Bridging Understanding with 3-Dimensions

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Target Grade: 5th grade

Time Required: 7 to 9, 30- minute sessions

Standards:

- **5.ETS2.1**: Use appropriate measuring tools, simple hand tools, and fasteners to construct a prototype of a new or improved technology.
- **5.ETS1.2**: Plan and carry out tests on one or more elements of a prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign the prototype.

Lesson Objectives:

Students will:

- Use tools to construct a prototype of something new
- Test their prototypes including controlled variable and failure points.
- Apply test results to redesign their prototype

Central Focus:

In this lesson students will be provided with a location of a remote village/population. They will be tasked with designing and creating a bridge that will allow their people to have greater access to resources such as education, medical care, and economy.

Background Information:

Students should be aware of how to use the website Tinkercad which will allow them to build their prototype. In order for this to run smoothly, students should be aware of how to use a 3D printer.

Materials

- Grid Paper
- A copy *of Bridges: History of the World's Most Spectacular Spans* by Judith Dupre (can be used as a reference by students in design phase)
- A copy of *How to Read Bridges: A Crash Course in Engineering and Architecture* by Edward Denison (can be used as a reference by students in design phase)

- Global Works printouts from *Bridges to Prosperity (*one per group)
- Challenge Pages (one per group)
- 3-D Printer
- Filament
- Bridge Evaluations printouts (one per student)

Instruction

Day 1:

Step1: With students in work groups, present them with the newest challenge. Provide each group with a global work profile (provided in hand-outs). Ask each group to examine how bridges impacted their individual's life.

Step 2: Walk students through the *Why Bridges?* page found on the *Bridges to Prosperity* page at https://bridgestoprosperity.org/why-bridges/.

Step 3: Begin by creating a concept map of bridges indicating at this point the benefits that bridges provide.

Step 4: After discussion, provide students with their challenge (provided challenge pages found in hand-outs section). Each group will be provided with a location of a remote village/population. They are being tasked with designing and creating a bridge that will allow their people to have greater access to resources such as education, medical care, and economy.

Day 2:

Step 1: Open with a recap of what they have already learned regarding bridges, using the concept map to support the conversation. "Today will be a day of thinking and designing. Groups will need to establish answers to each of the "thinking points" provided on your group challenge page". You may use Google Earth to assess in the answering of their questions.

Step 2: Following their responses to the "Thinking points," students will watch the following clip to get their thinking flowing concerning which type of bridge will best support their situation and population: https://www.ted.com/talks/ian_firth_bridges_should_be_beautiful/transcript?language=en - t-487806

Step 3: As an exit ticket, students will write a quick response on which type of bridge they think would support their needs, bending, compression or tension, and their reasoning behind why.

Day 3:

Step 1: Students will put their thoughts into action. Today each group will need to create a design on their graph paper along with planned measurements. It will be important to provide students access to the internet as well as the resource books mentioned in materials to help guide their thinking and design.

Step 2: Once each group has completed their design they will go and look at another groups design and provide feedback on the design utilizing constructive questioning.

Day 4:

Step 1: Students will now begin constructing. Students will be designing their group's model in Tinkercad and then print from there (depending on how far students are able to get this may take a few sessions).

Day 5:

Step 1: Now that students have a bridge prototype it is time for them to present the model to the group and see which bridge would best fit the situation/community's needs.

Step 2: Each group will create a 5-minute presentation detailing why their bridge is the best fit for the community, how it will solve the problems that are currently pressing and demonstrate the strength or usability for the class.

Day 6:

Students will present their projects for the class.

Following each presentation students will use 2-minutes to complete a survey of how they felt/perceived the bridge. They will rate the bridge on it's different attributes on a scale of 1-5 (this is included with the handouts).

Differentiation

For differentiation within this lesson, I would recommend strategic grouping. Another type of differentiation would be providing a preloaded file with some of the basic shapes that students may want to include into their bridge within Tinkercad account.

Assessment

- Throughout the lesson, the teacher will ask and answer questions to test the student's knowledge. On day two, students will be given an exit ticket at the end of the lesson.
- The assessment for this activity will be done through observation along with final project review. The student's/group's work will also be evaluated by their peers through the Bridge Evaluations page

Bridge Evaluation

Directions: Following each presentation, complete the sections of the table. Rate the areas of *working design, helps community, and cost effective* on a scale of 1, being the lowest, 5, being the highest.

Group Name & Challenge #	**Should This Bridge be Built?**	**Working Design**	**Helps Community**	**Cost Effective**	**Bridge Type** *(bending, compression, or tension)*

Johnny

Nicaragua

"I worked on the bridge; I helped to haul rocks and push wheelbarrows. I really liked pushing the loaded wheelbarrows and aligning the stones with the mason. I'd like to study masonry when I get older."

Planning for his future

Johnny was 11 years old when the El Pueblito bridge was being constructed in his community. Every day of the build, Johnny's grandfather, the mayor of the community, brought him along to work on the bridge. Johnny was a huge help during the construction process, and because of the skills he learned on the project, he now wants to be a mason when he grows up.

Johnny now has a reliable, year-round connection to the services he needs most, but beyond that, he also has new aspirations for his future.

Nicaragua

The Nicaragua program was established in 2011. Through collaboration with local governments and volunteer labor from beneficiary communities, the Nicaragua program has built 53 bridges, the highest number of B2P bridges in any country.

Bridges under construction	People served	Completed bridges
9	100,362	53

Indicators

Rural Access Index	28 %
Country Individuals Served	100,362
Completed Bridges	53
Rural Access Index (HDI)	1
Rural Population %	41 %
Total Identified Sites	95
Estimated # of People Without Safe Access	286,730

Bridges to Prosperity

Angelique

Rwanda

"I started school when I was 10 because I couldn't cross the old bridge by myself. I didn't study at nursery age, and when you study at nursery age, you learn more things. I used to be 30th in my class. I had repeated bad performance because I missed school. Now I'm 6th in my class - my marks have improved."

Advancing her education

Angelique is 13 years old and lives in the Shagasha community of Rwanda. Each day, in order to attend school, she, along with her classmates, was required to cross the Muyanza River. Because of the danger of the crossing, parents often delayed sending their children to school until they were older. Even then students were not allowed to cross when the rains were heavy, which meant they missed valuable days at school. Now that the Shagasha Suspended Footbridge is built, Angelique can attend school every day without fear and her grades have improved by 20%. Watch Angelique's story to learn more.

Rwanda

We've had a full-time program in Rwanda since 2012, with over 35 bridges built to date, all of which have been achieved through close cooperation with the government, industry partners, and local organizations.

Bridges under construction	People served	Completed bridges
5	215,210	36

Indicators

Rural Access Index	52 %
Country Individuals Served	215,210
Completed Bridges	36
Rural Access Index (HDI)	0
Rural Population %	70 %
Total Identified Sites	362
Estimated # of People Without Safe Access	564,054

Bridges to Prosperity

Olegario

Panama

"I'm completely sure that the construction of this bridge will change our lives forever, not only by reducing the risks of falling into the river, but by letting teachers spend more time with their families on the weekends, reducing the trip time from our homes to work from 11 hours to 4 hours."

Safe access to school

Olegario is a teacher at Centro Educativo Llano Bonito, where he lives from Sunday to Friday. Olegario sees that a lot of his students are from Cobrizo and Camarena communities, which are located on the opposite side of the river. Oftentimes, they are unable to access school because the river is too dangerous.

Olegario has firsthand experience with crossing the river during unsafe conditions. In 2016, he and his colleagues wanted to visit their families in other communities. As it was the rainy season, the water level was high, and they needed to swim to cross the river. One of Olegario's colleagues didn't know how to swim. To help her, they swam to find a boat, pulled it to where she was, and finally pulled her in the boat to the other side of the river. Fortunately, each of them safely reached the other side, but it is all too common that something goes wrong.

With the new bridge, Olegario and the rest of the community residents will not have to risk their lives to cross the river.

Panama

The Panama program was founded in 2013. During the first three build seasons, we focused mainly in Panama Oeste and Cocle. During 2017 and 2018, most projects focused on the Veraguas and Comarca Ngobe Bugle regions.

Bridges under construction	People served	Bridges completed
7	17,322	23

Indicators

Rural Access Index	77%
Country Individuals Served	17,322
Completed Bridges	23
Rural Access Index (HDI)	1
Rural Population %	33%
Total Identified Sites	279
Estimated # of People Without Safe Access	63,412

Bridges to Prosperity

Group A

Location: Tugwell Island,
British Columbia

People: Metlakatla Indian Tribe

Scenario: The Metlakatla Tribe is a protected tribe that holds ownership of several islands off the coast of British Columbia, Canada. The tribe relies on fishing as their main source of food. Their economy is based on fishing, tourism and forest products. The biggest issue the community faces is their lack of energy accessibility. The lack of accessibility causes them to have to be very careful with their energy consumption.

Challenge: Create a bridge that can not only provide a route to mainland for tourism and transportation but also provide an avenue for electricity to the island.

Thinking Points:
-What are the common weather conditions for this area?
-How much load is this bridge going to need to bear?
-What material will you use to construct it?
-Distance?

Group B

Location: Amazon Rainforest, Brazil

People: Amazon Tribes

Scenario: The tribes of the Amazon Rainforest have learned to cope with many changes to their environment including illegal logging and farming by intruders. While these troops have now began communicating with the larger world, they are also at a disadvantage due to location. Their location leaves them dependent on outside groups to provide basic necessities such as medicine and educational materials.

Challenge: Create a bridge that can provide a trade route for these small tribes to cross the Amazon River.

Thinking Points:

-What are the common weather conditions for this area?
-How much load is this bridge going to need to bear?
-What material will you use to construct it?
-Distance?