Grade Level: Pre-K through 2

Description: In this activity, students will ask questions and seek answers in a hands-on investigation. Students will observe as they learn about Harbor Bridge and explore the process of bridge design and building. Through the building challenge, students will work in collaborative groups to design a structure to support a given collection of items. Students will test their designs and make adjustments throughout the process.

For Educators: Educators can access a quick overview of “Bridge Basics” on PBS’ website https://www.pbs.org/wgbh/buildingbig/bridge/basics.html

Building Background Knowledge: Students engage in a guided visit of the Harbor Bridge exhibit. The teacher or librarian should facilitate a critical viewing of the exhibit. Draw attention to the structural components of the bridge and use age-appropriate language to discuss how the bridge is designed to support so much weight. Engage students in a conversation about photographs that show cars driving across the bridge. How is the bridge able to hold the weight of cars and the bridge itself?

Materials:
- Small cups
- Large craft sticks
- 20 small identical items
  (Lego® mini figures, plastic counting bears, unifix cubes, small blocks, etc) per group

Directions:
1. Begin a conversation with the students about bridge building. Discuss what an engineer is and the role engineers play in the design of a bridge. Make a connection with the engineers who worked on Harbor Bridge. What did they do to design the bridge in a way that would support the cars?

2. Divide the students into cooperative groups of 2 to 4 children. Review the handling of materials and how everyone will participate in the activity.

3. Explain that the goal is to build a bridge that will support all 20 items. Groups should try a number of different designs to see which one will hold all of the items without falling.

4. Each group needs 3 to 4 cups, 3 to 4 craft sticks, and a collection of 20 small items.

5. Give students time to build bridges and test their structures. Encourage students through the process of trial and error. Their bridges may fall or items may fall off, but that is part of the design process. They need to test their ideas to see what works and then make adjustments based on what is successful and what did not work.

6. If groups finish, they can move on to some “design challenges.” Have groups try building different structures that still hold the 20 items. Can they make the bridge taller? Can they build the bridge using less materials? Can they make a wider bridge? Can they build a bridge using alternate materials available in the classroom/library?

7. Bring the groups back together and discuss the results of the investigation. What worked well and what was difficult? How did it feel to make a structure that didn't quite work? How did you make changes to your bridge while you were working? What connections can they make with the engineers and builders of Harbor Bridge?

1 For additional information about the design of Harbor Bridge, view the video By Texans, For Texans: Building Harbor Bridge by visiting www.txdot.gov and searching the keywords “Harbor Bridge.”
ACTIVITY: CRAFT STICK BRIDGES (CONT'D)

TEKS:

Pre-K
Science VI.A.1. Child observes, investigates, describes, and discusses properties and characteristics of common objects.

Kindergarten
§112.11.2 Scientific investigation and reasoning. The student develops abilities to ask questions and seek answers in classroom and outdoor investigations.

First Grade
§112.12.2 Scientific investigation and reasoning. The student develops abilities to ask questions and seek answers in classroom and outdoor investigations.

Second Grade
§112.13.2 Scientific investigation and reasoning. The student develops abilities necessary to do scientific inquiry in classroom and outdoor investigations.
Grade Level: 3 through 5

Description: In this activity, students will learn about Harbor Bridge and explore the process of bridge design and building. Through the guided steps, they will fold paper and design various structures to support greater amounts of weight. Students will apply their knowledge and design their own bridge at the end of the activity.

For Educators: Educators can access a quick overview of “Bridge Basics” on PBS’ website here: https://www.pbs.org/wgbh/buildingbig/bridge/basics.html.

The Historic Bridge Foundation also offers a more detailed explanation of bridge types and components on its website: https://historicbridgefoundation.com/bridge-types/.

More activities, information, and photos are also available from TxDOT on the Beyond the Road: Resources for Educators page, under the heading “Historic Bridges”: https://www.txdot.gov/inside-txdot/division/environmental/resources-for-educators.html.

Building Background Knowledge: Students will engage in a guided visit of the Harbor Bridge exhibit. The teacher or librarian should facilitate a critical viewing of the exhibit. The educator may also have students view the video, By Texans, For Texans: Building Harbor Bridge, available by visiting www.txdot.gov and searching the keywords “Harbor Bridge.” Draw attention to the structural components of the bridge (trusses, arches, cantilevers). Focus attention on the design of the arches and the role they play in strengthening this bridge. Engage students in a conversation about photographs that show cars driving across the bridge. How is the bridge able to hold the weight of cars and the bridge itself?

Materials:
- Paper (suggested: construction or cardstock)
- 2 cups or something to elevate the paper (stacks of books will work)
- Paper clips, coins, washers, or anything that can be used as weights
- Tape
- Copies of the “Building Bridges” recording sheet
- Pencils

Directions:

1. Begin a conversation with the students about bridge building. Discuss the role of engineers in the design of a bridge and how they plan for a structure that will support a large amount of weight. Make a connection with the engineers who worked on Harbor Bridge. What did they do to support the weight of the bridge during building? How does the design help support weight? With older students, you can review the trusses, cantilevers, and arches.

2. Divide the students into cooperative groups of 2 to 4 children. Review the handling of materials and how they will need to pay close attention to the directions as they work through the activity.

3. Each group needs a recording sheet, pencil, 3 pieces of paper, 2 cups, and a handful of coins (or whatever you plan to use as weights). On the recording sheet, have students write down what they are using as weights. They should fill in the blank on “How Many ___________ Will It Support?”
Direct the students to create the first bridge. This bridge will be a single piece of paper balanced between 2 cups. Discuss with the students about the bridge. They can think of the space between the 2 cups as the ship channel. The paper bridge over the channel must support the cars to travel over the channel. Groups should place pennies in the middle of the paper bridge and they can observe how many coins the bridge will support before it collapses. Record the results.

Tell the students you are going to change the shape of the paper to help it support more weight. This is exactly what engineers do as they design bridges. Have the students fold the paper lengthwise as you would to make a fan (an accordion fold). Place the folded paper between the two cups so that the folds are arranged lengthwise. Place pennies across the bridge. How many coins can the bridge hold before it collapses? Record the results.

Review arches with students. Direct them to create an arch by folding 2 pieces of paper lengthwise. One piece will go across the cups and the other will be placed underneath in an arch to support the weight. Place pennies across the bridge. How many coins can the bridge hold before it collapses? Record the results.

Now that the students have explored different bridge-building structures, they should work with their groups to design their own paper bridge. Facilitate conversations with the groups about how they might create an even stronger bridge. What can they use from this investigation? What is something else they could do to strengthen their bridges? Are there different folds they can make or other ways they might reinforce the structure? Give groups more paper and time to design and build their own bridge. Students should record their designs on the recording sheet and then test their bridges. When a group finishes building their design, they should test it by placing coins across the bridge. How many coins can the bridge hold before it collapses? Record the results.

Bring the groups back together and discuss the results of the investigation. What worked well and what was difficult? What did they notice about the design and structure of the bridges? What connections can they make with the engineers and builders of Harbor Bridge?
<table>
<thead>
<tr>
<th>Bridge Design</th>
<th>How Many ____________ Will It Support?</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Bridge Design" /></td>
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<tr>
<td><img src="image2.png" alt="Bridge Design" /></td>
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<td><img src="image5.png" alt="Bridge Design" /></td>
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</tbody>
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ACTIVITY: PAPER BRIDGES (CONTD)

TEKS:

Third Grade
Science 3.2 (A) Plan and implement descriptive investigations, including asking and answering questions, making inferences, and selecting and using equipment or technology needed to solve a specific problem in the natural world.

Fourth Grade
Science 4.2 (A) Plan and implement descriptive investigations, including asking well-defined questions, making inferences, and selecting and using appropriate equipment or technology to answer questions.

Fifth Grade
Science 5.2 (A) Describe, plan, and implement simple experimental investigations testing one variable.
3  **ACTIVITY: BRIDGE BUILDING CHALLENGE**

**Grade Level: 6 through 8**

**Description:** In this activity, students will learn about Harbor Bridge and explore the process of bridge design and building. Through the building challenge, students will work in collaborative groups to design a structure to support the greatest amount of weight. The students will apply a knowledge of trusses as support elements.

**For Educators:** Educators can access a quick overview of “Bridge Basics” on PBS’ website here: [https://www.pbs.org/wgbh/buildingbig/bridge/basics.html](https://www.pbs.org/wgbh/buildingbig/bridge/basics.html).

The Historic Bridge Foundation also offers a more detailed explanation of bridge types and components on its website: [https://historicbridgefoundation.com/bridge-types/](https://historicbridgefoundation.com/bridge-types/).

More activities, information, and photos are also available from TxDOT on the **Beyond the Road: Resources for Educators page**, under the heading “Historic Bridges”: [https://www.txdot.gov/inside-txdot/division/environmental/resources-for-educators.html](https://www.txdot.gov/inside-txdot/division/environmental/resources-for-educators.html).

**Building Background Knowledge:** Students will engage in a guided visit of the Harbor Bridge exhibit. The teacher or librarian should facilitate a critical viewing of the exhibit. The educator may also have students view the video, *By Texans, For Texans: Building Harbor Bridge*, by visiting [www.txdot.gov](http://www.txdot.gov) and searching the keywords “Harbor Bridge.” Draw attention to the structural components of the bridge (trusses, arches, cantilevers). Focus student attention on the design of the trusses and the role they play in strengthening this bridge. How did the engineers use triangles to make this bridge stronger? How is the bridge able to hold the weight of cars and the bridge itself?

**Materials:**
- Plastic straws (not flexible)
- Scissors
- Scotch tape
- Items to test the weight bearing of the bridge (coins, washers, etc)

**Directions:**

1. **Begin a conversation with the students about bridge building.** Discuss the role of engineers in the design of a bridge and how they plan for a structure that will support a large amount of weight. Make a connection with the engineers who worked on Harbor Bridge. What did they do to support the weight of the bridge during building and how does the design help support weight? Review the use of trusses, cantilevers, and arches. Focus particularly on the truss and how it is integral to the bridge structure.

2. **Explore trusses further.** This can be modelled for the whole group or students can participate in creating a truss. Build a square with straws. Use scotch tape at the corners to hold the 4 pieces together. Show students how this structure is weak and will easily collapse under a small amount of force. Next, reinforce the square with straws to show how triangles strengthen the structure. This is accomplished by turning to the square into 2 or 4 triangles (see example).
ACTIVITY: BRIDGE BUILDING (CONT’D)

3. Review pictures of Harbor Bridge. Have students notice the trusses and structural components that allow the bridge to support large amounts of weight.

4. Introduce the bridge building challenge. Students will work in cooperative groups to build a bridge. The goal is for the bridge to support the greatest amount of weight. Students should apply their knowledge of bridge building, especially trusses, to design and construct their bridges. Pass out 20+ straws, scissors, and scotch tape to each group. (See bridge examples below for guidance. These are meant to guide educators, but the students should be encouraged to develop their own designs.)

5. When students are finished constructing their bridges, they should test them by placing them between two level surfaces. This can be two chairs, tables, stacks of books, etc. The area between represents the ship channel. Test the bridge’s weight-bearing ability by adding pennies, washers, etc., until the bridge collapses. The winner of the challenge is the bridge that is able to bear the greatest amount of weight.

6. Facilitate a follow up conversation with groups after all bridges have been tested. What went well? What challenges did they experience in the process? What did they learn that they would apply when building another bridge? What connections can they make with the engineers and builders of Harbor Bridge?

TEKS:

Sixth Grade

Seventh Grade
§111.27.1(A) Apply mathematics to problems arising in everyday life, society, and the workplace.

Eighth Grade
§111.28.1(A) Apply mathematics to problems arising in everyday life, society, and the workplace.
**Description:** In this activity, students will learn about Harbor Bridge and then engage with community members to gather oral histories of experiences on and around the bridge. Students will learn that historians study the distant past, and they also gather information about the more recent past to document and preserve for future generations.

**For Educators:** For a brief introduction to conducting an oral history interview, read “Composing Questions” and “Getting the Story” on the Baylor Oral History Institute’s website: https://www.baylor.edu/library/index.php?id=974460.

The Historic Bridge Foundation also offers a more detailed explanation of bridge types and components on its website: https://historicbridgefoundation.com/bridge-types/.

For more in-depth information about oral histories, educators may view a detailed guide on how to conduct an oral history interview in the article “The Heart of Oral History: How to Interview,” available at: https://www.baylor.edu/library/index.php?id=974461.

**Building Background Knowledge:** Students engage in a guided visit of the Harbor Bridge exhibit. The teacher or librarian should facilitate a critical viewing of the exhibit. Draw attention to the photographs of the community and use age-appropriate language to discuss the role the bridge has played in the community over the years. Engage students in a conversation about the impact of the bridge (both positive and negative) on the neighborhood, Corpus Christi, and the state of Texas. How has the bridge impacted the lives of different people and families in the community?

**Materials:**
- Chart paper
- Markers
- Students will need various materials depending on how they choose to share the information they collect

**Directions:**

1. Facilitate a conversation about the history of Harbor Bridge and the role it has played in the community. Ask students to share their own experiences with the bridge.

2. Show students a photograph of the old drawbridge and then the Harbor Bridge. Discuss how we know the history of the drawbridge because that was collected and archived (saved) by historians. Sometimes the work of historians is to document the more recent past in order to preserve it for the future. Historians are working now to collect the history of Harbor Bridge as the new bridge is being constructed. Explain to students that they will be historians in this activity.

3. Share the project with students. They will be collecting Harbor Bridge memories from community members. They might have grandparents, neighbors, parents, friends, etc who have memories to share about the Harbor Bridge. The memories can be from last week, last year, or 50 years ago. When have they been on the bridge? Have they ever experienced a special event on the bridge? Do they have any early memories of the bridge? Encourage students to generate questions they might ask in their interviews and record on chart paper.

4. On another piece of chart paper, generate a list of ideas for sharing. What are some ways students can share their memories/information after they collect them? Young students may simply draw a picture and write or dictate a sentence. They can also create videos of the interviews or of them re-telling the stories. Older students may consider creating posters, video reports, or multi-media presentations. Encourage students to consider creative ways to share with other members of their school communities and neighborhoods. Teachers and librarians are encouraged to find creative ways to share these collected oral histories.
ACTIVITY: COMMUNITY IMPACT (Cont'd)

TEKS:

Kindergarten - Social Studies
$113.11.14$ Social studies skills. The student communicates in oral and visual forms. The student is expected to: (A) place events in chronological order; (B) use social studies terminology related to time and chronology correctly, including before, after, next, first, last, yesterday, today, and tomorrow; (C) express ideas orally based on knowledge and experiences; and (D) create and interpret visuals, including pictures and maps.

First Grade - Social Studies
$113.12.16$ Social studies skills. The student applies critical-thinking skills to organize and use information acquired from a variety of valid sources, including technology. The student is expected to: (A) gather information about a topic using a variety of valid oral and visual sources such as interviews, music, pictures, symbols, and artifacts with adult assistance; and (B) sequence and categorize information.

Second Grade - Social Studies
$113.13.1$ History. The student understands the historical significance of landmarks and celebrations in the community, state, and nation. The student is expected to: (B) identify and explain the significance of various community, state, and national landmarks such as monuments and government buildings.

Third Grade - Social Studies
$113.14.1$ History. The student understands how individuals, events, and ideas have influenced the history of various communities. The student is expected to describe how individuals, events, and ideas have changed communities, past and present.

Fourth Grade - Social Studies
$113.15.5$ History. The student understands important issues, events, and individuals of the 20th century in Texas. The student is expected to explain the impact of various events on life in Texas such as the Great Depression, the Dust Bowl, and World War II, and notable individuals such as Audie Murphy, Cleto Rodriguez, Bessie Coleman, and other local individuals.

Fifth Grade - Social Studies
$v113.16.5$ History. The student understands important issues, events, and individuals in the United States during the 20th and 21st centuries. The student is expected to explain the significance of issues and events of the 20th century such as industrialization, urbanization, the Great Depression, the world wars, the civil rights movement, and military actions.

Sixth Grade - Social Studies
$113.18.2$ History. The student understands the influences of individuals and groups from various cultures on various historical and contemporary societies. The student is expected to describe the social, political, economic, and cultural contributions of individuals and groups from various societies, past and present.

Seventh Grade - Social Studies
$113.19.7$ History. The student understands how individuals, events, and issues shaped the history of Texas during the late 19th, 20th, and early 21st centuries. The student is expected to explain how the oil industry led to the industrialization of Texas.

Eighth Grade - Social Studies
$113.20.29$ Social studies skills. The student applies critical-thinking skills to organize and use information acquired through established research methodologies from a variety of valid sources, including technology. The student is expected to differentiate between, locate, and use valid primary and secondary sources such as media and news services, biographies, interviews, and artifacts to acquire information about the United States.