



**BRIDGE UP!  
ENGINEERING**

LESSON 8 – GRADE 8

## LESSON 8 – GRADE 8: Making Concrete



### Big Idea

How do concrete and cement work? Use concrete to make parts of bridges to see how they work together.



### Essential Questions

What materials would be needed to build a bridge?

What is important for bridge materials to do?

How would the deck be different than the foundations, piers?



### Background Information

Cement is the “glue” that holds the aggregate together to make concrete. Different types of concrete are made into piers, decking and roadways.



### Standards & Benchmarks

#### Minnesota Science Standards

##### 8.1.1.2 Inquiry

Scientific inquiry uses multiple interrelated processes to investigate questions and propose explanations about the natural world.

8.1.3.3 Science and engineering operate in the context of society and both influence and are influenced by this context.

8.1.3.4 Current and emerging technologies have enabled humans to develop and use models to understand and communicate how natural and designed systems work and interact.

#### Wisconsin Science Standards

A.8.1 Show that technology has allowed us to further the efforts of science and, in turn, science has enabled us to develop better technology.

A.8.7 Discover that human will or desire can lead to the design of new technology in order to seize an opportunity or solve a problem.



### Connections with Multimedia Program

Bridge Up! Mastering Materials

Bridge Up! iBook



### Activity Description

- Students will make concrete (modified from Bridges! by Johmann & Rieth).
- Activity after brainstorming essential questions, watch Tacoma Bridge at <http://www.youtube.com/watch?v=3mclp9QmCGs&safe=active>
- Read about cement at <http://en.wikipedia.org/wiki/Cement>



### Vocabulary

**Cement** – A substance that sets and hardens and can bind other materials together.

**Hydraulic cement** – Will set/dry in wet condition or underwater.

**Non-hydraulic cement** – Will not set in wet conditions, reacts with CO<sub>2</sub> in air to dry.

**Aggregate** – Sand, gravel, crushed stone and recycled crushed concrete.

**Concrete** – Composed mainly of water, aggregate and cement.

**Pozzolana** – Cement made with ash erupted from Mt. Vesuvius, named after the town, Pozzuoli, where it was found. It is waterproof and will harden even when wet.

**Arch** – A curved structure that spans a space and may or may not support weight above it.

**Pier** – A vertical support member for a bridge.

**Bridge Deck** – The surface of a bridge where vehicles and pedestrians travel.

**Beam Bridge** – Beam bridges are made of a flat piece, or beam, laid across two or more supports.



## Materials

- Tea kettle (or other pan to boil water) and double boiler, cookie sheet
- Mixing spoon and spatula
- Sand, pebbles and cornstarch  
(fine sand works better, pebbles should be small - pea gravel at any home store)
- Centering frame (a round oatmeal container or peanut butter jar)



## Procedure

- Boil water in bottom pot of double boiler - boil additional water in a separate pan or kettle
- Mix sand and cornstarch in top pot.
- Add 125 ml of water from kettle to the mixture.
- Stir mixture as it cooks - stop when it is too thick. You may need to add a little more hot water.
- Let it cool until you can touch it.
- You have made mortar, try and make an arch.
- Add some pebbles to the mortar to make concrete. Shape it into 2 piers and 2 rectangular beams. Curve one beam into an arch.
- Place on cookie sheet (place in oven at 275 °). Bake until dry.
- Make a beam bridge and test by adding weights.
- Make an arch bridge and test by adding weights.
- Compare the strength of each.
- Put one of the piers in water - is it waterproof?



### Assessment

- Student notes
- Teacher observations



### Extensions

- Building an arch (from Bridges! by Johmann & Rieth)



### Materials

- Clay/Play Doh (or mortar from above, step 6)
- Small rocks of similar size (flatter ones are easier to layer)
- Centering block - rounded oatmeal container, peanut butter jar)



### Procedure

- Lay a cylinder (PB jar or oatmeal container) on its side.
- Set a rock on either side of the cylinder (centering block).
- Add a layer of mortar (or clay/Play Doh).
- Continue to layer rocks and mortar until you reach the top.
- Slide out the centering block - does it stay up?
- Can you identify the keystone?



### Other Resources

- Read about arches at <http://science.howstuffworks.com/engineering/civil/bridge5.htm>

## LESSON 8.2 – GRADE 8: Native Americans



### Big Idea

Native Americans are very good at working at heights and held important jobs in bridge building history.



### Essential Questions

How are bridges and buildings constructed?

What kind of physical attributes would be required of the people that built these structures?

Do you think you could work in this environment?



### Background Information

Native Americans were very important in construction of bridges and other tall structures because of their physical and mental strength.



### Standards & Benchmarks

#### Minnesota Science Standards

##### *8.1.3.2 Culture*

Men and women throughout the history of all cultures, including Minnesota American Indian tribes and communities, have been involved in engineering design and scientific inquiry.

##### *Benchmark 8.1.3.2.1 Contributions of Cultures*

Describe examples of important contributions to the advancement of science, engineering and technology made by individuals representing different groups and cultures at different times in history.

#### Minnesota English Language Arts Standards

Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12

##### *Reading Benchmark 6.13.2.2. Literacy in 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.



### Connections with multimedia program

Bridge Up! iBook

Bridge Up! Web Modules



### Activity Description

Native Americans contributed much to the building of tall structures throughout history. This activity will enable students to better understand their contributions.



### Materials

- Computer
- Article found at <http://sonicmemorial.org/public/mohawk/mohawk.html>



### Procedure

Part 1:

- Show images of construction workers on skyscrapers and bridges - there are many available in Google searches.
- As students watch, have them write down thoughts about how pictures make them feel. Compile a list from all when done.

Part 2:

- Next, brainstorm on how bridges and skyscrapers are built. What kind of attributes would a person need in order to be a construction worker on these sites? Do you think you would be good at working in this environment?

Part 3:

- Read <http://sonicmemorial.org/public/mohawk/mohawk.html>. If you are able to print the article, students can underline and highlight text. Project article on Smart Board.
- Read through article one time together – ask for volunteers to read a paragraph. Have a short discussion.
- Some questions for discussion:
  - Which state and year did Mohawk Indians begin?
  - How did they get started working on bridges?
  - Which attributes did the Mohawks have that enabled them to be successful?

Part 4:

- Watch [https://www.nfb.ca/film/high\\_steel](https://www.nfb.ca/film/high_steel)
- Ask students to write a short summary of what they learned from the article and video.



### Extensions

Watch Build a Bridge <http://www.pbs.org/wgbh/nova/tech/build-bridge-p3.html>