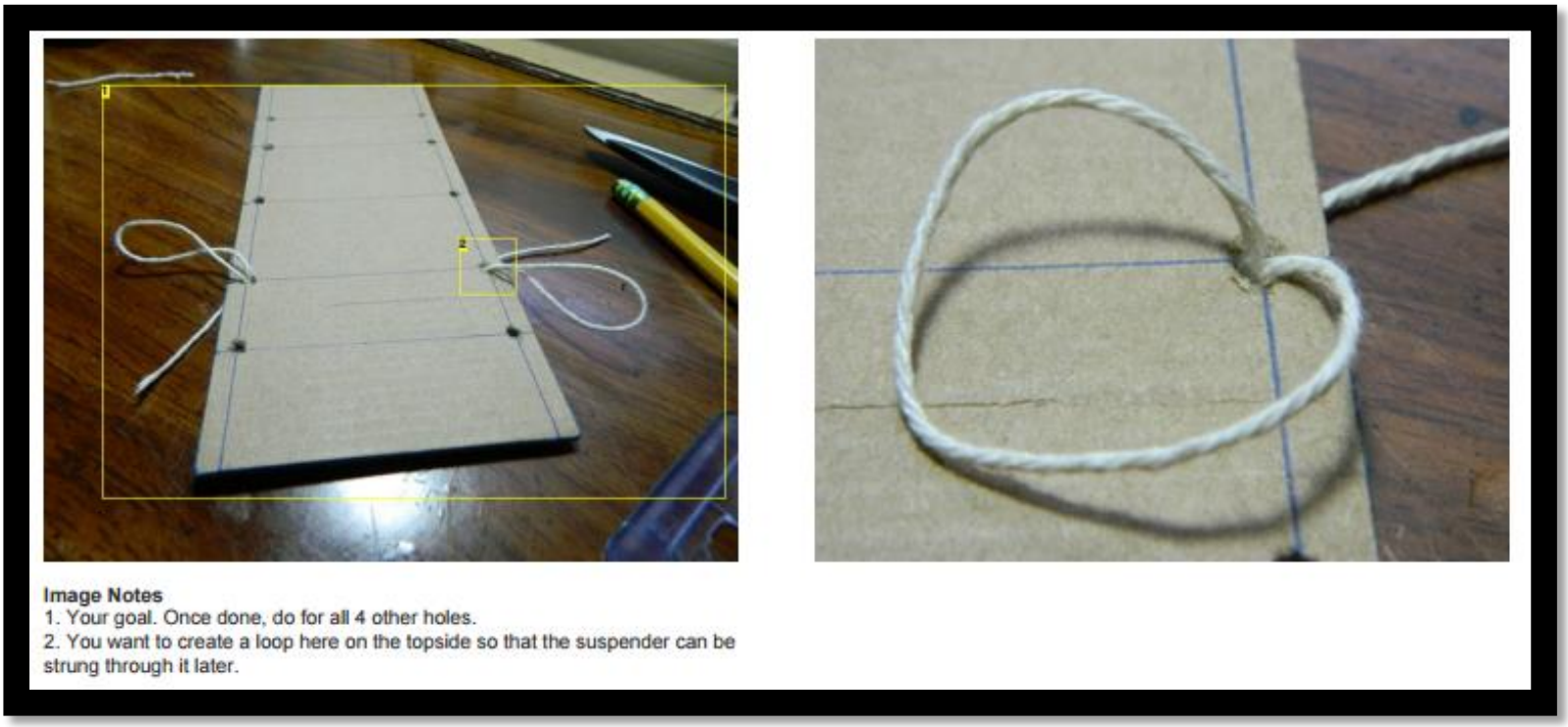
Stringing the deck(s)

This part of the process is placing the string you determined from the previous step into the holes of the deck. There are many ways to do this step.

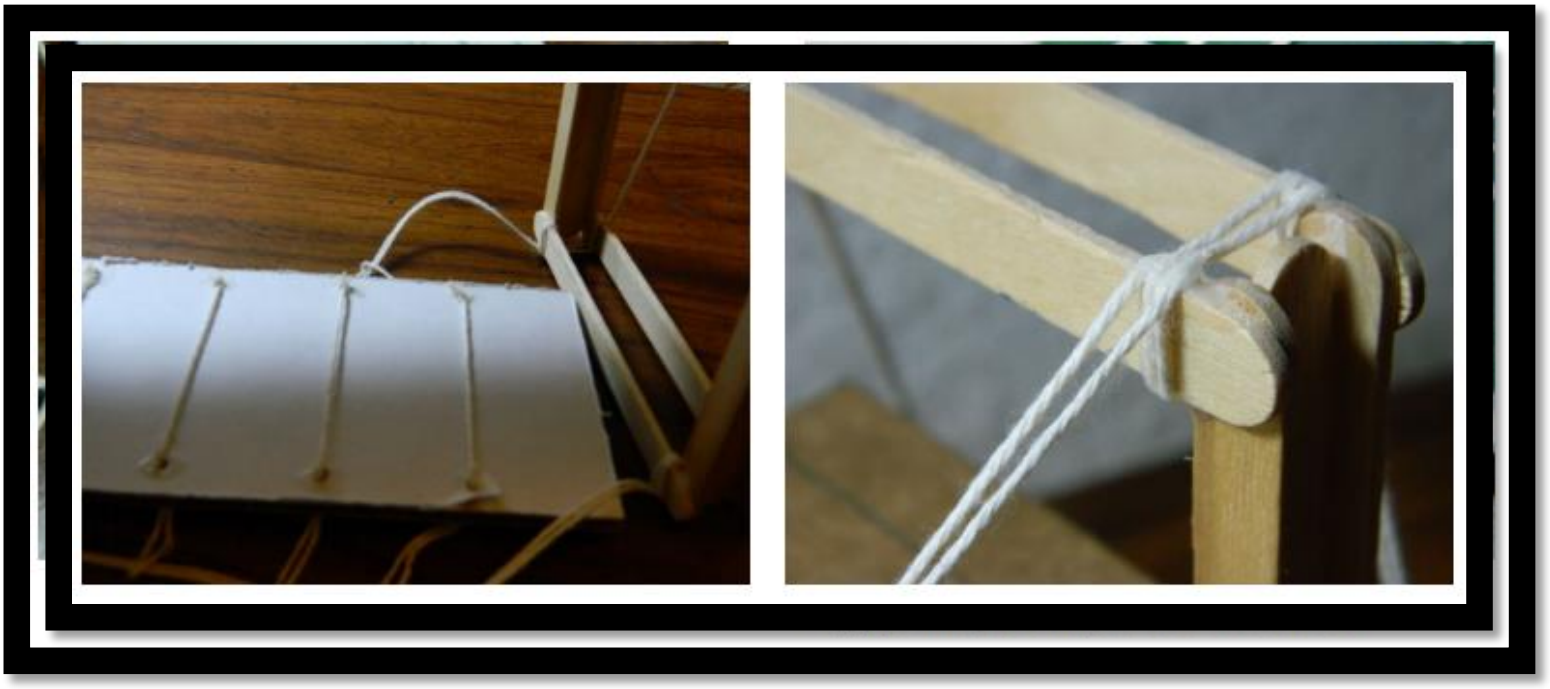
Just remember that if you have 5 total suspenders on each side of the deck, you'll need to make the 4 holes on each corner of the deck have longer loops than the one in the middle since the cable droops slightly, like the curve of a parabola with a positive a coefficient (y=ax2 +bx+c).

Tip!

If you hold a piece of string from both ends and let it hang downwards with nothing attached to it, it will create the shape that your finished suspension bridge's cable should have- you can then copy this shape to a piece of paper or cardboard and use it to figure out how long the suspender cables should be. This shape is also the shape of an ideal arch bridge upside down.



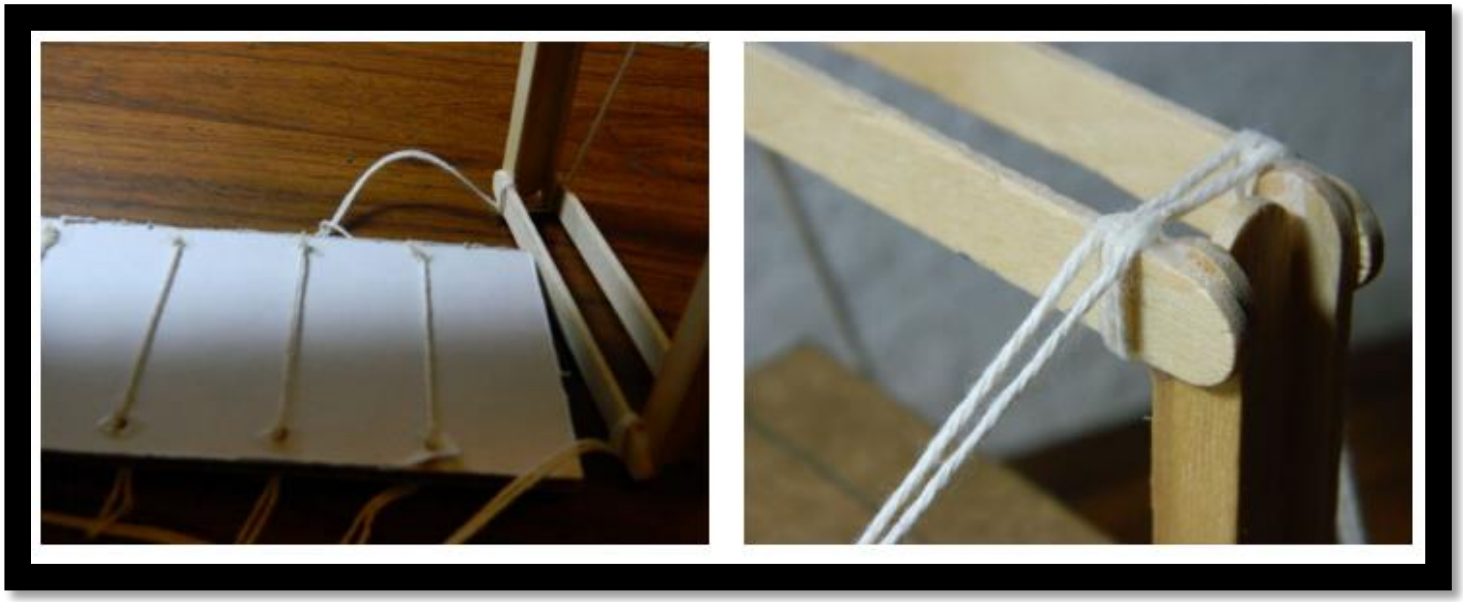
Top of Bridge Deck- a look into how to start the stringing process.



Bottom of Bridge Deck- a look into how to start the stringing process.

Bringing it together

These are a few images and close ups of a completed model. Remember that this is a very open ended project with no real set guidelines on the lengths and distances just like suspension bridges in real life. There are many ways this bridge can be built!

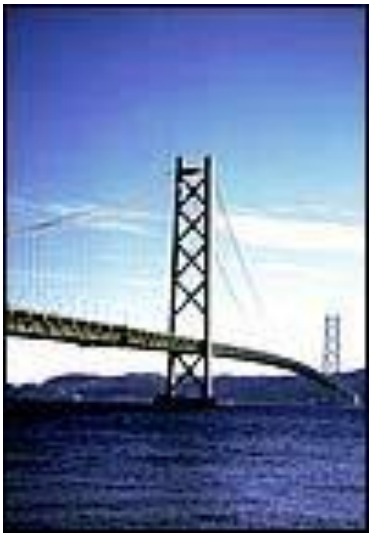


Spanning the Distance:

Akashi Kaiyko Bridge: The Longest Bridge in the World (so Far)

Bridges are the lifeline of Japan. Since the 1930s, the island nation has dreamt of linking its many parts as a whole. But WWII diverted the incredible resources needed to accomplish this, and only since 1960 has the dream moved again, slowly, toward reality. The final step in this massive undertaking was the Akashi-Kaikyo Bridge, currently the longest single-span suspension bridge in the world. This marvel of architectonics stands as a testament to the genius of Asian engineering and, judged in a context that perhaps the Japanese understand best, as the most beautiful bridge in the world.

In 1998, Japanese engineers stretched the limits of bridge engineering with the completion of the Akashi Kaikyo Bridge. Currently the longest spanning suspension bridge in the world, the Akashi Kaiyko Bridge stretches 12,828 feet across the Akashi Strait to link the city of Kobe with Awaji-shima Island. It would take four Brooklyn Bridges to span the same distance! The Akashi Kaikyo Bridge isn't just long -- it's also extremely tall. Its two towers, at 928 feet, soar higher than any other bridge towers in the world.

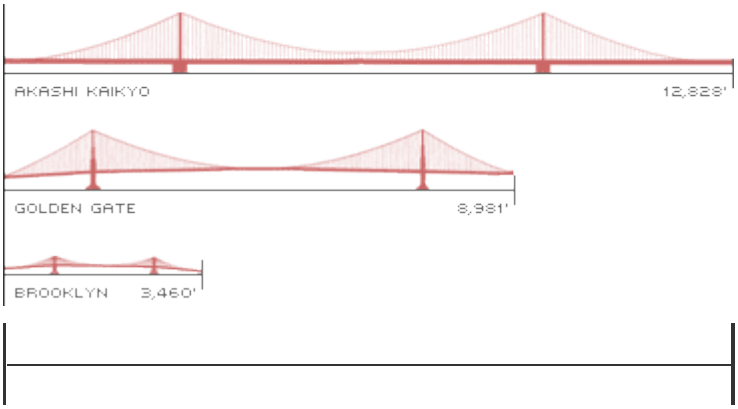


The Akashi Strait is a busy shipping port, so engineers had to design a bridge that would not block shipping traffic. They also had to consider the weather. Japan experiences some of the worst weather on the planet. Gale winds whip through the Strait. Rain pours down at a rate of 57 inches per year. Hurricanes, tsunamis, and earthquakes rattle and thrash the island almost annually.

How did the Japanese engineers get around these problems? They supported their bridge with a truss, or complex network of triangular braces, beneath the roadway. The open network of triangles makes the bridge very rigid, but it also allows the wind to blow right through the structure. In addition, engineers placed 20 tuned mass dampers (TMDs) in each tower. The TMDs swing in the opposite direction of the wind sway. So when the wind blows the bridge in one direction, the TMDs

sway in the opposite direction, effectively "balancing" the bridge and canceling out the sway. With this design, the Akashi Kaikyo can handle 180-mile-per-hour winds, and it can withstand an earthquake with a magnitude of up to 8.5 on the Richter scale!

Here's how this bridge stacks up against some of the longest-spanning bridges in the world. (Total length, in feet)



Akashi Kaikyo Bridge 12,828'

Fast Facts:

- The bridge is so long, it would take eight Sears Towers laid end to end to span the same distance.
- The length of the cables used in the bridge totals 300,000 kilometers. That's enough to circle the earth 7.5 times!
- The bridge was originally designed to be 12,825 feet. But on January 17, 1995, the Great Hanshin Earthquake stretched the bridge an additional three feet.
- The bridge holds three records: it is the longest, tallest, and most expensive suspension bridge ever built.

Vital Statistics:
Location: Kobe and Awaji-shima, Japan
Completion Date: 1998
Cost: $4.3 billion
Length: 12,828 feet
Type: Suspension
Purpose: Roadway
Materials: Steel
Longest Single Span: 6,527 feet
Engineer(s): Honshu-Shikoku Bridge Authority

Option: Watch selected clips from *Modern Marvels - The World's Longest Bridge* (by the History Channel) if available and/or clips from The Longest Suspension Bridge in The World by Big, Bigger, Biggest.

The Longest Suspension Bridge in The World

Day Twelve K-8 Standard Alignment

K

- 7.T/E.2 Apply engineering design and creative thinking to solve practical problems.
- 7.T/E.3 Use tools to measure materials and construct simple products.

These standards will be met and reinforced (and used as a guideline for student outputs and expectations) while students work as bridge engineers and build models of suspension bridges.

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3

- 7.T/E.1 Describe how tools, technology, and inventions help to answer questions and solve problems.
- 7.T/E.3 Identify appropriate materials, tools, and machines that can extend or enhance the ability to solve a specified problem.
- 7.T/E.5 Apply a creative design strategy to solve a particular problem.

These standards will be met and reinforced (and used as a guideline for student outputs and expectations) while students work as bridge engineers and build models of suspension bridges (working to overcome challenges and problems they encounter as they build). They will also be met as students learn about the Akashi Kaikyo bridge and how engineers met the challenges of construction and what approaches they took and tools and technology they used to solve their problems.

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- 7.T/E.1 Use appropriate tools to test for strength, hardness, and flexibility of materials.
- 7.T/E.2 Apply the engineering design process to construct a prototype that meets certain specifications.

These standards will be met and reinforced (and used as a guideline for student outputs and expectations) while students work as bridge engineers and build models of suspension bridges (working to overcome challenges and problems they encounter as they build). They will also be reinforced as students view real life examples and learn about the Akashi Kaikyo Bridge and how engineers met the challenges of construction and what approaches they took and tools and technology they used to solve their problems.

7

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Sample Academic Vocabulary to Reinforce Week 3

K

- Job
- Needs
- Tools
- Parts
- Location

1

- Property
- Push
- Pull
- Invent
- History
- Length
- Weight
- Property

2

- Type
- Distance
- History
- Natural Resources
- Compare
- Contrast
- Landmark
- River

3

- Landforms
- Natural resources
- Tools
- Conclusion
- Factor
- Capacity
- Force

4

- Expansion
- Weathering
- Exploration
- Accuracy
- Relationship
- Remainder

5

- Region
- View
- Model
- Core
- Gravity
- Solution
- Reconstruct
- Historian

6

- Technological
- Cause
- Effect
- Prototype
- Design Constraint

7

- Impact
- Topography
- Speed
- Function
- Property
- Juncture

8

- Human impact
- Variation
- Element
- Angles
- Tension
- Infrastructure

Sample Supply List Bridging the Gap Week 3

Day 9&10

- Paper strips (ex. Black & Red—for the bridge, Yellow—lights or stars?, Blue, Green, Purple,--water; Grey, White—Clouds/Fog)
- Q-tip, with the ends cut off (*You can purchase a special tool with a slit at the end for rolling your paper strips, but it really isn't* necessary.)
- scissors (or simply tear the strips to the lengths you want)
- Glue (***YES! Paste*** works well, but any white craft glue will work)
- toothpick for applying small amounts of glue
- for inspiration, have students check out the included images of the Golden Gate Bridge

Day 11

- A partner (someone of similar size works best)
- Straws
- Scissors
- Piece of string, four feet long, to use as a suspension cable
- Masking tape
- Large paper clip
- Load bucket (paper box takeout containers work well)
- Heavy nuts, bolts or anything else small but heavy to serve as weights
- Ruler
- Teacher made sample

Days 12 (& 13)

- Access to videos & links
- Cardboard
- Popsicle Sticks (24 for a bridge with 1 deck, 36 for 2 decks, etc.)
- String
- Scotch Tape
- Large Nail, Hobby Knife or Box cutter
- Scissors
- Ruler
- Pen/Pencil
- Sand Paper
- Elmer's Glue or Craft Glue

SOURCES& REFERENCES

- https://en.wikipedia.org/wiki/simple_suspension_bridge#living_bridges
- http://www.pbs.org/wgbh/buildingbig/bridge/index.html
- http://www.scientificamerican.com/article/bring-science-home-suspension-bridge/
- https://www.youtube.com/watch?v=N9fbRcRJY34
- http://www.pbs.org/wgbh/buildingbig/wonder/structure/akashi_kaikyo.html
- http://www.instructables.com/id/Simple-Suspension-Bridge-Model/
- http://www.allthingspaper.net/2013/06/quilled-golden-gate-bridge.html
- https://vimeo.com/27299211
- http://www.teachkidsart.net/quilled-paper-designs/