World Language – STEM MODULE – Bridges Around the World
A Bridge for the Future

World Language – STEM MODULE COVER SHEET
Bridges Around the World

| Target Language: English as a Second Language | Grade Level: 4 and 5 |
| Proficiency Level: Junior Novice Low – Junior Novice Mid |

Context and Storyline: The Bridge Engineering Security Team has sent the class a package about a mission to design “A Bridge for the Future” for cities devastated by a major disaster. The team must explore bridges that are located around the world that have been classified as great structures of the world. As they travel around the world to explore these bridges, the class will learn about the engineering design, type, and history for each bridge. Students will become members of the Bridge Engineering Security Team (BEST) by designing and constructing a “Bridge for the Future.”

Enduring Understanding: The design of bridges has greatly changed throughout history due to a variety of factors.

Essential Questions:
- What kinds of bridges do engineers build?
- What stories can bridges tell?

Module Duration and Lessons: The module is designed for three to five 30-minute class periods per week over three to five weeks. Instructional time will depend on students’ previous knowledge of content and vocabulary, as well as their language proficiency. Other factors include program type and whether the module is used as the main core of instruction or as a supplementary resource.

Lesson 1: Beam Bridges
Lesson 2: Arch Bridges
Lesson 3: Suspension Bridges
Lesson 4: The Chesapeake Bay Bridge and a Bridge for the Future
Lesson 5: Performance Assessment Tasks

Standards Targeted

<table>
<thead>
<tr>
<th>5Cs – World Languages Standards</th>
<th>NGSS/STEM Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Communication</strong></td>
<td><strong>NGSS</strong></td>
</tr>
<tr>
<td>- Students engage in brief exchanges about personal interests in the target language. (1.1.A)</td>
<td>- (E-5-ETS 1-1) Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</td>
</tr>
<tr>
<td>- Students understand spoken and written language on very familiar topics in the target language that promote the learning of basic linguistic structures. (1.2.A)</td>
<td>- (3-5-ETS 1-2) Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</td>
</tr>
<tr>
<td>- Students make short presentations and write simple communications on very familiar topics in the target language. (1.3.A)</td>
<td>- (3-5-ETS1-3) Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</td>
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</tbody>
</table>

| **Cultures**                    | **STEM**            |
| Students identify and describe the products within the cultures studied. (2.1.A) | **Engineering** |
| **Connections**                 | - (1.0.D) Plan how to construct a bridge. |
| Students access new information and reinforce |
existing knowledge of other content areas through the target language. (3.1.A)
- Math: Use math- and engineering-related vocabulary to describe bridges.
- Geography: Use bridges as clues to locate places and countries.

Comparisons
Students identify and compare the products, practices, and perspectives from the target cultures to their own. (4.2.A)
- Identify similarities and differences among bridges from different countries

Communities
Students use and extend their language proficiency and cultural knowledge through face-to-face encounters and/or the use of technology both within and beyond the school setting. (5.1.A)
- Share information about bridges with the community

<table>
<thead>
<tr>
<th>Knowledge: Students will know...</th>
<th>Skills: Students can...</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vocabulary (both linguistic and content areas)</strong></td>
<td><strong>Oral language: I can</strong></td>
</tr>
<tr>
<td><strong>Content obligatory language:</strong></td>
<td>- identify and label different types of bridges</td>
</tr>
<tr>
<td>- bridge</td>
<td>- show and name where bridges are found</td>
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<tr>
<td>- beam</td>
<td>- tell why bridges were built</td>
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<tr>
<td>- arch</td>
<td>- identify and label parts of a bridge</td>
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<tr>
<td>- suspension</td>
<td>- make simple comparisons between bridges</td>
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<tr>
<td>- bend</td>
<td><strong>Literacy: I can</strong></td>
</tr>
<tr>
<td>- compression</td>
<td>- read and understand descriptions of pictures about bridges</td>
</tr>
<tr>
<td>- load</td>
<td>- read and make simple comparisons between bridges</td>
</tr>
<tr>
<td>- tension</td>
<td>- write a simple description of a bridge using vocabulary and expressions that I have learned</td>
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<tr>
<td>- pier</td>
<td><strong>STEM and Other Subject: I can</strong></td>
</tr>
<tr>
<td>- to build</td>
<td>- identify types of bridges</td>
</tr>
<tr>
<td>- stone</td>
<td>- talk about math concepts in bridge</td>
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<tr>
<td>- concrete</td>
<td><strong>Content compatible language:</strong></td>
</tr>
<tr>
<td>- steel</td>
<td><strong>To walk across</strong></td>
</tr>
<tr>
<td>- log/wood</td>
<td><strong>To drive across</strong></td>
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<tr>
<td></td>
<td><strong>To open</strong></td>
</tr>
</tbody>
</table>
### Expressions and patterns
- What does that mean?
- Where is (x)?
- This is a (type of bridge).
- It has (characteristics of bridge).
- It is located in (country).
- It is made of (material).
- There is...
- The length is (x)
- $X$ feet = $X$ meters

### Presentational Task: Our Bridge For the Future
In Lesson 4, students worked in groups of four to design a new bridge that they presented to the class.

### Interpretive and Interpersonal Task: My Interview with the Bridge Engineering Security Team

#### Self-Evaluation
Students will work in pairs and take turns playing the role of the interviewer (Bridge Engineering Security Team member) and the interviewee, using a set of photographs with questions.

#### Optional: Earning a Bridge Engineering Security Team Badge: Evaluation by Teacher
- The teacher will play the role of a member of the Bridge Engineering Security Team and will interview the students individually.

### Presentational Task: My Bridge Engineering Security Team Notebook
- Assist students in the assembly of their Notebooks.
- Instruct students to share their notebooks and knowledge of bridges with a partner or in small groups.
Materials/Resources

Lesson One:
- A “virtual” globe
- Recording to play as the package is opened. Select “suspenseful” music such as the Mission Impossible theme song or other spy music
- Box addressed to the class from the Bridge Engineering Security Team with the following contents:
  - Envelope entitled, “Build a Bridge for the Future” containing:
    - 2 airline tickets to Quanzhou, China (from Resource 1b)
    - Letter from the Bridge Engineering Security Team
  - Foldable world map
  - Photos of the Luoyang Bridge and the Lake Pontchartrain Causeway (Resource 1c)
  - 5 baggies containing 50 pennies each
  - Package of 5 x 8 index cards
- Approximately 40 books to use as bridge supports/piers
- PowerPoint Slides 1 – 11
- Online pronunciation tool
- Resource 1a: Letter #1 from the Bridge Engineering Security Team*
- Resource 1b: Airline tickets to 3 locations to be used in Lessons 1, 2, and 3 (2 copies each)
- Resource 1c: Photos of the Luoyang Bridge and the Lake Pontchartrain Causeway
- Worksheet 1a: Bridge Engineering Security Team Notebook Cover*
- Worksheet 1b: Build Your Beam Bridge*
- Worksheet 1c: A Beam Bridge*
- Worksheet 1d: Beam Bridges*
- Worksheet 1e: Three Beam Bridges

* To be collected for the Bridge Engineering Security Team Notebook

Lesson Two:
- A virtual globe
- Recording to play as the package is opened. Select “suspenseful” music such as the Mission Impossible theme song or other spy music
- Box addressed to the class from the Bridge Engineering Security Team with the following contents:
  - Envelope with “Build a Bridge for the Future” written on outside
    - 2 airline tickets to Avignon, France (from Resource 1b)
    - A letter explaining their mission (in the envelope)
    - Photos of the Pont du Gard and the Natchez Trace Parkway Bridge
  - 5 baggies containing 50 pennies each
  - Package of 5 x 8 index cards
  - A foldable world map
- PowerPoint Slides 12 – 28
- Resource 2a – Photos of the Pont du Gard and the Natchez Trace Parkway Bridge
- Resource 2b – Six Bridges to Compare (one set per student)*
- Worksheet 2a – Second Letter from Bridge Engineering Security Team*
- Worksheet 2b – Build an Arch Bridge*
- Worksheet 2c – An Arch Bridge*
- Worksheet 2d – Arch Bridges*
- To be collected for the Bridge Engineering Security Team Notebook
Lesson Three:
- A virtual globe
- Music to play as the package is opened
- Box addressed to the class from the Bridge Engineering Security Team with the following contents:
  - envelope with “Build a Bridge for the Future” written on outside
    - 2 airline tickets to Kobe, Japan (from Resource 1b)
    - a letter explaining their mission (in the envelope)
  - 5 baggies containing 50 pennies each
- Package of 5 x 8 index cards
  - A foldable world map
  - Photos of the Akashi Kaikyo Bridge and the Golden Gate Bridge
- 3 pieces of string for each group of students, 24” in length
- 1 piece of string for each group of students, 48” in length
- 2 hardcover books of similar size for each group of students
- Scissors
- Bridge PowerPoint Slides 29-41
- Resource 3a: Photos of the Akashi Kaikyo Bridge and the Golden Gate Bridge
- Resource 3b: Letter from the Bridge Engineering Security Team*
- Worksheet 3a: A Suspension Bridge*
- Worksheet 3b: Suspension Bridges to Compare*
- Worksheet 3c: Suspension Bridges*
* To be collected for the Bridge Engineering Security Team Notebook

Lesson Four:
- world map
- a virtual globe
- Bridge PowerPoint Slides 42-46
- Driving directions from your school to Stevensville, Maryland (to be placed in an envelope labeled “Build a Bridge for the Future”)
- photo of the Chesapeake Bay Bridge
- popsicle sticks
- pipe cleaners
- glue
- markers
- scissors
- string
- rulers
- plain paper
- 5 bags of 50 pennies each
- a hair dryer or fan for testing the bridges
- Resource 4a: Letter from the Bridge Engineering Security Team*
- Resource 4b: Engineering a Bridge*
- Resource 4c: Interpersonal and Presentational Task: Our Bridge for the Future Rubric
- Worksheet 4a: My Bridge for the Future*
*To be collected for the Bridge Engineering Security Team Notebook
Lesson Five: Performance Assessment Tasks

- Bridge PowerPoint (as needed)
- **Resource 5a:** Photo Books of Bridges 1 and 2
- **Resource 5b:** Photo Book of Bridges
- **Resource 5c:** BEST World Class Bridge Engineer Badges
- **Worksheet 5a:** Self-Evaluation*

* To be collected for the Bridge Engineering Security Team Notebook

**STEM Background for Teachers:**

- There are 3 major types of bridges: Beam, Arch, and Suspension.
- Bridge designs depend on how the bridge will be used and the terrain where the bridge will be built.
- A span is the distance between two bridge supports. Beam bridges usually span about 200 feet (60 meters); arch bridges can span 800 – 1,000 feet (240 – 300 meters); suspension bridges can span 2,000 – 7,000 feet (610 – 2,134 meters).
- Compression and tension are present in all bridges. Compression is the force that pushes the bridge together. Tension is the force that pulls it apart.

- The first bridges were probably logs that were laid across a stream or river.
- Weather is a major reason for bridges to fail.

**ADDITIONAL RESOURCES:**

**Beam Bridges**

Beam Bridge: A road (deck) is constructed over at least two piers. The length between two piers is a “span.” Today there are many bridges that use beams in combination with other types of bridges. Beam bridges are constructed for relatively short distances, and/or in combination with other types of bridges.

The two beam bridges featured in Lesson 1 of this module are:

- The Luoyang Bridge is the oldest stone beam bridge in China. It was built between 1053 and 1059. It is one of the four famous ancient Chinese bridges. (The others are Beijing’s Lugou Bridge, Hebei’s Zhaozhou Bridge, and Guangdong’s Guanji Bridge.) Originally, the bridge, built out of granite, was 1,200 meters long and 5 meters wide; with 46 piers, 500 balustrade posts, 28 carved lions, 7 stone kiosks, and 5 stone pagodas. The site of a former temple lies on the north end of the bridge; and Cai Xiang Temple stands on the opposite end. Inside the temple is a stone tablet from the Song Dynasty (960–1279 A.D.) with an inscription by Cai Xiang recording his *Notes on Wan’an Bridge*. With its exquisite carvings, the tablet gained the reputation of Three Superbs: superb calligraphy, superb article, and superb carving.
  
• Lake Pontchartrain Causeway was named for the Count de Pontchartrain who served as minister of finance during the reign of France’s Louis XIV, for whom Louisiana is named. The Causeway spans 24 miles and is the longest bridge over water in the world. The bridge is supported by over 9,000 concrete pilings.

Famous Beam Bridges Around the World:
• Manchac Swamp Bridge, United States
• Tianjin Grand Bridge, China
• Lake Pontchartrain Causeway, United States
• Donghai Bridge, China
• King Fahd Causeway, Bahrain & Saudi Arabia
• Vasco da Gama Bridge, Portugal
• Confederation Bridge, Canada
• Great Belt Bridge, Denmark
• Chapel Bridge, Switzerland
• Chengyang Bridge, China

Arch Bridges
The arch bridge is one of the most popular types of bridges, which came into use over 3000 years ago. The arch bridge is a form of a beam bridge, being able to withstand more weight and span longer distances (up to 800 feet) vs. a beam bridge that can span up to 250 feet. Even today arch bridges remain in use with the help of modern materials. The basic principle of an arch bridge is its curved design, which does not push load forces straight down; but instead they are conveyed along the curve of the arch to the supports on each end. These supports (called abutments) carry the load of the entire bridge and are responsible for holding the arch in the precise unmoving position. Conveying of forces across the arch is done via a central keystone on the top of the arch. Its weight pushes the surrounding rocks down and outward, making the entire structure very rigid and strong.

Because of this design, stone and wood arch bridges became very popular during the Roman Empire; whose architects managed to build over 1000 stone arch bridges in Europe, Asia and North Africa. Many of those bridges remain standing even today, giving us the chance to personally see the wonders of this ancient architecture. Roman designs were usually made with semicircular arches. These arch bridges had one crucial design advantage which separated them from ordinary semicircular bridges – they enabled bridge builders to build arches of the bridge much higher and lower the mass of the entire structure. These changes enabled bridges to survive stresses of floods and strong rivers. During the life of Roman Empire, they built many bridges like the Pont du Gard in France.

Renaissance architects built arch bridges creating some of the most beautiful and famous bridges of modern human civilization (such as Rialto Bridge in Venice.) In the last 150 years, iron, steel and concrete enabled creation of much more ambitious arch bridges which can now be seen in every country in the world.

One of the most revolutionary arch bridges in recent years is the Natchez Trace Parkway Bridge in Franklin, Tennessee, which was opened to traffic in 1994. It is the first American arch bridge to be constructed from segments of precast concrete, a highly economical material. Two graceful arches support the roadway above. Usually arch bridges employ vertical supports called spandrels to distribute the weight of the roadway to the arch below, but the Natchez Trace Parkway Bridge was designed without spandrels to create a more open and aesthetically-pleasing appearance. As a result, most of the
live load is resting on the crowns of the two arches, which have been slightly flattened to better carry it. Already the winner of many awards, the bridge is expected to influence bridge design for years to come.

**The History of London Bridge**
London Bridge survived the Great Fire of London in 1666 but its arches and foundations were weakened. In the 1820s, a new London Bridge was built on another site, north of the old one. This new bridge opened in 1831; and the old bridge was demolished. In the 1960s yet another London Bridge was built. The London Bridge of 1831 was transported, stone by stone, to Lake Havasu in Arizona, USA.

**The Nursery Rhyme:**
There is another Nursery Rhyme called “London Bridge is Broken Down.” Its origin relates to Queen Anne Boleyn - fascinating!

London Bridge is falling down, falling down, falling down.  
London Bridge is falling down, my fair Lady.

Build it up with wood and clay, wood and clay, wood and clay.  
Build it up with wood and clay, my fair Lady.

Wood and clay will wash away, wash away, wash away.  
Wood and clay will wash away, my fair Lady.

Build it up with bricks and mortar, bricks and mortar, bricks and mortar.  
Build it up with bricks and mortar, my fair Lady.

**Suspension Bridges**

Pleasing to look at, light, and strong, suspension bridges can span distances from 2,000 to 7,000 feet—far longer than any other kind of bridge. They also tend to be the most expensive to build. True to its name, a suspension bridge suspends the roadway from huge main cables, which extend from one end of the bridge to the other. These cables rest atop high towers and are secured at each end by anchorages.

The towers enable engineers to stretch the main cables over long distances. The cables carry most of the bridge’s weight to the anchorages, which are embedded in either solid rock or massive concrete blocks. Inside the anchorages, the cables are spread over a large area to evenly distribute the load and to prevent the cables from breaking free. Some of the earliest suspension-bridge cables were made from twisted grass. In the early 19th century, engineers began using iron chains for such cables. Today, the cables are made of thousands of individual steel wires bound tightly together. Steel, which is very strong under tension, is an ideal material for cables; a single steel wire only 0.1-inch thick can support over half a ton without breaking. Currently, the Humber Bridge in England has the world’s longest center span—measuring 4,624 feet. But this record won't stand for long. In 1998 the Japanese unveiled the $7.6 billion Akashi Kaikyo Bridge, linking the islands of Honshu and Shikoku via Awaji Island. The bridge’s center section stretches a staggering 6,527 feet. To keep the structure stable, engineers have added pendulum-like devices on the towers to keep them from swaying and a stabilizing fin beneath the center deck to resist typhoon-strength winds.
Because suspension bridges are light and flexible, wind is always a serious concern—as the residents of Tacoma, Washington can surely attest. At the time it opened for traffic in 1940, the Tacoma Narrows Bridge was the third-longest suspension bridge in the world. It was promptly nicknamed "Galloping Gertie," due to its behavior in wind. Not only did the deck sway sideways, but vertical undulations also appeared in quite moderate winds. Drivers reported that cars ahead of them would completely disappear and reappear from view several times as they crossed the bridge.

Attempts were made to stabilize the structure with cables and hydraulic buffers, but they were unsuccessful. On November 7, 1940, only four months after it opened, the Tacoma Narrows Bridge collapsed in a wind of 42 mph—even though engineers had ostensibly designed the structure to withstand winds of up to 120 mph.

The failure came as a severe shock to the engineering community. Why did a great span, more than half a mile in length and weighing tens of thousands of tons, spring to life in a relatively light wind? And how did slow, steady, and comparatively harmless motions suddenly transmogrify into a catastrophic force? To answer these questions, engineers began applying the science of aerodynamics to bridge design. Technical experts still disagree on the exact cause of the bridge's destruction, but most agree the collapse had something to do with a complex phenomenon called resonance, the same force that can cause a soprano's voice to shatter a glass.
Lesson 1 of 5: *Beam Bridges*

**Objectives**

<table>
<thead>
<tr>
<th>I can:</th>
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<tbody>
<tr>
<td><strong>Oral language:</strong></td>
</tr>
<tr>
<td>- Identify the parts of a beam bridge</td>
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<tr>
<td><strong>Literacy</strong></td>
</tr>
<tr>
<td>- Read and write short labels to identify parts of a beam bridge</td>
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<tr>
<td>- Read short facts about the beam bridges</td>
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<tr>
<td><strong>STEM and Other Subject Areas:</strong></td>
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<tr>
<td>- Show the location of the beam bridges on a world map or a virtual globe</td>
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<td>- Compare the force of tension to the force of compression</td>
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</tbody>
</table>

**Vocabulary and Expressions**

<table>
<thead>
<tr>
<th>Previously-learned:</th>
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<tbody>
<tr>
<td>- numbers 0-1,000</td>
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</tbody>
</table>

**Content obligatory vocabulary**

- disaster
- beam bridge
- log
- bend
- compression
- load
- tension
- pier
- stone
- steel
- concrete
- wood

**Content compatible vocabulary**

- engineer
- simple
- flat
- long/short
- old/new
- heavy/light
- to open
- to show
- to look at
- to label
- first
- home
- river
### Expressions and patterns
- What does this mean?
- Where is _____?
- This is a (type of bridge, parts of bridge).
- It is located in _____ (country).
- It is made of _____ (material).
- The length is _____ (X feet = X meters)

### Materials/Resources
- A virtual globe
- Recording to play as the package is opened. Select “suspenseful” music such as the Mission Impossible theme song or other spy music
- Box addressed to the class from the Bridge Engineering Security Team with the following contents:
  - Envelope entitled, “Build a Bridge for the Future” containing:
    - 2 airline tickets to Quanzhou, China (from Resource 1b)
    - Letter from the Bridge Engineering Security Team
  - Foldable world map
  - Photos of the Luoyang Bridge and the Lake Pontchartrain Causeway (Resource 1c)
  - 5 baggies containing 50 pennies each
  - Package of 5 x 8 index cards
- Approximately 40 books to use as bridge supports/piers
- PowerPoint Slides 1 – 11
- Online pronunciation tool
- Resource 1a: Letter #1 from the Bridge Engineering Security Team*
- Resource 1b: Airline tickets to 3 locations to be used in Lessons 1, 2, and 3 (2 copies each)
- Resource 1c: Photos of the Luoyang Bridge and the Lake Pontchartrain Causeway
- Worksheet 1a: Bridge Engineering Security Team Notebook Cover*
- Worksheet 1b: Build Your Beam Bridge*
- Worksheet 1c: A Beam Bridge*
- Worksheet 1d: Beam Bridges*
- Worksheet 1e: Three Beam Bridges*
* To be collected for the Bridge Engineering Security Team Notebook

### Lesson Storyline

The Bridge Engineering Security Team wants the help of the class to design bridges for cities that have lost their bridges during major disasters. First the class has to learn about different types of bridges so they can plan the right kind of bridge for each different situation. The class receives a package from Bridge Engineering Security Team about its next mission. The class has to figure out how to use the contents of the package to learn about beam bridges.

In the package is an envelope with a letter and two airline tickets to Quanzhou, China. On the outside of the envelope is this message: Build a Bridge for the Future. The package also contains a world map, photographs of the Luoyang Bridge in China, and the Lake Pontchartrain Causeway in...
Louisiana, USA, 5 rolls of pennies, and a package of 5 x 8 index cards.

<table>
<thead>
<tr>
<th>Key Elements</th>
<th>Lesson 1 – Beam Bridges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engagement</td>
<td>The class has received a package from the Bridge Engineering Security Team. The Task Force wants the class to help design bridges that will withstand future disasters.</td>
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<tr>
<td></td>
<td>Before beginning this module, refer to an online audio tool for target language pronunciation in Chinese and English as indicated in Materials/Resources.</td>
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<tr>
<td></td>
<td>Teacher goes to the door and finds a package addressed to the class from the Bridge Engineering Security Team.</td>
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<tr>
<td>PPT 2</td>
<td>T: Look! It’s a package from a Bridge Engineering Security Team. Let’s see what’s inside. ______, will you open the package and show us all what is inside?</td>
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<td></td>
<td>Music starts to play. The student opens the package, pulls items out of the box, and shows the items to the class.</td>
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<td>Identify each item by saying:</td>
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<tr>
<td>PPT 3</td>
<td>T: Let’s see! Here we have.....</td>
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<tr>
<td></td>
<td>• photos of the Luoyang Bridge in China, and the Lake Pontchartrain Causeway in Louisiana, USA.</td>
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<tr>
<td></td>
<td>• 5 rolls of pennies</td>
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<tr>
<td></td>
<td>• a package of index cards</td>
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<tr>
<td></td>
<td>• an envelope that says “Build a Bridge for the Future”</td>
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<tr>
<td></td>
<td>T: Hmmm...I wonder what’s inside the envelope. (Open the envelope.)</td>
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<tr>
<td></td>
<td>T: There are two airline tickets to China in the envelope. What do you think these are for?</td>
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<td></td>
<td>Students respond.</td>
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<tr>
<td></td>
<td>T: Well, class, it looks like someone is going to China! This should be interesting.</td>
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<tr>
<td>PPT 4 and Resource 1a</td>
<td>T: Oh, there is a letter from the Bridge Engineering Security Team. It’s addressed to all of us.</td>
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<tr>
<td></td>
<td>Read the letter to the class.</td>
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<td>Discuss “disaster.”</td>
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<tr>
<td></td>
<td>T: What happens when a disaster strikes? to homes? to rivers? to bridges?</td>
</tr>
<tr>
<td></td>
<td>T: What do you think The Bridge Engineering Security Team wants us to do?</td>
</tr>
<tr>
<td></td>
<td>Students respond.</td>
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<tr>
<td></td>
<td>T: The Bridge Engineering Security Team would like us to take notes. Let’s start by making a cover for our notebooks. Let’s call the team “BEST.”</td>
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</tbody>
</table>
Distribute **Worksheet 1a.** Instruct students to write their names in the space provided. Collect the worksheets.

### Exploration
- Objects and phenomena are explored
- Hands-on activities, with guidance

**Students explore the parts of a beam bridge and conduct an experiment.**

**T:** *Did we receive a package yesterday? Who was it from? What items were in it?* (Take out the items from the box and chorally repeat each item.)

**T:** *What do you think BEST wants us to do?*

Students respond.

**T:** *Right! We will learn about beam bridges first.*

**T:** *Now let’s experiment by building a beam bridge with these items and see how big a LOAD the bridge can support. Let’s make our own teams to build and test our bridges for the BEST.*

Divide students into groups of four.

- Distribute one **Worksheet 1b** to each student.
- Using the directions on the worksheet, construct a beam bridge for the class with the books and index card.
  - **T:** (Place two stacks of four books each (of the same height) 4 inches apart on a table.) *These are the piers.* Chorally repeat.
  - **T:** (Place one index card across the books.) *This is the beam.* Chorally repeat.
  - **T:** (Point to the pennies.) *The pennies are the load.* Chorally repeat.
  - **T:** *On a real bridge, a load would be a car. Anything else?* Students respond.
- Conduct Experiment #1 for the class. Place pennies, one at a time on the card. Instruct students to chorally count until the card almost touches the table.
  - **T:** *How many pennies did our bridge hold?* Students respond.
- Instruct students to record the number of pennies in the last column.
  - **T:** *In your teams, experiment with the bridge.*
    - *You may change the design of your bridge by adding more books to your piers, change the distance between the piers, and add more cards to the beam.*
    - *Experiment with different loads, which are your pennies.*
    - *Redesign your bridge based on the results.*
    - *Record your data on the chart on the worksheet.*
- Hand out five index cards, a bag of 50 pennies to each group, a ruler, and eight books of similar height to each group.
- Instruct student to make two stacks of books, four books for each stack, and four inches apart.
- Instruct students to conduct the rest of the experiments in their teams, following the directions on the worksheet.
- While students conduct their experiments, circulate and ask students to show you the piers, the beam, and the load.
- After the teams have finished the experiments, ask students to share their conclusions with the class.
<table>
<thead>
<tr>
<th>Explanation</th>
<th>Students discuss the effects of load on beam bridges.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Students explain their understanding of concepts and processes</td>
<td>T: What kind of bridge did we build yesterday? How many pennies did your bridge hold? Who remembers what the BEST wants us to do? Students respond. Review the vocabulary pier, beam, and load.</td>
</tr>
</tbody>
</table>
| • New concepts and skills are introduced as conceptual clarity and cohesion are sought | PPT 5: The BEST wants us to learn more about beam bridges. First we can look at the parts of a beam bridge. Chorally repeat the words:  
  • A beam bridge consists of beams and piers.  
  • The elephant, like your pennies, is heavy like a “load.” People, cars and trucks on a bridge are the load also.  
  • This is compression. A load, like your pennies, puts weight on a beam. It makes the beam compress. What made your bridge compress?  
  • Compression forces inward. (Instruct student to perform a gesture with you of extended arms coming together.)  
  • This is tension. Piers create tension to counter the compression from the load. (Instruct student to perform a gesture with you of folded arms extending outward.)  
  • This is the bend. The heavier the load, the bigger the bend. The lighter the load, the less the beam will bend. (Refer to the photo in the slide.)  
  • To demonstrate these concepts, ask two students to re-construct the experiment with the books and index cards, using objects of varying weight for the load. |
| Distribute Worksheet 1c                                                    | T: Label your picture of a beam bridge. (Circulate and assist where needed. Collect the worksheet. It will be included in the Notebook.)  
  T: Now that we know the basics about beam bridges, we’re ready for the next step of our mission. Do you remember how the BEST gave us airline tickets in the envelope? Who remembers the destination? Students respond.  
  Collect Worksheet 1c. It will be included in the notebook. |
| PPT 6                                                                      | T: Right! It’s China! Where is China? Students respond. |
| PPT 7                                                                      | T: Where is Quanzhou?  
  T: The Luoyang Bridge is in Quanzhou, China. The bridge is old. Look at the date: 1053. Can anyone figure out how old this bridge is? The bridge is made of stone. Look at all the stones. It looks bumpy, doesn’t it? Do you see cars using the bridge? Students respond.  
  T: What do you see on the bridge? |
Students respond.
T: Right. Bicycles and motorcycles and people. People are walking on the bridge. The Luoyang Bridge is a beam bridge. Next time, we’ll visit other beam bridges.

Elaboration
• Activities allow students to apply concepts in contexts, and build on or extend understanding and skill

Students compare two beam bridges: in China and in the United States.

PPT 7
T: The Bridge Engineering Security Team sent us to China, to the Quanzhao to see the Luoyang Bridge. What kind of bridge is it?
Students respond.

PPT 8
T: Look at the diagram of a beam bridge. It is simple and flat. Look at the Luoyang Bridge. This is a beam bridge because it is ... (invite student response, prompt as needed.)
T: Now look at the photo of the log. People use the logs to walk across the river. Do you think this log is a beam bridge? Why?
Students respond.
T: Yes! The log is a beam bridge!

PPT 9
T: Now let’s go to Louisiana. Where is Louisiana?
Students respond.
T: Where is New Orleans?
Students respond.
T: The Lake Pontchartrain Causeway is in New Orleans. This is also a bridge. Does this bridge look old and bumpy, like the Luoyang Bridge?
Students respond.
T: Correct! The bridge is new, not old.
T: The Lake Pontchartrain Causeway Bridge is made of concrete, not stone. Do you see people walking on it? Why not?
T: What do you see on this bridge?
Students respond.
T: Right! Cars and trucks are using this bridge.

PPT 10
T: Let’s look at our three beam bridges next to each other. Is the Luoyang Bridge old or new? What bridge is this? Is the Pontchartrain Causeway old or new? Is the Luoyang Bridge made of stone or concrete? Is the Pontchartrain Causeway made of stone or concrete?
Students respond.
T: Beam bridges are simple and flat. Tomorrow we will talk about what we will tell the Bridge Engineering Security Team. But first, let’s take notes for the BEST in our notebooks.
Distribute Worksheet 1d (Circulate and assist where needed. Collect the worksheet. It will be included in the Notebook.)

Evaluation
Putting it all together
World Language – STEM MODULE – Bridges Around the World
A Bridge for the Future

- Students assess their knowledge, skills and abilities. Activities permit evaluation of student development and lesson effectiveness.

Make sure that the world map is nearby so that students can point out where the bridges are located in the world.

**PPT 11** (or visuals of the three bridges)

Give students images of the Luoyang Bridge, the Pontchartrain Causeway, and the log bridge. Make sure that the world map is nearby so that students can point out where the bridges are located in the world.

Model a question/answer activity about the images:

T: Where is the Luoyang Bridge? And the Pontchartrain Causeway?
- What kind of bridge is the Luoyang Bridge? And the Pontchartrain Causeway? And the log bridge?
- Is the Luoyang Bridge old or new? And the Pontchartrain Causeway? And the log bridge?
- Is the Luoyang Bridge made of stone or concrete? And the Pontchartrain Causeway? Is the log bridge made of stone or concrete? No, it is made of wood, isn’t it?
- Is the Luoyang Bridge for cars or for walking? And the Pontchartrain Causeway? And the log bridge?
- Is the Luoyang Bridge simple? Flat? Is the log bridge simple? Flat?
- Why are the Luoyang Bridge/ the Pontchartrain Causeway/ the log bridge beam bridges?
- Can you identify its parts?

Distribute **Worksheet 1e**.

T: Now it is your turn. With your partner, see how many different questions you can ask about these bridges. Keep track of how many you ask in the box provided.

Circulate and assist where needed.

After five minutes, ask for pairs of volunteers to share a question and answer with the class.

Collect **Worksheet 1e**. It will be included in the notebook

*Note: Retain the students’ worksheets 1a-e as well as Resource 1a. These will be the first pages of the Notebook that will be assembled at the end of the entire module.*

---

**Teacher Reflection Lesson 1 – What is a beam bridge?**

<table>
<thead>
<tr>
<th>What worked well?</th>
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<tr>
<th>What did not work well?</th>
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<tr>
<th>What would I do differently?</th>
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<table>
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<tr>
<th>Other comments</th>
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## Lesson 2 of 5: Arch Bridges

### Objectives

**I can:**

**Oral language:**
- Identify the parts of an arch bridge

**Literacy**
- Read and write short labels to identify parts of an arch bridge
- Read short facts about arch bridges

**STEM and Other Subject Areas:**
- Show the location of the arch bridges using a world map or Virtual globe
- Show how compression holds up an arch bridge
- Compare an arch bridge to a beam bridge

### Vocabulary and Expressions

#### Content obligatory vocabulary
- *arch*
- *curve*
- *keystone*
- *load*
- *abutments*
- *shear force*

#### Content compatible vocabulary
- *simple*
- *flat*
- *long/short*
- *old/new*
- *strong/weak*
- *heavy/light*
- *to open*
- *to show*
- *to look at*
- *to label*
- *first*
- *to figure out*

#### Expressions and patterns
- *What does this mean?*
- *Where is (x)?*
- *This is a (type of bridge).*
- *It has (characteristics of bridge).*
- *It is located in (country).*
- *It is made of (material).*
- *The length is (x) X feet = X meters*
Materials/Resources

- A virtual globe
- Recording to play as the package is opened. Select “suspenseful” music such as the *Mission Impossible* theme song or other spy music
- Box addressed to the class from the Bridge Engineering Security Team with the following contents:
  - envelope with “Build a Bridge for the Future” written on outside
  - 2 airline tickets to Avignon, France (from Resource 1b)
  - a letter explaining their mission (in the envelope)
  - photos of the Pont du Gard and the Natchez Trace Parkway Bridge
  - 5 baggies containing 50 pennies each
  - Package of 5 x 8 index cards
  - A foldable world map
- PowerPoint Slides 12 – 28
- **Resource 2a** – Photos of the Pont du Gard and the Natchez Trace Parkway Bridge
- **Resource 2b** – Six Bridges to Compare (one set per student)*
- **Worksheet 2a** – Second Letter from Bridge Engineering Security Team*
- **Worksheet 2b** – Build an Arch Bridge*
- **Worksheet 2c** – An Arch Bridge*
- **Worksheet 2d** – Arch Bridges*

* To be collected for the Bridge Engineering Security Team Notebook

Lesson Storyline

The Bridge Engineering Security Team sent a package about its next mission. In the package was an envelope with two airline tickets to Avignon, France and another letter from the BEST. On the outside of the envelope was this message: *Build a Bridge for the Future*. The package also contained a world map, a photo of the Pont du Gard in France, the Natchez Trace Parkway Bridge in USA, and London Bridge.

The class must discover how to use the contents in the package to learn about arch bridges.

Key Elements

**Lesson 2 – Arch Bridges**

A new package arrives from the Bridge Engineering Security Team.

T: Look! It’s another package from the Bridge Engineering Security Team. Let’s see what’s inside. ________, will you open the package?

Music starts to play. Student opens package and pulls items out of the box and shows the item to the class. Identify and chorally repeat each item.

T: Let’s see! Here we have...

  - a world map
  - photos of the Pont du Gard in France, the Natchez Trace Parkway Bridge in the United States, and London Bridge.
5 baggies containing 50 pennies each
package of 5 x 8 index cards
another envelope

T: I wonder what’s in the envelope. (Open the envelope.) Here are two airline tickets! Are they to China again? No - to Avignon, France!

Hmm...what does this mean? Oh! Here’s another letter. I wonder what our next mission is. This is strange...some of the words are missing. Do you think we can figure it out? Let’s do it together.

PPT 12
Distribute Worksheet 2a, Read the letter and ask students to complete the missing words.
Collect Worksheet 2a. It will be included in the notebook.

Exploration
- Objects and phenomena are explored
- Hands-on activities, with guidance

Students construct an arch bridge.

PPT 13
T: The package includes a picture of the Pont du Gard of France. Where is France?
Students respond.

PPT 14
T: Where is Avignon?
Students respond.
The Pont du Gard is near Avignon, France. The bridge is old. The bridge is made of stone. What bridge did we visit in the last session that was made of stone? (the Luoyang Bridge in China)

PPT 15
T: The Pont du Gard is a different kind of bridge. It’s called an arch bridge. (Chorally repeat the new vocabulary as you gesture with your hand to point out the arch and other parts of the bridge.) See the arch here. Let’s look at the parts of the arch on the Pont du Gard. The load is at the top of the arch. The abutments are the sides of the arch. Compression and shear force hold up the arch. At the top of the arch is the keystone.

PPT 16
T: Let’s compare the Luoyang Bridge to the Pont du Gard. Are they both old and new? What are they made of – stone or concrete? Is the Louyang Bridge an arch bridge?
Students respond.
T: No, it is a beam bridge. Can you see the difference? Remember when you made a beam bridge? Now let’s make an arch bridge using the same materials from our package that was delivered today.
Distribute Worksheet 2b, the index cards, books and pennies. Assist students as needed. Collect Worksheet 2b. It will be included in the notebook.

(NOTE: Make sure that you measure the height of your books ahead of time so that the stack is not too tall for your cardboard arch.)
Discuss the experiments and their results.

**PPT 17**
T: *The package also includes a photograph of the Natchez Trace Parkway Bridge in Tennessee. Where is Tennessee in the United States?*
T: *Where is Franklin?*
Students respond.

**PPT 18**
T: *Does this bridge look new or old?*
Students respond.
T: *The bridge is made of concrete, not stone.*

**PPT 19**
T: *Which bridge is old? Which bridge is new? Which bridge is made of concrete? Which bridge is made of stone? Is the Pont du Gard old or new? Is the Natchez Trace Parkway Bridge old or new? The Pont du Gard is an arch bridge. How many arches can you count? The Natchez Trace Parkway Bridge is also an arch bridge. How many arches can you count?*

### Explanation
- Students explain their understanding of concepts and processes
- New concepts and skills are introduced as conceptual clarity and cohesion are sought

**Students discuss the effects of load on arch bridges.**

**PPT 20**
T: (Point to the different parts of the arch bridge. *Let’s look at the arch of the Natchez Trace Parkway Bridge. Can you find these parts of an arch bridge on the Natchez Trace Parkway Bridge? Here is the:*
- load
- compression
- abutments
- force from abutments
- shear force
- keystone

Distribute **Worksheet 2c.**
T: *Can we label the parts of an arch bridge?*
T: *Let’s look at one more bridge. This bridge is in London, England. Do you remember the children’s song “London Bridge is Falling Down?”* Collect **Worksheet 2c.** It will be included in the notebook.

**PPT 21**
Lead students in singing the song.
T: *We are going to see the real London Bridge from the song.*

**PPT 22**
T: *Where is England? Where is London?*

**PPT 23**
T: *Here it is, the real London Bridge. What can you tell me about it, just by looking at it?*
Students respond.
T: In this picture the bridge was new, but now it looks very old, doesn’t it? In what year was it built? How old is it?

PPT 24
T: What do you see on the bridge? Who is using the bridge? (Prompt if necessary):
- Are people walking?
- Do you see cars?
- Do you see trucks?
- Do you see horses?

T: This bridge was built for people walking, for horses, and for carts or buggies. Later, when there were cars and trucks instead of carts and horses, it was too heavy for the bridge, so London Bridge was falling down.

PPT 25
T: In 1971 they took the old London Bridge, one stone at a time and moved it to Arizona!! A very rich man paid over two million dollars for it.

PPT 26
T: So now London Bridge is not falling down any more! Here it is, in Lake Havesu, Arizona!

PPT 27
T: So, let’s review the two types of bridges that the BEST wants us to research. What kinds of bridges do you see?

Students respond.

Resource 2b
Distribute sets of the photographs of the six bridges. These visuals are also available on PPT 28.

Lead students in an interpretive activity in which you use the vocabulary in context. Students will hold up the correct photograph being described.

Examples:
- The Pont du Gard is a stone arch bridge in France.
- Concrete was used to build the Pontchartrain Causeway in New Orleans.
- London Bridge was made of stone.
- The Natchez Trace Parkway is an arch bridge in Tennessee.
- A log bridge is a beam bridge made of wood.
- The Luoyang Bridge in China is made of stone.

Instruct students to work in pairs and play “Stump the Expert.” Encourage students to ask as many questions as possible about the six bridges. Post model questions if needed.

Examples:
- Is London Bridge in London?
- Is the Pont du Gard new or old?
- Where is the Pont du Gard?
- Where is the Pontchartrain Causeway?
A Bridge for the Future

- Which bridge is made of wood?
- What sort of bridge is the Luoyang Bridge?
- Where is the Natchez Trace Parkway Bridge?
- Can you find the load/compression/force from abutments/shear force/keystone?

Summarize the activity by asking pairs of students to pose their questions to the class in order to “Stump the Expert.”

Elaboration
- Activities allow students to apply concepts in contexts, and build on or extend understanding and skill

Students make a human arch bridge.

Choose two students who are about the same height telling them:

T: We are going to make a human arch bridge. (Figure 1)

- Instruct the students to stand facing each other and form an arch by placing their palms together above their heads and leaning toward each other, sliding their feet as far back as possible without losing their balance.
- Point to the keystone and abutments and chorally repeat.
- Use gestures to demonstrate compression, shear force, load, and force from abutments.
- Tell the students to push their palms together. Ask: Where do you feel a compression or a force?
- Students respond.
- Instruct another student to gently push down on the top of the arch made by the students’ palms. Ask: Is it difficult to break the arch?
- Student responds.
- Discuss how to make the bridge stronger.
- Instruct two additional students to sit with their backs against the feet of the arch-makers. (Figure 2)
- Instruct another student to gently push down on the top of the arch made by the students’ palms.
- Ask the seated students: What do you feel? Do you have to push to stay in place? What is this called?
- Students respond.
- Instruct the arch-makers to move their feet closer together/ farther apart.
- Ask: What changed? How did you feel?
### World Language – STEM MODULE – Bridges Around the World
### A Bridge for the Future

- Ask a series of questions to reinforce the vocabulary:
  - *Where is the keystone?*
  - *Where are the abutments?*
  - *Where is the compression that makes the arch strong?*
- Select volunteers and repeat, always asking about the parts of the arch “bridge.”

### Evaluation
- Students assess their knowledge, skills and abilities. Activities permit evaluation of student development and lesson effectiveness.

**Students demonstrate knowledge of arch bridges.**

Distribute **Worksheet 2d**. Circulate and assist as needed. Collect **Worksheet 2d**. It will be included in the notebook.

### Teacher Reflection Lesson 2 – Arch Bridges

<table>
<thead>
<tr>
<th>What worked well?</th>
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<tr>
<th>What did not work well?</th>
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<th>Other comments or notes</th>
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# Lesson 3 of 5: Suspension Bridges

## Suspension Bridges

<table>
<thead>
<tr>
<th>Objectives</th>
<th>I can:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oral language:</strong></td>
<td>Identify the parts of a suspension bridge</td>
</tr>
<tr>
<td><strong>Literacy:</strong></td>
<td>Read and write short labels to identify parts of a suspension bridge</td>
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<td></td>
<td>Read short facts about suspension bridges</td>
</tr>
<tr>
<td><strong>STEM and Other Subject Areas:</strong></td>
<td>Show the location of suspension bridges using a virtual globe</td>
</tr>
<tr>
<td></td>
<td>Compare the force of tension to compression</td>
</tr>
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<td></td>
<td>Compare suspension, arch, and beam bridges</td>
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</table>

<table>
<thead>
<tr>
<th>Vocabulary and Expressions</th>
<th>Content obligatory vocabulary</th>
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<tbody>
<tr>
<td><strong>Content obligatory vocabulary</strong></td>
<td>beam</td>
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<tr>
<td></td>
<td>arch</td>
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<tr>
<td></td>
<td>suspension</td>
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<td>compression</td>
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<td>tension</td>
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<td>load</td>
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<td>main cable</td>
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<td>hanger</td>
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<td>anchorages</td>
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<td>to stabilize</td>
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<th>Content compatible vocabulary</th>
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<tr>
<td><strong>Content compatible vocabulary</strong></td>
<td>stone</td>
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<tr>
<td></td>
<td>steel</td>
</tr>
<tr>
<td></td>
<td>concrete</td>
</tr>
<tr>
<td></td>
<td>This is... (bridge parts)</td>
</tr>
<tr>
<td></td>
<td>the length is (x meters)</td>
</tr>
<tr>
<td></td>
<td>x feet = x meters</td>
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<tr>
<td></td>
<td>Japanese</td>
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<tr>
<td></td>
<td>Chinese</td>
</tr>
<tr>
<td></td>
<td>American</td>
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<tr>
<td></td>
<td>French</td>
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<td></td>
<td>string</td>
</tr>
<tr>
<td></td>
<td>scissors</td>
</tr>
<tr>
<td></td>
<td>to hang</td>
</tr>
<tr>
<td></td>
<td>to push down</td>
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</tbody>
</table>
### Expressions and patterns
- What does this mean?
- Where is (x)?
- This is a (type of bridge).
- It has (characteristics of bridge).
- It is located in (country).
- It is made of (material).
- The length is (x) X feet = X meters
- Long, longer, longest
- New, newer, newest
- Old, older, oldest

### Materials/Resources
- A virtual globe
- Music to play as the package is opened
- Box addressed to the class from the Bridge Engineering Security Team with the following contents:
  - envelope with “Build a Bridge for the Future” written on outside
    - 2 airline tickets to Kobe, Japan (from Resource 1b)
    - a letter explaining their mission (in the envelope)
  - 5 baggies containing 50 pennies each
- Package of 5 x 8 index cards
  - A foldable world map
  - Photos of the Akashi Kaikyo Bridge and the Golden Gate Bridge
- 3 pieces of string for each group of students, 24” in length
- 1 piece of string for each group of students, 48” in length
- 2 hardcover books of similar size for each group of students
- Scissors
- Bridge PowerPoint Slides 29-41
- Resource 3a: Photos of the Akashi Kaikyo Bridge and the Golden Gate Bridge
- Resource 3b: Letter from the Bridge Engineering Security Team*
- Worksheet 3a: A Suspension Bridge*
- Worksheet 3b: Suspension Bridges to Compare*
- Worksheet 3c: Suspension Bridges*
* To be collected for the Bridge Engineering Security Team Notebook

### Lesson Storyline
The class received a package from the Bridge Engineering Security Team with the next step in their mission to design a Bridge for the Future. In the package were two airplane tickets to Kobe, Japan, and other clues for their next stop on their mission.
<table>
<thead>
<tr>
<th>Key Elements</th>
<th>Lesson 3 – <em>Suspension Bridges</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engagement</strong></td>
<td>A new package arrives from the Bridge Engineering Security Team.</td>
</tr>
<tr>
<td>• Object, event or question used to engage students</td>
<td><strong>PPT 29</strong></td>
</tr>
<tr>
<td>• Connections facilitated between what students know and can do</td>
<td>Music begins to play.</td>
</tr>
<tr>
<td></td>
<td><em>T:</em> Look! It’s another package from the Bridge Engineering Security Team. Let’s see what’s inside. _____, will you open the package and show us what is inside?</td>
</tr>
<tr>
<td></td>
<td>(Student opens package and pulls items out of the box and shows the items to the class. The teacher identifies each item.)</td>
</tr>
<tr>
<td></td>
<td><strong>T:</strong> Let’s see! Here we have.....</td>
</tr>
<tr>
<td></td>
<td>• A world map</td>
</tr>
<tr>
<td></td>
<td>• Photos of the Akashi Kaikyo Bridge in Japan and the Golden Gate Bridge in the United States.</td>
</tr>
<tr>
<td></td>
<td>• String</td>
</tr>
<tr>
<td></td>
<td>• Scissors</td>
</tr>
<tr>
<td></td>
<td>• An envelope that says “Build a Bridge for the Future”</td>
</tr>
<tr>
<td></td>
<td><strong>T:</strong> I wonder what is inside the envelope. (Opens envelope) There are two airline tickets to Kobe, Japan. ________ what is the message on the front of the envelope?</td>
</tr>
<tr>
<td></td>
<td>Student responds.</td>
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<tr>
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<td><strong>T:</strong> Hmmmm.....what does this mean? Do you think the bridge for the future is in Japan? (Click slide again to show letter.) Let’s see what it says.</td>
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<td><strong>PPT 30</strong></td>
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<td></td>
<td>Read the letter aloud.</td>
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<td><strong>PPT 31</strong></td>
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<td><strong>T:</strong> So we are going to see a bridge in Japan this time. (Point out Japan on the map.)</td>
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<td><strong>T:</strong> Where else did we go in the world?</td>
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<td>(Invite students to point out the United States, China, England, and France on the map.) <strong>Right, we have been around the world looking for bridges for the future.</strong></td>
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<tr>
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<td><strong>PPT 32</strong></td>
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<tr>
<td></td>
<td><strong>T:</strong> Our bridge is in Kobe, Japan.</td>
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<tr>
<td></td>
<td><strong>T:</strong> Where is Kobe?</td>
</tr>
<tr>
<td></td>
<td><strong>T:</strong> The Akashi Kaikyo Bridge is in Kobe. Does the bridge look like the other bridges we have seen? This bridge is made of steel. It is called a suspension bridge.</td>
</tr>
<tr>
<td><strong>Exploration</strong></td>
<td><strong>Making a Suspension Bridge</strong></td>
</tr>
<tr>
<td>• Objects and phenomena are explored</td>
<td><strong>T:</strong> The Bridge Engineering Security Team sent us to Japan to visit the Akashi Kaikyo Bridge. The BEST would like us to learn more about this type of bridge.</td>
</tr>
</tbody>
</table>
Hands-on activities, with guidance

PPT 33

T: Let’s look at the parts of a suspension bridge. Chorally repeat the main cable, the dowel, the hanger, the pier, the road.

Distribute Worksheet 3a. Assist students in labeling the parts of the suspension bridge.

Collect Worksheet 3a. It will be included in the notebook.

T: Let’s make our own suspension bridge.

Model this experiment first, explaining in the target language. Then distribute the books and string to groups or pairs of students.

We are going to make a suspension bridge with books and strings.

Figure A:

1. Tie a 24-inch string around a hardcover book.
2. Repeat with a second hardcover book of similar size.
3. Tie a third 24-inch string to each loop so that it hangs loosely between the books.
4. Press down on the center string. What happens?

Figure A

Figure B

Figure B:

5. Stand the two books upright about 10 inches apart.
6. Put a stack of heavy books 8” from each of the upright books.
7. Secure each end of a 48”-inch string under the stack of books. Pass the string over each upright book, letting some string hang loosely between the books.
8. Press again on the center of the second string. What happens this time? Notice how the anchorages (stacks of books) help to stabilize the bridge.

Chorally repeat each part of the bridge, instructing students to point to their own “bridge” as they repeat.

Instruct students to experiment further with their bridges in their groups.

• Use books of different thicknesses for each end. Discuss the effect of pressure on the road. For example, if two different sized books (piers) are used, does one withstand the pressure more than the other?
• Vary the distance between the upright books. Does this affect the stability of the bridge?
• Vary the distance between the upright and the flat books. Does this affect the stability of the bridge?
Write students’ findings on the board.

PPT 34
T: Let’s identify the parts of the bridge in our experiment.
Ask a student volunteer to point to each part as you lead the class in choral repetition.
Chorally repeat the vocabulary (cable, hanger, road, pier, compression, tension, dowel, and anchorage.)

Comparing Three Suspension Bridges

PPT 35
T: Here’s another suspension bridge. It is called the Golden Gate Bridge. Do you know where it is?
Students respond.
T: Has anyone seen the Golden Gate Bridge?
T: It is in San Francisco, California.
Point to several parts of the bridge and ask students to identify them.

T: Do you remember the other suspension bridge we visited? Do you remember its name? Where is it located? Let’s compare it to the Golden Gate Bridge.

PPT 36
Look at the world map: San Francisco is over here, in North America, and Kobe is over there, in Asia.

PPT 37
T: But both bridges look alike.
T: The Akashi Kaikyo Bridge opened in 1998. The Golden Gate Bridge opened in 1937. Are the bridges new? Which bridge is older?
Students respond.
T: Look at the length. (Chorally repeat the length of each bridge.) Which bridge is longer?
Students respond.

PPT 38
T: Now I’m going to introduce you to another suspension bridge. See the different parts of the bridge: the main cable, the dowel, the hanger, the pier, the road. (Chorally repeat.) It is called the Brooklyn Bridge. Do you know where the Brooklyn Bridge is?
Students respond.
T: Yes. Can you find New York on the map? (Point to map.)
The Brooklyn Bridge is a suspension bridge. It was the longest suspension bridge in the world until 1903.

PPT 39
T: Look at the three bridges. The Brooklyn Bridge is long. But, which bridge
**World Language – STEM MODULE – Bridges Around the World**  
**A Bridge for the Future**

<table>
<thead>
<tr>
<th><strong>Elaboration</strong></th>
<th><strong>Reviewing the three types of bridges</strong></th>
</tr>
</thead>
</table>
| Activities allow students to apply concepts in contexts, and build on or extend understanding and skill | **PPT 40**
T: *Now, let’s look at these bridges. Can you name each type?*
Students respond.

**PPT 41**
T: *Now let’s look at another bridge in London, called the Tower Bridge.*
T: *What parts of bridge do you see?*
(If students need help, point out the beam bridge and the suspension bridge parts. Refer to PPT 40)
Students respond.

T: *So, in this bridge, we can see that it is possible to combine parts of a beam bridge and a suspension bridge.* |

<table>
<thead>
<tr>
<th><strong>Evaluation</strong></th>
<th><strong>Assessment is completed in the Bridge Engineering Security Team Notebook.</strong></th>
</tr>
</thead>
</table>
| • Students assess their knowledge, skills and abilities. Activities permit evaluation of student development and lesson effectiveness. | Distribute **Worksheet 3c** and assist as needed.
Review and discuss responses.

---

*is longer than the Brooklyn Bridge? Which bridge is the longest of all three?*

T: *Do you think these bridges are busy? Do people walk on them? Can they carry a heavy load? Can you explain why you think so? (Because Kobe, San Francisco, and New York are cities with lots of people and cars.)*

OPTIONAL: Practice converting the measurements of the bridges from feet to meters. (1 ft. = 0.30 m)

T: *Look at the years the bridges were opened. Which bridge is oldest? Which bridge is newest? Which bridge is older than the Golden Gate bridge? Assist students as needed to determine the age of each bridge.*

Distribute **Worksheet 3b**.
Assist students with the completion of the worksheet.
Collect **Worksheet 3b**. It will be included in the notebook.
### Teacher Reflection Lesson 3 – Suspension Bridges

<table>
<thead>
<tr>
<th>What worked well?</th>
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</thead>
<tbody>
<tr>
<td>What did not work well?</td>
<td></td>
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<tr>
<td>What would I do differently?</td>
<td></td>
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<tr>
<td>Other comments</td>
<td></td>
</tr>
</tbody>
</table>
Lesson 4 – The Chesapeake Bay Bridge and a Bridge for the Future

<table>
<thead>
<tr>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can:</td>
</tr>
<tr>
<td>Oral language:</td>
</tr>
<tr>
<td>• Identify different types of bridges</td>
</tr>
<tr>
<td>• Identify different parts of a bridge</td>
</tr>
<tr>
<td>Literacy</td>
</tr>
<tr>
<td>• Read and write short labels for the bridge I design</td>
</tr>
<tr>
<td>STEM and Other Subject Areas:</td>
</tr>
<tr>
<td>• Show the location of different bridges around the world</td>
</tr>
<tr>
<td>• Create a bridge for the future</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vocabulary and Expressions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content obligatory vocabulary</td>
</tr>
<tr>
<td>• beam</td>
</tr>
<tr>
<td>• arch</td>
</tr>
<tr>
<td>• suspension</td>
</tr>
<tr>
<td>• bridge</td>
</tr>
<tr>
<td>Content compatible vocabulary</td>
</tr>
<tr>
<td>• long/short</td>
</tr>
<tr>
<td>• new/old</td>
</tr>
<tr>
<td>• strong</td>
</tr>
<tr>
<td>Expressions and patterns</td>
</tr>
<tr>
<td>• Where is (x)?</td>
</tr>
<tr>
<td>• This is a (type of bridge).</td>
</tr>
<tr>
<td>• It has (characteristics of bridge).</td>
</tr>
<tr>
<td>• It is located in (country).</td>
</tr>
<tr>
<td>• It is made of (material).</td>
</tr>
<tr>
<td>• The length is (x) X feet = X meters</td>
</tr>
<tr>
<td>• long, longer, longest</td>
</tr>
<tr>
<td>• new, newer, newest</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Materials/Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>• world map</td>
</tr>
<tr>
<td>• a virtual globe</td>
</tr>
<tr>
<td>• Bridge PowerPoint Slides 42-46</td>
</tr>
<tr>
<td>• Driving directions from your school to Stevensville, Maryland (to be placed in an envelope labeled “Build a Bridge for the Future”)</td>
</tr>
<tr>
<td>• photo of the Chesapeake Bay Bridge</td>
</tr>
<tr>
<td>• popsicle sticks</td>
</tr>
<tr>
<td>• pipe cleaners</td>
</tr>
<tr>
<td>• glue</td>
</tr>
<tr>
<td>• markers</td>
</tr>
</tbody>
</table>
World Language – STEM MODULE – Bridges Around the World
A Bridge for the Future

- scissors
- string
- rulers
- plain paper
- 5 bags of 50 pennies each
- a hair dryer or fan for testing the bridges
- Resource 4a: Letter from the Bridge Engineering Security Team*
- Resource 4b: Engineering a Bridge*
- Resource 4c: Interpersonal and Presentational Task: Our Bridge for the Future Rubric
- Worksheet 4a: My Bridge for the Future*
* To be collected for the Bridge Engineering Security Team Notebook

Lesson Storyline
The class received a package from Bridge Engineering Security Team with the next step in their mission to design a Bridge for the Future. In the package are clues for their next stop on their mission.

Key Elements
<table>
<thead>
<tr>
<th>Engagement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object, event or question used to engage students</td>
</tr>
<tr>
<td>Connections facilitated between what students know and can do</td>
</tr>
</tbody>
</table>

Lesson 4 – A Bridge for the Future

A new package arrives from the Bridge Engineering Security Team.

PPT 42
Music starts to play.
T: Look! It’s another package for us from the Bridge Engineering Security Team.

PPT 43
T: Let’s see what’s inside. __________, will you open the package?
(Student opens package and pulls items out of the box and shows the items to the class.
T: Let’s see! Here we have...

- photo of the Chesapeake Bay Bridge
- an envelope that says “Build a Bridge for the Future”
- popsicle sticks
- pipe cleaners
- glue
- markers
- scissors
- string
- rulers
- plain paper
- 5 bags of 50 pennies each

T: On the envelope is this message: BUILD A BRIDGE FOR THE FUTURE! I wonder what is inside the envelope. (Open the envelope.) There are driving directions to Stevensville, Maryland. What does this mean?
A Bridge for the Future

PPT 44
T: Here’s another letter. Who would like to read it?
(A student reads the letter.)

PPT 45
T: This is the Chesapeake Bay Bridge. Has anyone crossed the Chesapeake Bay Bridge? What was it like?
Students respond.
Solicit a variety of responses based on students’ vocabulary: It is long, high, scary, etc.
T: Is this bridge in Maryland? Where is Maryland in the United States? The Bridge Engineering Security Team gave us directions to Stevensville, Maryland. Where is Stevensville?

Display an online virtual globe of the Chesapeake Bay Bridge. Pan across the image and instruct students to identify the type of bridge that they see as you move from the western shore to the eastern shore of Maryland. Stevensville is on the eastern shore.

T: What parts of a bridge do you see? (Have students work together in pairs or small groups to discover all the components of the bridge and then share what they discover.)

T: Right! The Chesapeake Bridge is a beam bridge, an arch bridge, and a suspension bridge all in one! Do you think this can be the bridge for the future that the Bridge Engineering Security Team was talking about? Why?
Students respond.

T: Yes! I believe we have solved the Bridge Engineering Security Team’s puzzle!
We have a big task ahead of us...to design the best bridge for the future against any and all disasters!

Exploration
- Objects and phenomena are explored
- Hands-on activities, with guidance

Engineering a Bridge for the Future

T: It is your turn to make a bridge for the future. With your team of engineers:
- First, discuss the types of bridges that you have learned and decide what type or types of bridges will be the strongest to withstand a disaster.
- Design your bridge on paper and label its parts.
- Examine the materials and decide which materials would be best for each part of your bridge.
- Construct your bridge.

Divide students into groups of four.
Distribute the materials to each group and assist as needed.

Explanation
Students explain their

The engineering teams describe and test their bridges.
Distribute Worksheet 4a and instruct students to complete Parts 1 and 2 only. Circulate and assist as needed.
<table>
<thead>
<tr>
<th>Understanding of concepts and processes</th>
<th>Collect the worksheets for use in the next Elaboration segment. T: <em>Fantastic! Tomorrow will be our bridge competition!</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Elaboration</strong></td>
<td><strong>How Strong Are Our Bridges?</strong></td>
</tr>
<tr>
<td></td>
<td>T: <em>Yesterday we tested the loads of our bridges. But remember, the Cyber wants to make sure that our bridges will withstand natural disasters. So today, we will test our bridges for strong winds.</em></td>
</tr>
<tr>
<td></td>
<td>Re-distribute <strong>Worksheet 4a</strong> and instruct students to complete Part 3 as directed. Circulate and assist as needed.</td>
</tr>
<tr>
<td></td>
<td>Worksheet will be included in the Bridge Engineering Security Team Notebook.</td>
</tr>
<tr>
<td><strong>Evaluation</strong></td>
<td><strong>Presenting...Our Bridges for the Future</strong></td>
</tr>
<tr>
<td>- Students assess their knowledge, skills and abilities. Activities permit evaluation of student development and lesson effectiveness.</td>
<td>Allow time for students to rehearse their presentations. Complete <strong>Resource Sheet 4b</strong> (Rubric) for each group.</td>
</tr>
<tr>
<td><strong>Teacher Reflection Lesson 4 – A Bridge for the Future</strong></td>
<td></td>
</tr>
<tr>
<td>What worked well?</td>
<td></td>
</tr>
<tr>
<td>What did not work well?</td>
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</tbody>
</table>
Lesson 5 – Integrated Performance Assessments

<table>
<thead>
<tr>
<th>Presentational Task: <strong>Our Bridge For the Future</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>In Lesson 4, students worked in groups of four to design a new bridge that they presented to the class.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interpretive and Interpersonal Task: <strong>My Interview with the Bridge Engineering Security Team</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-Evaluation</strong></td>
</tr>
<tr>
<td>• Students will work in pairs. They will take turns playing the role of the interviewer (Bridge Engineering Security Team member) and the interviewee.</td>
</tr>
<tr>
<td>• Each interviewee will look at a different set of photographs on Resource Sheet 5a (either Photo Book 1 or 2) and answer simple questions about the bridges.</td>
</tr>
<tr>
<td>o <em>What kind of bridge is it?</em></td>
</tr>
<tr>
<td>o <em>Where is the bridge?</em></td>
</tr>
<tr>
<td>o <em>Can you describe the bridge?</em></td>
</tr>
<tr>
<td>• Distribute Worksheet 5a to be completed by each student. Collect Worksheet 5a. It will be included in the notebook.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Optional: Earning a Bridge Engineering Security Team Badge: Evaluation by Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The teacher will play the role of a member of the Bridge Engineering Security Team and will interview the students individually.</td>
</tr>
<tr>
<td>• The students will look at one of the sets of photographs on Resource Sheet 5b and answer simple questions about the bridges.</td>
</tr>
<tr>
<td>o <em>What kind of bridge is it?</em></td>
</tr>
<tr>
<td>o <em>Can you identify some parts of the bridge?</em></td>
</tr>
<tr>
<td>After completion of the interview, award the student a BEST Badge. (Resource Sheet 5c)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Presentational Task: <strong>My Bridge Engineering Security Team Notebook</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Assist students in the assembly of their Notebooks.</td>
</tr>
<tr>
<td>• Instruct students to share their notebooks and knowledge of bridges with a partner or in small groups.</td>
</tr>
</tbody>
</table>