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

World Language – STEM MODULE COVERSHEET
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: 
Lesson 2: 
Lesson 3: 
Lesson 4: 
Lesson 5: Performance Assessment Tasks

Standards Targeted

<table>
<thead>
<tr>
<th>Standards Targeted</th>
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<tbody>
<tr>
<td><strong>NGSS/STEM Standards</strong></td>
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<tr>
<td><strong>NGSS</strong></td>
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<tr>
<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>
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<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>
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<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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<tr>
<td><strong>Communication</strong></td>
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<tr>
<td>Students engage in brief exchanges about personal interests in the target language. (1.1.A)</td>
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<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>
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<tr>
<td>Students make short presentations and write simple communications on very familiar topics in the target language. (1.3.A)</td>
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<td><strong>Cultures</strong></td>
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<td>Students identify and describe the products within the cultures studied. (2.1.A)</td>
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<td><strong>Connections</strong></td>
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<td><strong>STEM</strong></td>
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<td>Engineering</td>
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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>
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<tr>
<td>جسر</td>
<td>- show and name where bridges are found</td>
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<tr>
<td>عرضة</td>
<td>- tell why bridges were built</td>
</tr>
<tr>
<td>قوس</td>
<td>- identify and label parts of a bridge</td>
</tr>
<tr>
<td>إنهاء</td>
<td>- make simple comparisons between bridges</td>
</tr>
<tr>
<td>ضغط</td>
<td><strong>Literacy: I can</strong></td>
</tr>
<tr>
<td>حملة</td>
<td>- read and understand descriptions of pictures about bridges</td>
</tr>
<tr>
<td>توتر</td>
<td>- read and make simple comparisons between bridges</td>
</tr>
<tr>
<td>تكزية</td>
<td>- write a simple description of a bridge using vocabulary and expressions that I have learned</td>
</tr>
<tr>
<td>بناء</td>
<td><strong>STEM and Other Subject: I can</strong></td>
</tr>
<tr>
<td>جسر</td>
<td>- identify types of bridges</td>
</tr>
<tr>
<td>أمستن</td>
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</tbody>
</table>
Expressions and patterns

ما معنى هذا؟
أين (س) ؟
هذا (نوع جسر)
عنده (خصائص جسر)
يقع في (بلد)
مصنوع من (مواد)
هناك...
طوله (س سنتميتر)
متر سم=قدم سم

• talk about math concepts in bridge building
• show the location of some bridges using a virtual globe
• ask and answer questions about bridges
• tell how bridges are the same and different
• create a model bridge

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

* To be collected for the Bridge Engineering Security Team Notebook

Lesson Two:
   o A virtual globe
   o Recording to play as the package is opened. Select “suspenseful” music such as the(estحيلةالمهمةtheme song or other spy music
   o Box addressed to the class from the Bridge Engineering Security Team with the following contents:
      o envelope with “بناء جسر المستقبل” 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
      o 5 baggies containing 50 pennies each
      o Package of 5 x 8 index cards
      o A foldable world map
      o PowerPoint Slides 12 – 28
Resource 2a – Photos of the Pont du Gard and the Natchez Trace Parkway Bridge
Resource 2b – ستة جسور للمقارنة (one set per student)*
Worksheet 2a – الرسالة الثانية من فريق هندسة آمن الجسور*
Worksheet 2b – بناء جسر قوس*
Worksheet 2c – جسر قوس*
Worksheet 2d – جسور قوس*

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 “بناء جسر المستقبل” 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: معلق جسر*
Worksheet 3b: جسور معلقة للمقارنة*
Worksheet 3c: جسور معلقة*

* 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 “بناء جسر المستقبل”)
photo of the Chesapeake Bay Bridge
popsicle sticks
pipe cleaners
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

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 Guangi 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 table 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.
  
  Source: (http://www.whatsonxiamen.com/xiamen-info-743.html)

- 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
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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 – Beam Bridges

**Lesson 1 of 5:**

<table>
<thead>
<tr>
<th>Objectives</th>
<th>I can:</th>
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<tbody>
<tr>
<td><strong>Oral language:</strong></td>
<td>Identify the parts of a beam bridge</td>
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<tr>
<td><strong>Literacy</strong></td>
<td>Read and write short labels to identify parts of a beam bridge</td>
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<td></td>
<td>Read short facts about the beam bridges</td>
</tr>
<tr>
<td><strong>STEM and Other Subject Areas:</strong></td>
<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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<table>
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<tr>
<th>Vocabulary and Expressions</th>
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</thead>
<tbody>
<tr>
<td><strong>Content obligatory vocabulary</strong></td>
<td>أرقام 0-1,000</td>
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<tr>
<td>كارثة</td>
<td>جسر عارضة</td>
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<td>جسر عارضة</td>
<td>جذع شجر</td>
</tr>
<tr>
<td>ضغط</td>
<td>حمولة</td>
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<tr>
<td>حمولة</td>
<td>توتر</td>
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<tr>
<td>توتر</td>
<td>ركزة</td>
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<td>ركزة</td>
<td>حجر</td>
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<tr>
<td>حجر</td>
<td>فولاذي</td>
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<tr>
<td>فولاذي</td>
<td>إستمرت</td>
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<td>إستمرت</td>
<td>خشب</td>
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<table>
<thead>
<tr>
<th>Content compatible vocabulary</th>
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<tbody>
<tr>
<td>مهندس</td>
<td>بسيط</td>
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<tr>
<td>بسيط</td>
<td>مسطح</td>
</tr>
<tr>
<td>مسطح</td>
<td>خفيف/ثقيل</td>
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<tr>
<td>خفيف/ثقيل</td>
<td>قديم/جديد</td>
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<tr>
<td>قديم/جديد</td>
<td>طويل/قصير</td>
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<td>طويل/قصير</td>
<td>فتح</td>
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<td>فتح</td>
<td>عرض</td>
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<tr>
<td>عرض</td>
<td>ننظر إلى</td>
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<tr>
<td>ننظر إلى</td>
<td>تسمية</td>
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</tbody>
</table>
### Expressions and patterns

- ما يعني هذا؟
- أين (سن)؟
- هذا (نوع جسر)
- عده (خصوصيات جسر)
- يقع في (بلد)
- مصنوع من (مواد)
- هناك...
- طوله (سنتمتر)
- متر ـ قدم

### Materials/Resources

- A virtual globe
- Recording to play as the package is opened. Select “suspenseful” music such as the المهمة المستحيلة theme song or other spy music
- Box addressed to the class from the Bridge Engineering Security Team with the following contents:
  - Envelope entitled, "بناء جسر المستقبل" 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**: غطاء دفتر فريق هندسة أمن الجسور*
- **Worksheet 1b**: أيضي جسر عرضة*
- **Worksheet 1c**: جسر عرضة*
- **Worksheet 1d**: جسور عرضة*
- **Worksheet 1e**: ثلاثة جسور عرضة*

* 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: جسر المستقبل: بناء. 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 – جسور عارضة</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></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></td>
<td>Identify each item by saying:</td>
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<td></td>
<td>Students respond.</td>
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A Bridge for the Future

**PPT 4 and Resource 1a**

Read the letter to the class.

Discuss “Karate.”

**Students respond**

A: What is the topic of the letter?

A: What is the goal of the engineering team?

A: What is the team planning to build?

A: What is the purpose of building the bridge?

**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.**

A: What is the procedure described?

A: What is the goal of the experiment?

A: Is the answer correct?

**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. Chorally repeat.
  - T: Place one index card across the books. Chorally repeat.
  - T: Point to the pennies. Chorally repeat.

**Students respond.**

A: Which beam has the highest load?

A: What is the purpose of the pennies?

A: Which team designed the best bridge?

A: 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.

A: How many pennies can we place on the bridge?
- 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 حمولة, العارضة, and الرواكز.
- After the teams have finished the experiments, ask students to share their conclusions with the class.
- Collect Worksheet 1b. It will be included in the notebook.

**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 beam bridges.**

- أ: ما هو نوع الجسر الذي نبنيه؟
- كم عدد البنينات التي نستخدمها؟
- كم عدد رقمي البنينات التي نستخدمها؟
- كم عدد البنينات التي نعمل عليها؟
- أ: ما هو المفضل؟
- أ: ما هو الفعل؟

Students respond.

Review the vocabulary حمولة, العارضة, الرواكز.

**PPT 5**

أ: الأفضل أن نأهله لأن نتعلم أكثر ما يخص جسور العارضة.
أ: كم عددي لجزء جسر العارضة?

Chorally repeat the words.

- حمولة: على البنينات تضغط مثل حمولة، على الأشخاص، السيارات، والشاحنات فوق الجسر.
- على العارضة: على حمولة، مثل البنينات، تضغط علية.
- كم عدد حمولة؟
- كم عدد حمولة؟

- الضغط يضغط بالقوة نحو الداخل.

(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.

- (Instruct student to perform a gesture with you of extended arms coming together.)

- (Instruct student to perform a gesture with you of folded arms extending outward.)

- هذا توتر الرواكز تحدث توتر لمواجهة الضغط الناتج من الحمولة

- هذا الإنجناء، كلما تقلت الحمولة، كلما تقلت الحمولة، بالعكس، في حالة الإنجناء العارضة.

(Refer to the photo in the slide.)
Distribute **Worksheet 1c**

Students respond.

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

**PPT 6**

Students respond.

**PPT 7**

Students respond.

**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**

Students respond.

**PPT 8**

Students respond.

**PPT 9**

Students respond.
Students respond.

A: In New Orleans?

Students respond.

A: This bridge in New Orleans. Is this bridge that looks like a ramp?

Students respond.

A: This bridge is not old.

Students respond.

What is the bridge like?

Students respond.

Correct! Cars and trucks use the bridge.

**PPT 10**

T: Look at the three bridges. Is this bridge new? What kind of bridge is this?

Students respond.

T: The bridges are simple and flat. We will write notes in our notebook.

**Evaluation**

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

**Putting it all together**

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:

- What is the bridge type?
- What is the bridge made of?
- What are the bridge uses?
World Language – STEM MODULE – Bridges Around the World
A Bridge for the Future

- هل جسر لويانغ بسيط؟ مسطح؟ هل جسر جذع الشجرة بسيط؟ مسطح؟
- لماذا جسر لويانغ/ جسر بحيرة بونتشارتن/ جسر جذع الشجرة جسور عارضة؟ هل تستطيع أن تحدد أجزاء؟

Distribute Worksheet 1e.
T:
الآن دورك، مع رفيقك، تصور كم عدد الأسئلة المختلفة تستطيع أن تسأل بما يخص هذه الجسور. تتبع كم استطيع أن تسأل في صندوق الإجابة.

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>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>What did not work well?</td>
<td></td>
</tr>
<tr>
<td>What would I do differently?</td>
<td></td>
</tr>
<tr>
<td>Other comments</td>
<td></td>
</tr>
</tbody>
</table>
**Lesson 2 of 5: Arch 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 an arch bridge</td>
</tr>
<tr>
<td><strong>Literacy:</strong></td>
<td>Read and write short labels to identify parts of an arch bridge</td>
</tr>
<tr>
<td></td>
<td>Read short facts about arch bridges</td>
</tr>
<tr>
<td><strong>STEM and Other Subject Areas:</strong></td>
<td>Show the location of the arch bridges using a world map or Virtual globe</td>
</tr>
<tr>
<td></td>
<td>Show how compression holds up an arch bridge</td>
</tr>
<tr>
<td></td>
<td>Compare an arch bridge to a beam bridge</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vocabulary and Expressions</th>
<th>Content obligatory vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>قوس</td>
</tr>
<tr>
<td></td>
<td>جسر</td>
</tr>
<tr>
<td></td>
<td>حجر العقد</td>
</tr>
<tr>
<td></td>
<td>حمولة</td>
</tr>
<tr>
<td></td>
<td>دعامات</td>
</tr>
<tr>
<td></td>
<td>قوة الجز</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content compatible vocabulary</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ما معنى؟</td>
<td>أين (رس)؟</td>
</tr>
<tr>
<td>هذا (نوع جسر) عنده (خصائص جسر)</td>
<td>يقع في (بلد)</td>
</tr>
<tr>
<td>مصنوع من (مواد) طوله (س متر)</td>
<td>هناك...</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expressions and patterns</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ما معنى؟</td>
<td>أين (رس)؟</td>
</tr>
<tr>
<td>هذا (نوع جسر) عنده (خصائص جسر)</td>
<td>يقع في (بلد)</td>
</tr>
<tr>
<td>مصنوع من (مواد) طوله (س متر)</td>
<td>هناك...</td>
</tr>
</tbody>
</table>
### Materials/Resources
- A virtual globe
- Recording to play as the package is opened. Select “suspenseful” music such as the "المهمة المستحيلة" theme song or other spy music
- Box addressed to the class from the Bridge Engineering Security Team with the following contents:
  - envelope with "بناء جسر المستقبل" 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** – ستة جسور للمقارنة
- (one set per student)*
- **Worksheet 2a** – الرسالة الثانية لفريق هندسة أمن الجسور
- **Worksheet 2b** – بني جسر قوس* 
- **Worksheet 2c** – جسر قوس *
- **Worksheet 2d** – جسور قوس *
* 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: "بناء جسر المستقبل". 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

<table>
<thead>
<tr>
<th>Engagement</th>
<th><strong>Lesson 2</strong> – جسور القوس</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object, event or question used to engage students</td>
<td>A new package arrives from the Bridge Engineering Security Team.</td>
</tr>
<tr>
<td>Connections</td>
<td>T: انظر إحدى هذه طرقات قلوب هندسة أمن الجسور. هيا نرى ما بي من داخله.</td>
</tr>
</tbody>
</table>
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:

هل ترى هنا ما عبنا...
- خريطة العالم
- صور لجسر جارد، جسر نانشيز ترايس متعدد المسار في الولايات المتحدة،و جسر لندن.
- خمسة أكياس فيها 50 إينياسات في كل واحد
- رزمة بطاقات 8x5
- طرد آخر

(Open the envelope)

هل هو، أنا أسأل، ما الذي يوجد في الطرد، هل هو للصين أيضاً؟
- هناك بطاقتي سفر بالطائرة، هل هي للصين أيضًا؟
- لا، هي أفينيون، فرنسا
- هل هو ما معني هذا؟ هل ترى رسالتي أخرى، هل تسأل ما هي مهمتنا القادمة؟
- هل ترى بعض الكلمات مفقودة، هل تظن أنت تستطيع معرفتها؟
- هل تتم بهذا معاً!

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:

الطرد يحتوي على صورة لجسر جارد بفرنسا. أين فرنسا؟

Students respond.

PPT 14
T:

أين أفينيون؟

Students respond.

PPT 15
T:

جسر جارد بفرنسا، الجسر الذي، يجمع مصنوع من الحجر. أي جسر زرت الحصة الماضية مصنوع من الحجر (جسر لويانغ بالصين).

جسر جارد نوع مختلف من الجسور. إسمه جسر القوس.
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A Bridge for the Future

(Chorally repeat the new vocabulary as you gesture with your hand to point out the arch and other parts of the bridge.)

- Look at the arch here. We see the arch in the bridge. The arch supports the load. The pressure and weight are placed on the arch. If the arch is high,
  the arch is very strong.

PPT 16
T:
Why do we compare Lo Yang Bridge with a new arch? Are they old or new? Are they made of stone or cement?

Students respond.

T:
And, we built the Lo Yang Bridge. When you made the comparison of a bridge, it is the same. Now, you can build the arch. It is the same 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 experiment is also on a picture of the bridge. Name the bridge with the state?

T:
And, the Franklin Bridge?

Students respond.

PPT 18
T:
Is the bridge old or new?

Students respond.

T:
The bridge is not cement, it is made of stone.

PPT 19
T:
What is the old bridge? What is the new bridge? What bridge is made of cement? What bridge is made of stone?

T:
If the arches are not to float, can you count the arches? If the arches are not to float, can you count the number of the arches?

Explanation
- Students explain their

Students discuss the effects of load on arch bridges.
understanding of concepts and processes

- New concepts and skills are introduced as conceptual clarity and cohesion are sought

T: (Point to the different parts of the arch bridge.

هل تستطيع تسمية أجزاء جسر قوس؟

T:

هل تنظر إلى قوس جسر ناتشيز ترايس متعدد المسار.

هل تستطيع أن تجد أجزاء جسر ناتشيز ترايس متعدد المسار؟ هنا:

حمولة
ضغط
دعامات
قوة من الدعامات
حجر العقد

Distribute Worksheet 2c.

هل تستطيع تسمية أجزاء جسر قوس؟

T:

هل تنظر إلى جسر آخر. هذا الجسر في لندن،إنجلترا. هل تتذكر أغنية الصغر.

“This is London Bridge”

Collect Worksheet 2c. It will be included in the notebook.

PPT 21
Lead students in singing the song.

سنرى جسر لندن الحقيقي من الأغنية.

PPT 22

أين إنجلترا،أين لندن؟

PPT 23

ما هو جسر لندن الحقيقي؟ماذا تستطيع أن تقول عنه،من خلال النظر إليه فقط؟

Students respond.

T:

في هذه الصورة الجسر كان جديد،أما الآن يظهر قديما،ليس كذلك؟

في أي عام بني الجسر؟كم عمره؟

PPT 24

ماذا ترى فوق الجسر؟ من يستعمل الجسر؟

(Prompt if necessary):

هل الأشخاص تمشي؟

هل ترى سيارات؟
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:

- جسر جارد هو جسر قوس بالحجر في فرنسا
- استعمل الإسمنت لبناء جسر بحيرة بوتشارترین في نيويورلينز
- جسر لندن صنع من الحجر
- جسر ناناهز ترايس متعدد المسار هو جسر قوس في تينيسي
- جسر جدع الشجرة هو جسر عرضة مصنوع من الخشب
- جسر لويانغ في الصين مصنوع من الحجر

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:

- هل جسر لندن في لندن؟
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>هل جسر جارد جديد أو قديم؟</td>
<td>أين جسر جارد؟</td>
</tr>
<tr>
<td>أين جسر بحيرة بونتشارترس؟</td>
<td>ما هو الجسر المصنوع من الخشب؟</td>
</tr>
<tr>
<td>ما نوع الجسور هو جسر لويغان؟</td>
<td>أين جسر ناتشيز ترايس متعادل المسار؟</td>
</tr>
<tr>
<td>هل تستطيع أن تجد الحموولة/ضغط/قوة من الدعامات/قوة الجزع/حجر العقد؟</td>
<td>Summarize the activity by asking pairs of students to pose their questions to the class in order to “Stump the Expert.”</td>
</tr>
</tbody>
</table>

### 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:

*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 حجر العقد and الدعامات and chorally repeat.
- Use gestures to demonstrate الضغط, القوة من الدعامات, قوة الجزع, and القوة من الدعامات.
- Tell the students to push their palms together.
- Ask: هل تشعر بالضغط أو القوة؟
- Students respond.
- Instruct another student to gently push down on the top of the arch made by the students’ palms.
- Ask: هل هو صعب كسر القوس؟
- 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:
  - لماذا تشعر؟ هل يجب أن تدفع لكي تبقى في مكانك؟
  - Students respond.
World Language – STEM MODULE – Bridges Around the World
A Bridge for the Future

- Instruct the arch-makers to move their feet closer together/farther apart.
- Ask:

  ماذا تغير؟

  بماذا

Figure 2

- Ask a series of questions to reinforce the vocabulary:
  - أين حجر العقد؟
  - أين الدعامات؟
  - أين الضغط الذي يجعل القوس قوي؟
- Select volunteers and repeat, always asking about the parts of the arch “bridge.”

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Students demonstrate knowledge of arch bridges.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students assess their knowledge, skills and abilities. Activities permit evaluation of student development and lesson effectiveness.</td>
<td>Distribute Worksheet 2d. Circulate and assist as needed. Collect Worksheet 2d. It will be included in the notebook.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teacher Reflection Lesson 2</th>
<th>جسور القوس –2</th>
</tr>
</thead>
<tbody>
<tr>
<td>What worked well?</td>
<td></td>
</tr>
<tr>
<td>What did not work well?</td>
<td></td>
</tr>
<tr>
<td>What would I do differently?</td>
<td></td>
</tr>
<tr>
<td>Other comments or notes</td>
<td></td>
</tr>
</tbody>
</table>
Lesson 3 – Suspension Bridges

<table>
<thead>
<tr>
<th>Lesson 3 of 5: الجسور المعلقة</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>Vocabulary and Expressions</th>
<th>Content obligatory vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• عارضة</td>
</tr>
<tr>
<td></td>
<td>• قوس</td>
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<td></td>
<td>• معلق</td>
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<td></td>
<td>• ضغط</td>
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<td></td>
<td>• توتر</td>
</tr>
<tr>
<td></td>
<td>• حمولة</td>
</tr>
<tr>
<td></td>
<td>• السلك الأساسي</td>
</tr>
<tr>
<td></td>
<td>• وتثبيت</td>
</tr>
<tr>
<td></td>
<td>• متعلق</td>
</tr>
<tr>
<td></td>
<td>• anchorages</td>
</tr>
<tr>
<td></td>
<td>• تثبيت</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Content compatible vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td>• حجر</td>
</tr>
<tr>
<td>• الفولاذي</td>
</tr>
<tr>
<td>• اسمنت</td>
</tr>
<tr>
<td>• هذه (أجزاء الجسر)</td>
</tr>
<tr>
<td>• طوله (س مترا)</td>
</tr>
<tr>
<td>• مترا=قدم س ياباني</td>
</tr>
<tr>
<td>• صيني</td>
</tr>
<tr>
<td>• أمريكك</td>
</tr>
<tr>
<td>• فرنسي</td>
</tr>
<tr>
<td>• خيط</td>
</tr>
</tbody>
</table>
### 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 “بناء جسر المستقبل” 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**: جسر معلق
- **Worksheet 3b**: جسر معلق للمقارنة
- **Worksheet 3c**: جسور معلقة

*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.

Key Elements

<table>
<thead>
<tr>
<th>Engagement</th>
<th>Lesson 3 – Suspension Bridges</th>
</tr>
</thead>
</table>
| • Object, event or question used to engage students  
• Connections facilitated between what students know and can do | A new package arrives from the Bridge Engineering Security Team. |
| PPT 29 Music begins to play.  
T: أنظر إلى هذا طرد من فريق هندسة أمن الجسور. هيا نرى ما بي من داخله.  
______________ ، سيفتح الطرد و يرينا ما بداخله. | (Student opens package and pulls items out of the box and shows the items to the class. The teacher identifies each item.) |
| T: نرى هناك! هنا عندنا ... خريطة العالم.  
• صور لجسر كاكيو باليابان و جسر البوابة الذهبية بالولايات المتحدة  
• خيط  
• مقص  
• طرد يقول "بناء جسر المستقبل". | (Click slide again to show letter.) |
| T: أنا أتساءل ماذا في الطرد؟ (إفتح الطرد). هناك بطاقتي سفر بالطائرة إلى كوبى باليابان. ما هو الخطاب على غلاف الطرد؟ | Student responds. |
| T: هيهه... ما معنى هذا؟ هل تظن أن جسر المستقبل في اليابان؟ | (Point out Japan on the map.) |
| T: هو يرى ما يقال؟ | (Invite students to point out the United States, China, England, and France on the map.) |
| PPT 30 Read the letter aloud. | "سنرى جسرًا في اليابان هذه المرَّة." |
| PPT 31 T: إلى أي مكان آخر ذهبتنا في العالم؟  
(Point out Japan on the map.) | صحيح، ذهبتنا حول العالم نبحث عن جسور المستقبل." |
| T: (Invite students to point out the United States, China, England, and France on the map.) |
### Exploration
- Objects and phenomena are explored
- Hands-on activities, with guidance

### Making a Suspension Bridge

**PPT 32**

<table>
<thead>
<tr>
<th>T:</th>
<th>Jssra fi Kubi, Aljapan.</th>
</tr>
</thead>
<tbody>
<tr>
<td>T:</td>
<td>Ain Kubi?</td>
</tr>
<tr>
<td>T:</td>
<td>Jssr Akaishi Kaiko存在于 Kubi. Hal adh jssr yishra al jssr altherii atri Rayana?</td>
</tr>
</tbody>
</table>

**PPT 33**

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chorally repeat</td>
<td>Hya ntnr ol dwzr jssr mltq.</td>
</tr>
<tr>
<td>Distribute Worksheet 3a. Assist students in labeling the parts of the suspension bridge.</td>
<td></td>
</tr>
<tr>
<td>Collect Worksheet 3a. It will be included in the notebook.</td>
<td></td>
</tr>
<tr>
<td>T:</td>
<td>Hya ntns Jssra mltq.</td>
</tr>
</tbody>
</table>

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

#### 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 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.

**Explanation**

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

**Comparing Three Suspension Bridges**

**PPT 35**

T: 

هنا جسر مععلق آخر. يسمى جسر البوابة الذهبية. هل تعرف أين يوجد؟

Students respond.

T: 

هل أحد رأى جسر البوابة الذهبية؟

إنه في سان فرانسيسكو، كاليفورنيا.

Point to several parts of the bridge and ask students to identify them.

T: 

هل تتذكر الجسر المععلق الآخر الذي زرناه؟ هل تتذكر إسمه؟ أين يوجد؟ هي نقارنه بجسر البوابة الذهبية.

**PPT 36**

انظر إلى خريطة العالم: سان فرانسيسكو هنا، في شمال أمريكا وكونوا في آسيا.

**PPT 37**
<table>
<thead>
<tr>
<th><strong>T:</strong></th>
<th>لكن الجسران يشبهان بعضهم البعض.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T:</strong></td>
<td>جسر آكاشي كابو فتح في 1998. جسر البوابة الذهبية فتح في 1937. هل الجسور جديدة؟ أي الجسور أقدم؟</td>
</tr>
<tr>
<td>Students respond.</td>
<td>(Chorally repeat the length of each bridge.)</td>
</tr>
<tr>
<td><strong>T:</strong></td>
<td>أي الجسور أطول؟</td>
</tr>
<tr>
<td>Students respond.</td>
<td>(Chorally repeat.)</td>
</tr>
<tr>
<td><strong>T:</strong></td>
<td>الآن، أنا سأقدم لكم جسر معلق آخر. أنظر إلى أجزاء الجسر المختلفة: السلك الأساسي، وتوج، طريق.</td>
</tr>
<tr>
<td><strong>PPT 38</strong></td>
<td>يُسمى جسر بروكلين. هل تعرف أين يوجد جسر بروكلين؟</td>
</tr>
<tr>
<td>Students respond.</td>
<td></td>
</tr>
<tr>
<td><strong>T:</strong></td>
<td>نعم. هل تستطيع البحث عن نيويورك على الخريطة؟ (أشر للخريطة) جسر بروكلين هو جسر معلق. كان أكثر الجسور طولاً في العالم حتى سنة 1903.</td>
</tr>
<tr>
<td><strong>PPT 39</strong></td>
<td>أنظر إلى الجسور الثلاثة. جسر بروكلين طويل، ولكن، أي جسر أطول من جسر بروكلين؟ ما هو الجسر الأكثر طولاً ما بين الجسور الثلاثة؟</td>
</tr>
<tr>
<td><strong>T:</strong></td>
<td>هل تظن أن هذه الجسر مليئة بالحركة؟ هل تستطيع حمل حمولة ثقيلة؟ هل تستطيع الشرح لماذا؟ (لأن كوب، سان فرانسيسكو ونيويورك، من فيها الكثير من الأشخاص والسياارات)</td>
</tr>
<tr>
<td></td>
<td>OPTIONAL: Practice converting the measurements of the bridges from feet to meters. (1 ft. = 0.30 m)</td>
</tr>
<tr>
<td><strong>T:</strong></td>
<td>أنظر إلى السنوات التي فتحها الجسور. ما هو الجسر الأقدم؟ ما هو الجسر الأحدث؟ أي جسر أقدم من جسر البوابة الذهبية؟</td>
</tr>
</tbody>
</table>

Elaboration Reviewing the three types of bridges

Distribute Worksheet 3b.
Assist students with the completion of the worksheet.
Collect Worksheet 3b. It will be included in the notebook.
Activities allow students to apply concepts in contexts, and build on or extend understanding and skill

| **PPT 40** |  
|---|---|
| **T:** الآن، هيا ننظر إلى هذه الجسور. هل تستطيع تسمية كل الأنواع؟ | الان، هيا ننظر إلى هذه الجسور. هل تستطيع تسمية كل الأنواع؟ |
| Students respond. | Students respond. |
| **T:** هل تتذكر الجسر المشهور الذي رأيناه في لندن؟ | هل تتذكر الجسر المشهور الذي رأيناه في لندن؟ |
| Students respond. | Students respond. |
| **PPT 41** |  
| **T:** الآن، هيا ننظر إلى جسر آخر في لندن، بسمي جسر البرج. | الان، هيا ننظر إلى جسر آخر في لندن، بسمي جسر البرج. |
| **T:** ما هي أجزاء الجسر التي ترى؟ | ما هي أجزاء الجسر التي ترى؟ |
| (If students need help, point out the beam bridge and the suspension bridge parts. Refer to PPT 40) | (If students need help, point out the beam bridge and the suspension bridge parts. Refer to PPT 40) |
| Students respond. | Students respond. |
| **T:** إذاً، في هذا الجسر نرى أننا نستطيع دمج أجزاء جسر العارضة والجسر المعلق. | إذاً، في هذا الجسر نرى أننا نستطيع دمج أجزاء جسر العارضة والجسر المعلق. |

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

**Assessment is completed in the Bridge Engineering Security Team Notebook.**

Distribute **Worksheet 3c** and assist as needed. Review and discuss responses.

### Teacher Reflection Lesson 3 – الجسور المعلقة

| **الجسور المعلقة** – **What worked well?** |
|---|---|
| **What did not work well?** |
| **What would I do differently?** |
| **Other comments** |
### Lesson 4 – The Chesapeake Bay Bridge and a Bridge for the Future

<table>
<thead>
<tr>
<th>Lesson 4 of 5:</th>
<th>جسر تشيسابيك و جسر المستقبل</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objectives</strong></td>
<td><strong>I can:</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Oral language:</strong></td>
</tr>
<tr>
<td></td>
<td>- Identify different types of bridges</td>
</tr>
<tr>
<td></td>
<td>- Identify different parts of a bridge</td>
</tr>
<tr>
<td></td>
<td><strong>Literacy</strong></td>
</tr>
<tr>
<td></td>
<td>- Read and write short labels for the bridge I design</td>
</tr>
<tr>
<td></td>
<td><strong>STEM and Other Subject Areas:</strong></td>
</tr>
<tr>
<td></td>
<td>- Show the location of different bridges around the world</td>
</tr>
<tr>
<td></td>
<td>- Create a bridge for the future</td>
</tr>
<tr>
<td><strong>Vocabulary and Expressions</strong></td>
<td><strong>Content obligatory vocabulary</strong></td>
</tr>
<tr>
<td></td>
<td>عرضة</td>
</tr>
<tr>
<td></td>
<td>قوس</td>
</tr>
<tr>
<td></td>
<td>معلق</td>
</tr>
<tr>
<td></td>
<td>جسر</td>
</tr>
<tr>
<td></td>
<td><strong>Content compatible vocabulary</strong></td>
</tr>
<tr>
<td></td>
<td>طويل/ قصير</td>
</tr>
<tr>
<td></td>
<td>قديم/ جديد</td>
</tr>
<tr>
<td></td>
<td>قوي</td>
</tr>
<tr>
<td><strong>Expressions and patterns</strong></td>
<td>ما يعني؟</td>
</tr>
<tr>
<td></td>
<td>أين (رس)؟</td>
</tr>
<tr>
<td></td>
<td>هذا (نوع جسر)</td>
</tr>
<tr>
<td></td>
<td>في (بلد)</td>
</tr>
<tr>
<td></td>
<td>مصنوع من مواد</td>
</tr>
<tr>
<td></td>
<td>هناك...</td>
</tr>
<tr>
<td></td>
<td>طوله (رس)</td>
</tr>
<tr>
<td></td>
<td>مترا/ قدم</td>
</tr>
<tr>
<td></td>
<td>أطول/ أكثر طولا</td>
</tr>
<tr>
<td></td>
<td>جديد/ جديدا</td>
</tr>
<tr>
<td><strong>Materials/Resources</strong></td>
<td>world map</td>
</tr>
<tr>
<td></td>
<td>a virtual globe</td>
</tr>
<tr>
<td></td>
<td>Bridge PowerPoint Slides 42-46</td>
</tr>
<tr>
<td></td>
<td>Driving directions from your school to Stevensville, Maryland (to be...</td>
</tr>
</tbody>
</table>
A Bridge for the Future

placed in an envelope labeled (بناء جسر المستقبل)
- 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: *Henadsa جسر
- Resource 4c: Interpersonal and Presentational Task: جسر للمستقبل *Rubric
- Worksheet 4a: جسر للمستقبل*
* 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.

<table>
<thead>
<tr>
<th>Key Elements</th>
<th>Lesson 4 – جسر للمستقبل</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engagement</td>
<td>A new package arrives from the Bridge Engineering Security Team.</td>
</tr>
<tr>
<td></td>
<td>PPT 42</td>
</tr>
<tr>
<td></td>
<td>Music starts to play.</td>
</tr>
<tr>
<td></td>
<td>T:</td>
</tr>
<tr>
<td></td>
<td>أنظر لهذا طرد من فريق هندسة أمن الجسور.</td>
</tr>
<tr>
<td></td>
<td>PPT 43</td>
</tr>
<tr>
<td></td>
<td>T:</td>
</tr>
<tr>
<td></td>
<td>هيا نرى ما بي من داخله.</td>
</tr>
<tr>
<td></td>
<td>؛ سيفتح الطرد و برينما يداخلي.</td>
</tr>
<tr>
<td></td>
<td>(Student opens package and pulls items out of the box and shows the items to the class.</td>
</tr>
<tr>
<td></td>
<td>T:</td>
</tr>
<tr>
<td></td>
<td>هيا نرى/ هنا عدنا ...</td>
</tr>
<tr>
<td></td>
<td>• صورة لجسر تشيسابيك</td>
</tr>
<tr>
<td></td>
<td>• طرد يقول “بناء جسر المستقبل”</td>
</tr>
<tr>
<td></td>
<td>• عصي المصاحصة</td>
</tr>
<tr>
<td></td>
<td>• منظمات الأنابيب</td>
</tr>
</tbody>
</table>
### Exploration
- Objects and phenomena are explored
- Hands-on activities, with guidance

### Engineering a Bridge for the Future

Now it's turn to design a bridge for the future! Discuss design challenges and safety factors:

- What are the key components of a bridge?
- How can we ensure safety and durability?
- What materials are best suited for our design?

Students design and present their bridge proposals. Discuss feedback and potential improvements.
### World Language – STEM MODULE – Bridges Around the World
**A Bridge for the Future**

<table>
<thead>
<tr>
<th>Explanation</th>
<th>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. Collect the worksheets for use in the next Elaboration segment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elaboration</td>
<td>How Strong Are Our Bridges?</td>
</tr>
<tr>
<td></td>
<td>ت: البارحة اختبرنا الحمولات للجسور. لكن تذكر أن سايبير يريد التأكد أن الجسور ستصمد أمام الظروف الطبيعية إذا اليوم سنختبر الجسور مع رياح شديدة. Re-distribute Worksheet 4a and instruct students to complete Part 3 as directed. Circulate and assist as needed. Worksheet will be included in the Bridge Engineering Security Team Notebook.</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Presenting...Our Bridges for the Future</td>
</tr>
<tr>
<td></td>
<td>Students assess their knowledge, skills and abilities. Activities permit evaluation of student development and lesson effectiveness. Allow time for students to rehearse their presentations. Complete Resource Sheet 4b (Rubric) for each group.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teacher Reflection Lesson 4 – جسر للمستقبل</th>
</tr>
</thead>
<tbody>
<tr>
<td>What worked well?</td>
</tr>
<tr>
<td>What did not work well?</td>
</tr>
<tr>
<td>What would I do differently?</td>
</tr>
<tr>
<td>Other comments or notes</td>
</tr>
</tbody>
</table>
Lesson 5 – Integrated Performance Assessments

**Presentational Task:** 

<table>
<thead>
<tr>
<th>جسر نا للمستقبل</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>

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

**Self-Evaluation**

- Students will work in pairs. They will take turns playing the role of the interviewer (Bridge Engineering Security Team member) and the interviewee.
- 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.
  - ما هو نوع هذا الجسر؟
  - أين الجسر؟
  - هل تستطيع وصف الجسر؟

- Distribute **Worksheet 5a** to be completed by each student. Collect **Worksheet 5a**. It will be included in the notebook.

**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.
- The students will look at one of the sets of photographs on **Resource Sheet 5b** and answer simple questions about the bridges.
  - ما هو نوع هذا الجسر؟
  - هل تستطيع تمييز أجزاء هذا الجسر؟

After completion of the interview, award the student a BEST Badge. (**Resource Sheet 5c**)

**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.