

Bridging The Gap

Lesson Objective & Summary

Objective: Students will learn about the four main types of bridges by working through the PBS “Build a Bridge” online activity. Students will predict which type of bridge will be able to hold the most weight using the materials given. Students will work together to build a freestanding bridge of their choice from the materials given. Students will be able to confirm their previous predictions by placing increasing amounts of weight on their bridges. Student be able to construct a virtual bridge utilizing their prior knowledge of angles and other geometry and engineering concepts through “West Point Bridge Designer” software.

Grade Level:
Middle School

DURATION:
2 hour 15 mins

SUBJECTS:
STEAM

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Summary: In this lesson, students will begin by watching [The Sydney Harbour Bridge](#). This video will hook students into the concept of bridges they will be learning about the rest of the lesson. Following video viewing, students will engage in an online bridge activity where they will learn about the different types of bridges and their uses. Next, students will be shown the materials they will use to build their own bridges where they will attempt to build a bridge that holds the most weight possible. Their bridge will be one of the four types they learned about in the online activity. After building their bridges in groups, students will make predictions of how much weight their bridge will hold and then will determine the actual weight by placing various amounts of weight on their bridges.

Standards & Benchmarks

From the Common Core Standards for Science and Technical Subjects

- Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
- Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks
- Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flow chart, diagram, model, graph, or table).

From the Common Core Standards for Math: Geometry

- Represent three-dimensional figures using nets made of up rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problem.
- Solve real world and mathematical problems involving area, volume, and surface-area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

From the Common Core Standards for Comprehension and Collaboration

- Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners, topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

From the Common Core Standards for Presentation of Knowledge and Ideas

- Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.

Background Information for Educators

There are four main types of bridges used for different purposes around the world.

Arch bridge: The weight is distributed on each end of the bridge, rather than pushing straight down. Arch bridges should be made of strong materials that will withstand the compression put on the bridge by traffic and itself.

Beam bridge: Most simple and inexpensive of all bridge types. In a beam bridge, a horizontal beam is supported by piers at each end. Weight goes straight down on the piers in a beam bridge.

Suspension bridge: Suspension bridges can span long distances and is the longest of any type of bridge. The roadway suspends from huge cables, often times over water. Suspension bridges are light and flexible and wind can be a serious concern because of this.

Cable-Stayed bridge: These bridges look similar to suspension bridges, but with this type the cables are attached to the tower so they bear all the weight themselves. These bridges are used for medium length spans, they require less cable than a suspension bridge, making them more cost effective, and they are faster to build than suspension bridges as well.

Key Vocabulary

Arch	Compression
Column	Arch bridge
Beam	Beam bridge
Cable	Suspension bridge
Suspension	Cable-Stayed bridge

Lesson Plan 1A - Introduction to Bridges

1. Write the word "Bridge" on the board.
2. Call students to the board to write their thoughts and/or ideas about bridges on the board for a "Chalk Talk" activity.
3. As a class, view [The Sydney Harbour Bridge](#) video.
4. Have students work at computers or with tablets on the website <http://www.pbs.org/wgbh/nova/tech/build-bridge-p1.html> to learn more about the four types of bridges. Students will begin with "Survey the Sights" then work through "Do Your Homework" and finally "Play the Game."

Lesson Plan 1B - Build A Bridge

Materials Needed: popsicle sticks (20 per group), masking tape, balance scale weights, and "Building A Bridge" worksheet (provided at end of document).

1. Review the four different types of bridges and their uses with students.
2. Tell students their task for the day is going to be to build one of the four types of bridges from the popsicle sticks and masking tape given. Their goal is to build the strongest bridge that will hold the most amount of weight possible in their groups.
3. Organize students into bridge building groups and pass out the "Build a Bridge" worksheet to each group.
4. Students will work through the steps on the worksheet.
5. Discuss with the class as a whole how much weight their bridges held and if their predictions were close to the actual weight the bridges could hold.

Lesson Plan 1C- Virtual Bridge Design: Lesson Extension Option

Materials Needed: West Point Bridge Designer software downloaded (this is a free download)

Download the free West Point Bridge Designer Software and have students work through this to design their own virtual bridges: <http://bridgecontest.org/resources/download/>.

Assessment: (All assessments will be made using a rubric)

1. Students will be assessed based on their participation in class discussions
2. Students will be assessed based on their collaboration in group work
3. Students will be assessed based on their participation in group work
4. Students will be assessed based on their ability to apply their knowledge of bridges to the construction of their own bridge
5. Students will be assessed based on the completion of their "Building a Bridge" worksheet

Assessment Rubric	Below Expectations	Meets Expectations	Exceeds Expectations
Contributions to Group Work	Student rarely provides ideas when participating in the group. Might refuse to participate.	Student sometimes provides ideas when participating in the group. A strong group member who tries hard.	Consistently provides useful ideas when participating in the group. A lot of effort is contributed to the group's efforts with definite leadership skills shown.
Participation in Class Discussion	Student lacks participation and enthusiasm and/or contributions detract from class discussions.	Student participates with enthusiasm and contributes to class discussions.	Student regularly participates with enthusiasm and contributes meaningfully to class discussions.
Construction of Bridge	Materials were not selected appropriately and bridge does not appear to represent any specific type of bridge.	Materials were used on appropriate and creative ways. Bridge represents one of the four types discussed, but model might have slight inaccuracies.	Materials were used in appropriate and creative ways. Bridge clearly represents one of the four types discussed.

Building A Bridge

1. Which type of bridge will your group be building?

2. Why do you think this type of bridge is the best choice for this assignment?

3. Build your bridge using the materials given.

4. How much weight do you think your bridge will hold? _____

5. Place balance scale weights on your bridge, starting with the lightest and working your way up to heavier weights.

6. How much weight did your bridge hold before collapsing? _____