Grade 5

Bridges That Move

Problem

Your engineering firm has been hired to design and build a bridge that can move to allow a vehicle to pass over/through the obstacle described in the scenario you have written.

Lesson Summary

Student teams will study and research the major types of bridges. Each engineering team will then design a scenario of a location/situation that needs a bridge that can move. Each team will design and build a model of a bridge using recycled materials, Scratch programming, and at least one component from the Hummingbird robot kit.

Major Topic and SOL

Math SOL (2009)

Measurement 5.8 The student will

d) estimate and then measure to solve problems, using U.S. Customary and metric units; and

e) choose an appropriate unit of measure for a given situation involving measurement using U.S. Customary and metric units.

Science SOL (2010)

Scientific Investigation, Reasoning, and Logic

5.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which

i) inferences are made and conclusions are drawn;

j) models are constructed to clarify explanations, demonstrate relationships, and solve needs; and

k) current applications are used to reinforce science concepts.

Language Arts SOL (2010)

Communication: Speaking, Listening, Media Literacy

5.1 The student will listen, draw conclusions, and share responses in subject-related group learning activities.

a) Participate in and contribute to discussions across content areas.

b) Organize information to present in reports of group activities.

c) Summarize information gathered in group activities.

d) Communicate new ideas to others.

e) Demonstrate the ability to collaborate with diverse teams.

f) Demonstrate the ability to work independently.

5.2 The student will use effective verbal and nonverbal communication skills to deliver planned oral presentations.

World Geography

WG.2 The student will analyze how selected physical and ecological processes shape the Earth's surface by

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Grade 5

c) explaining how technology affects one's ability to modify the environment and adapt to it.

Computer Technology

Demonstrate an operational knowledge of various technologies.

C/ T 3-5.1 A. Use various types of technology devices to perform learning tasks.

- Use a keyboard, mouse, touchscreen, touchpad, and other input devices to interact with a computer.

C/T 3-5.2 B. Use content-specific tools, software, and simulations to complete projects.

Use tools in various content areas as directed by the teacher

ISTE Standards

1. Creativity and innovation: a. Apply existing knowledge to generate new ideas, products, or processes. c. Use models and simulations to explore complex systems and issues.
2. Communication and collaboration: d. Contribute to project teams to produce original works to solve problems.
3. Research and information fluency: b. Locate, organize, analyze, evaluate, synthesize and ethically use information from a variety of sources and media.
4. Critical thinking, problem solving, and decision making: b. Plan and manage activities to develop a solution or complete a project.

Length of Time 9-12 weeks/ one hour

Student Objectives

- Students will be able to identify the major types of bridges and their characteristics.
- Students will create a scenario of a location/ situation where a bridge is needed
- Students will design and build a bridge to meet the needs of their location/ situation
- Students will program their bridge to move using hummingbird robotics components

21st Century Skills

- Critical-Thinking and Problem Solving
- Communication
- Creativity and Innovation
- Collaboration
- Information and Media Literacy
- Contextual Learning

Assessment Evidence

- The students will be assessed by the actual product (model of a bridge) using the rubric at the end of their design brief.
- Students will be assessed based on whether they have all the required items completed: 1. Bridge information sheets using information from pages p. 14-18 the National Building Museum Bridge Basics Unit

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Grade 5

2. Bridge scenario design (attached)
3. Bridge design portfolio, including all required components listed on the Bridge Design Brief (attached)

Lesson 1:

- Students are challenged to build a bridge that will span 8". Materials—1 piece of copy paper. Watch the Brainpop Bridges video clip and discuss what kind of bridges we build (Most will be beam bridges, a few arches maybe.)
- See Bridges Intro Design Brief (attached)

Lesson 2:

- Students divide into groups and use the bridge basics information sheets from pages p. 14-18 the National Building Museum Bridge Basics Unit http://nationalbuildingmuseum.net/pdf/bridges_basics.pdf to fill out a Bridge Investigations Worksheet about each type of bridge (beam, truss, cable stayed, suspension and arch).

Lesson 3:

- Student groups design a scenario for a location/situation where a bridge needs to be built and shy a bridge needs to be built there. Use Bridge Scenario Design Worksheet (attached)

Lesson 4:

- Students look online at a variety of ways bridges can move and then design bridges for their scenarios using the Bridge Design Brief (attached) and the first 2 steps of the Bridge design Portfolio (attached).

Lesson 5: (this step takes several class periods)

- Students build their bridges and program them to move (Please reference Hummingbird Robotics site and Scratch programming page).

Lesson 6:

- Students evaluate their bridges using the design, test and evaluate steps of the Bridge Design Portfolio

Lesson 7:

- Student groups present their bridges to the rest of the class.

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A brief study of bridges

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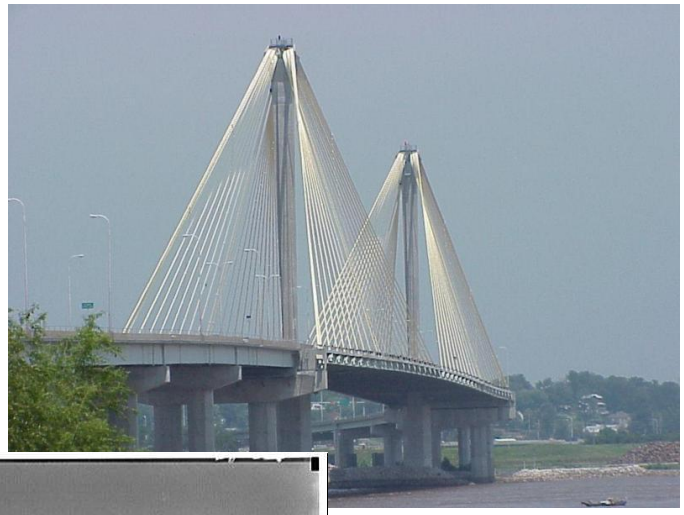
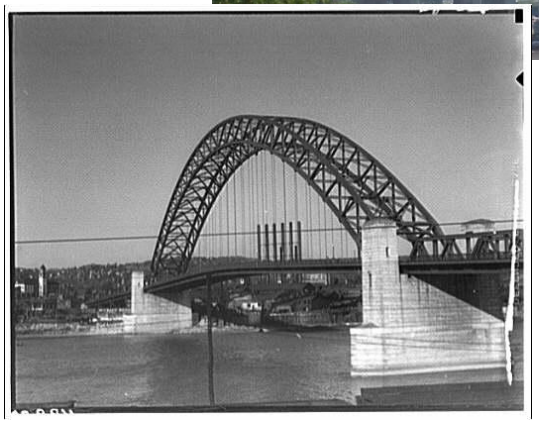
We build different bridges for different needs





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Covered Bridge

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Covered Bridges

In the 18th and 19th century many bridges were covered

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Covered Bridges

Why do you think these bridges were covered?

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Covered Bridges

Some say it was for protection from a sudden storm

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Covered Bridges

Some say to keep horses from shying at the sight of rippling water

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Covered Bridges

Some say to provided a romantic setting for a hug or kiss

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Covered Bridges

However…

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Covered Bridges

The real reason was to protect the timber from the effects of rain and snow

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Beam Bridge

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Beam Bridge

The simplest and least expensive

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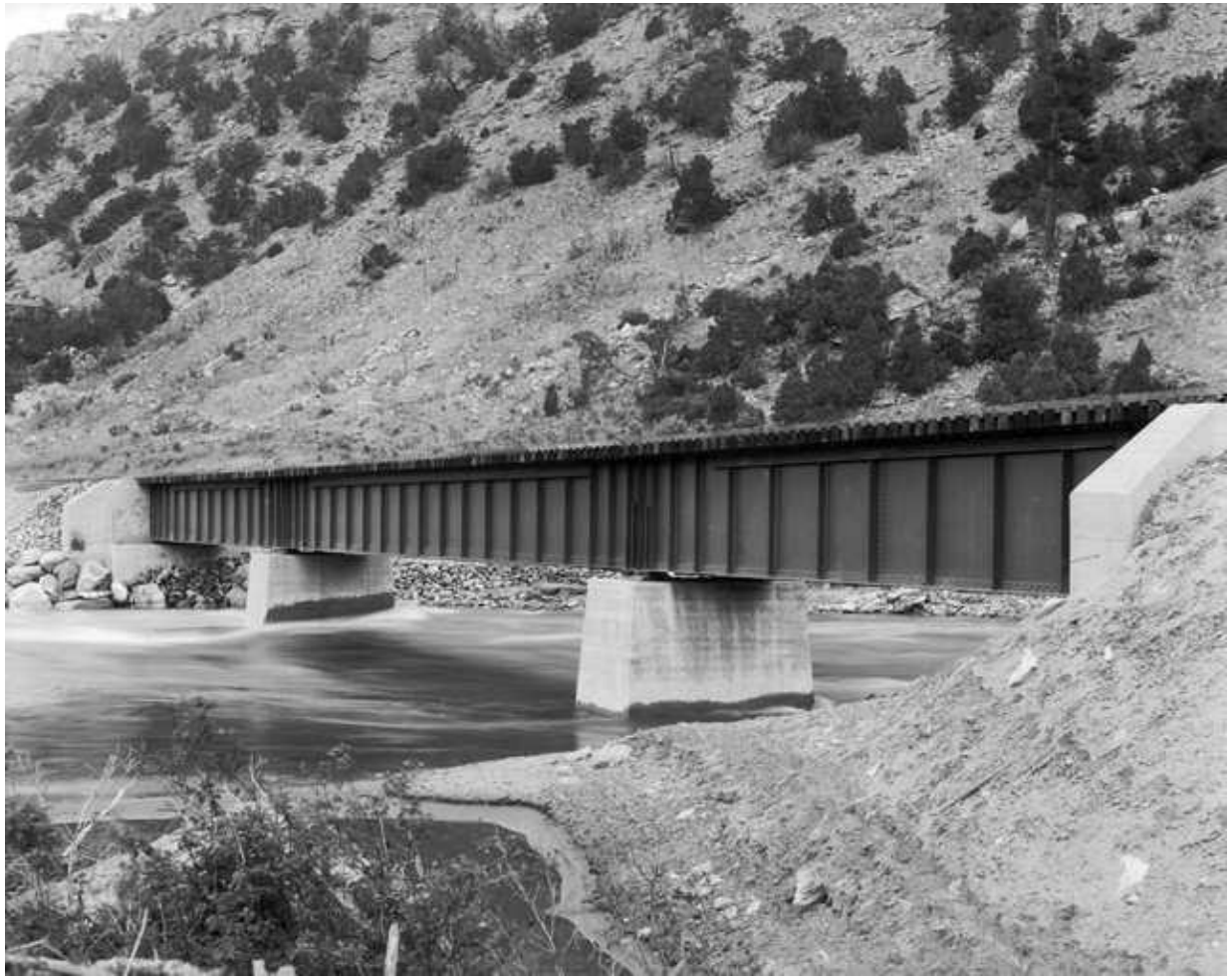
Beam Bridge

Can be made of steel



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Beam Bridge

Concrete

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Beam Bridge

or even wood

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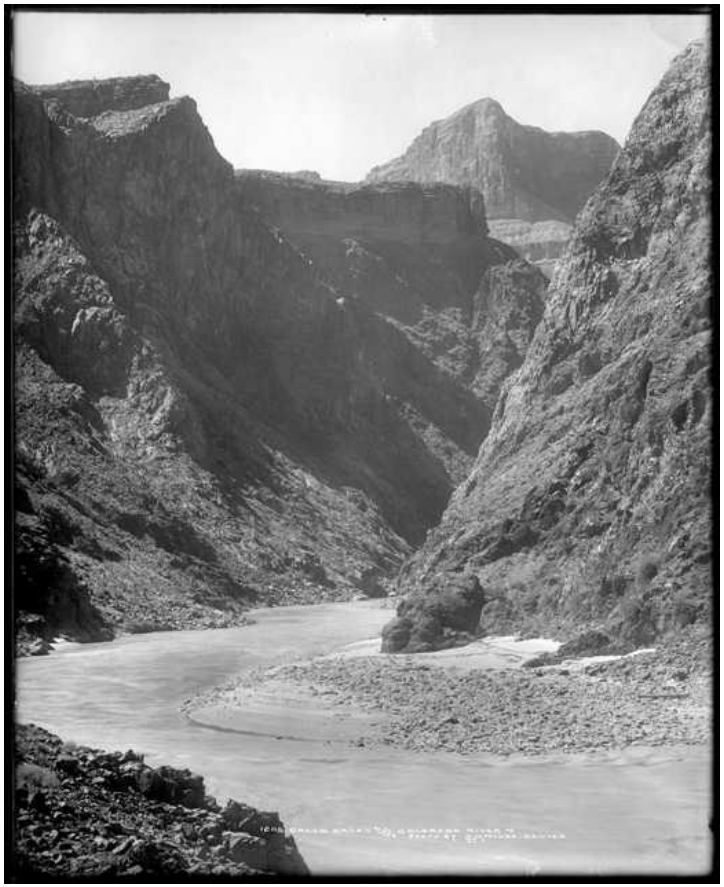
Beam Bridge

Not the best for long or high spans



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Suspension Bridge

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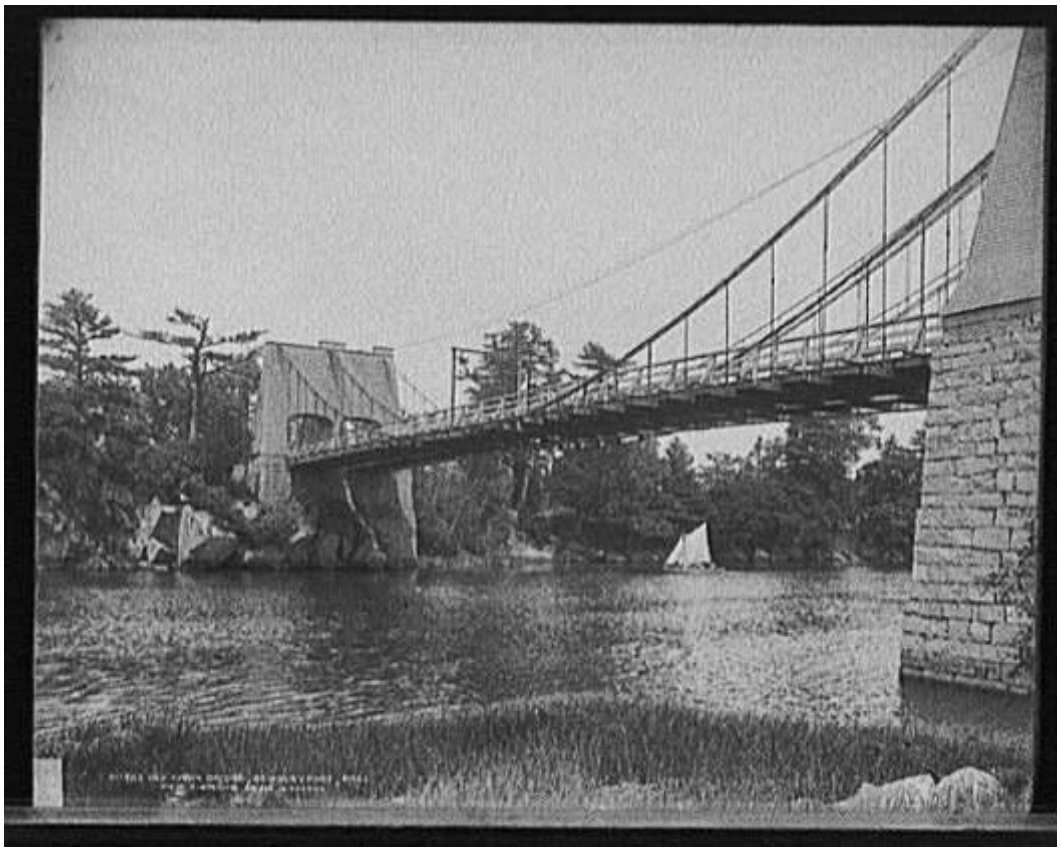
Suspension Bridge

Better for Long spans

More Majestic



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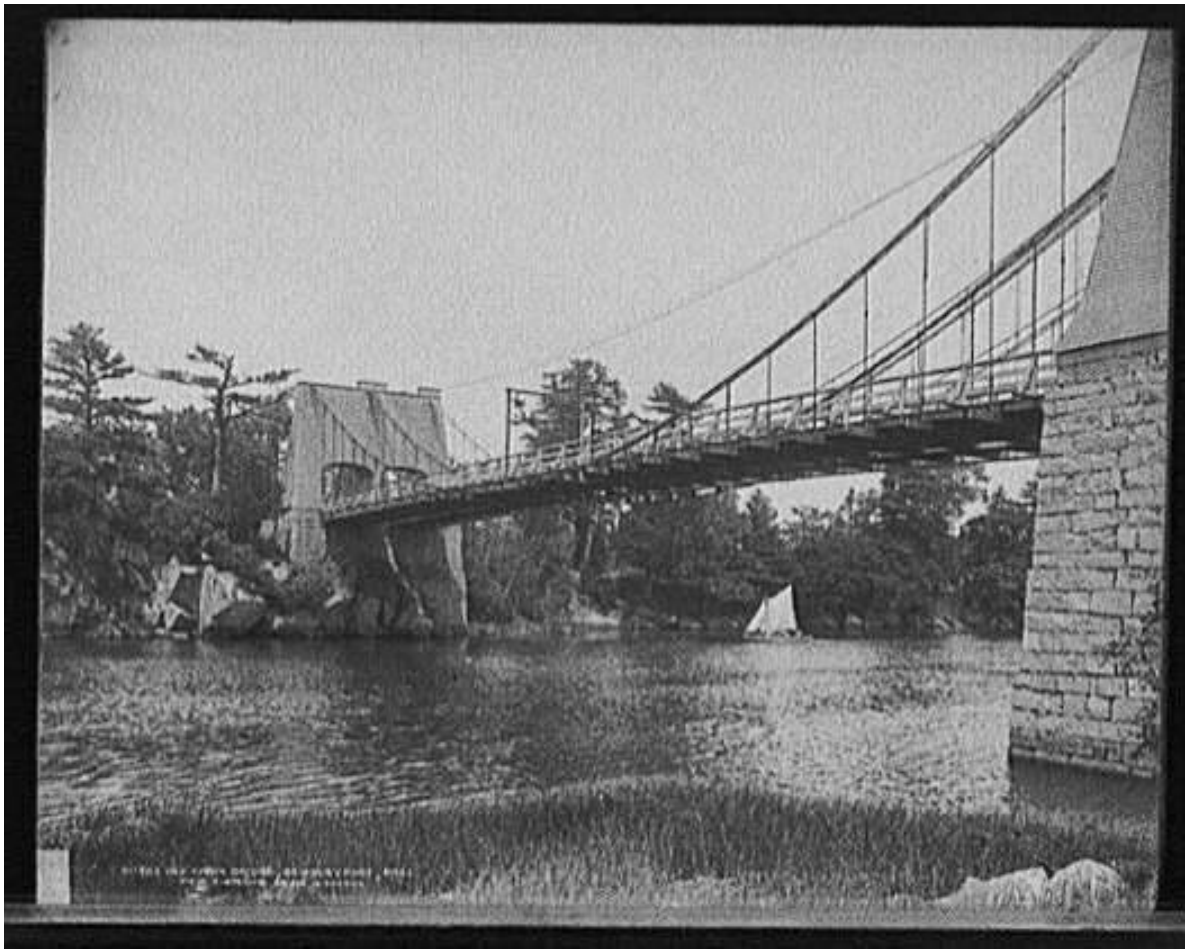
First suspension bridge in America Newburyport, Mass.

Built around 1900



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Golden Gate Bridge

Perhaps the most famous bridge in the world

Why is it called the Golden Gate?

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Golden Gate Bridge

Perhaps the most famous bridge in the world

It spans the Golden Gate Strait

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The worlds 10 longest spans are all suspension bridges

No.	Bridge	Span (m)	Country	year
1	Akashi-Kaikyo	1991	Japan	1998
2	Great Belt East	1624	Denmark	1998
3	Runyang South	1490	China	2005
4	Humber	1410	UK	1981
5	Jiangyin	1385	China	1999
6	Tsing Ma	1377	China	1997
7	Verrazano-Narrows	1298	USA	1964
8	Golden Gate	1280	USA	1937
9	Höga Kusten	1210	Sweden	1997
10	Mackinac	1158	USA	1957

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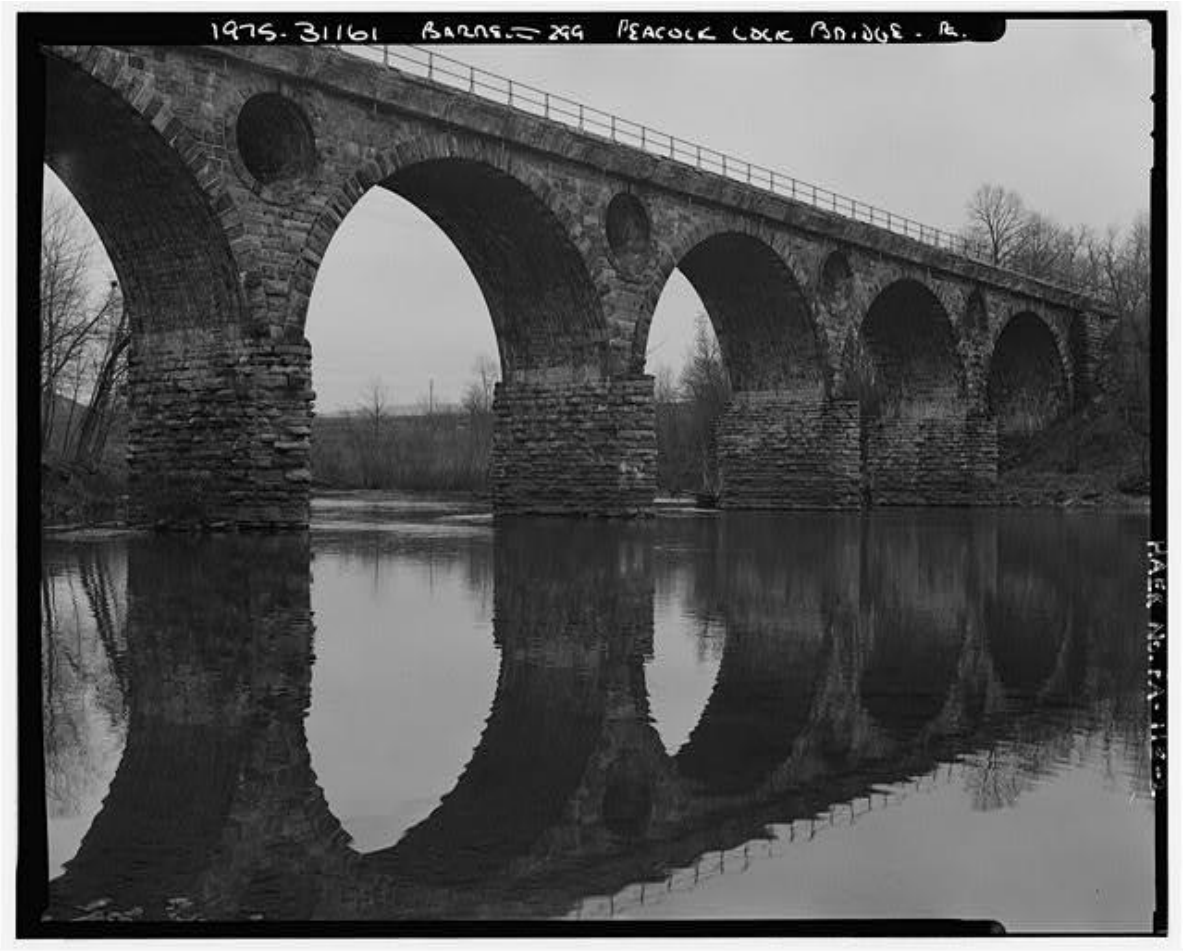
Arch Bridge



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Arch Bridge

Very strong

Can last a very long time

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Arch Bridge

This is
Pont du Gard
a 2000 year
old Roman
aqueduct

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Arch bridge

This is a bridge built so that a stream of water could cross a stream of water

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Cable Stayed Bridge

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Cable Stayed bridge

Long spans

Elegant structure

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Sunshine Skyway Bridge

St. Petersburg, FL

Requires Less labor

Requires less material

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Sunshine Skyway Bridge

St. Petersburg, FL

Similar to Clark bridge in Alton, IL

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Lift Bridge

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Lifting Bridge

Do you know the name of this bridge?

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Lifting Bridge

It is not London Bridge.

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Lifting Bridge

Tower Bridge

It is over 100 years old

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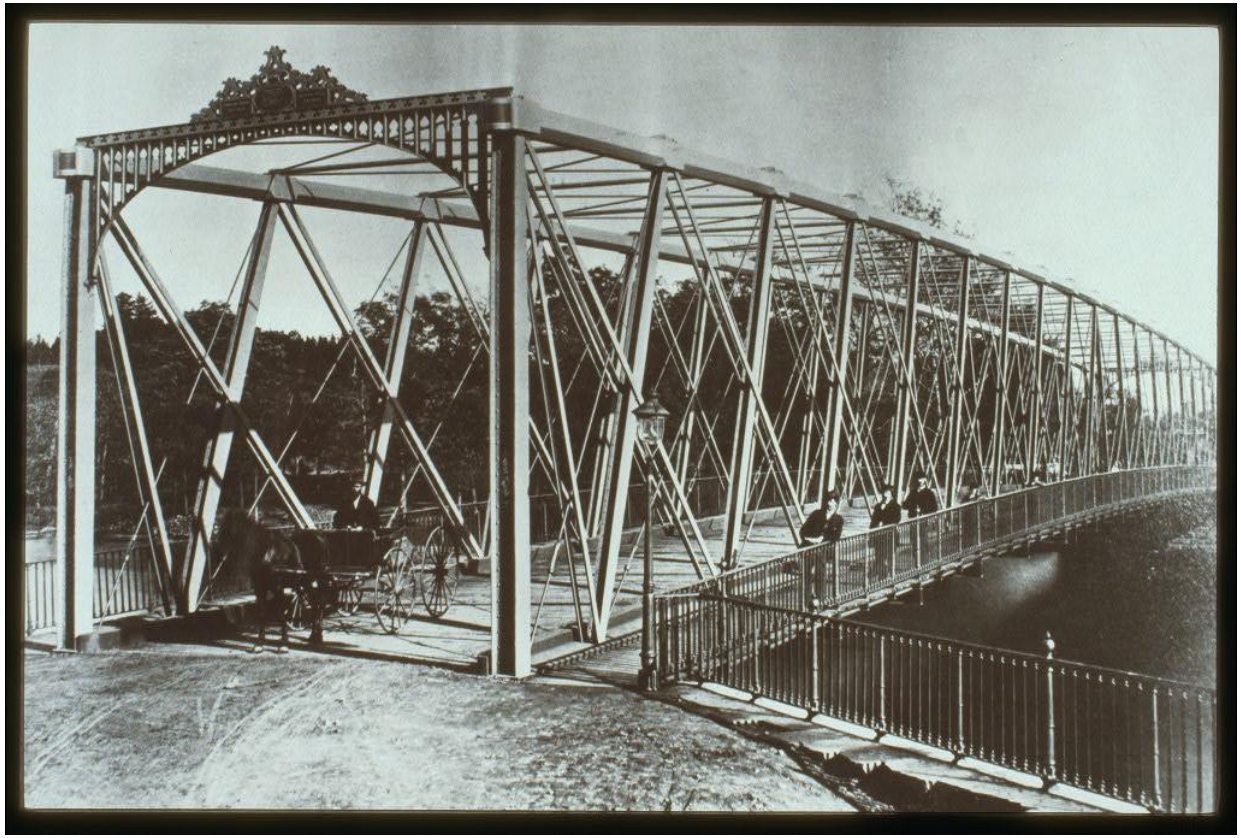
Truss Bridge



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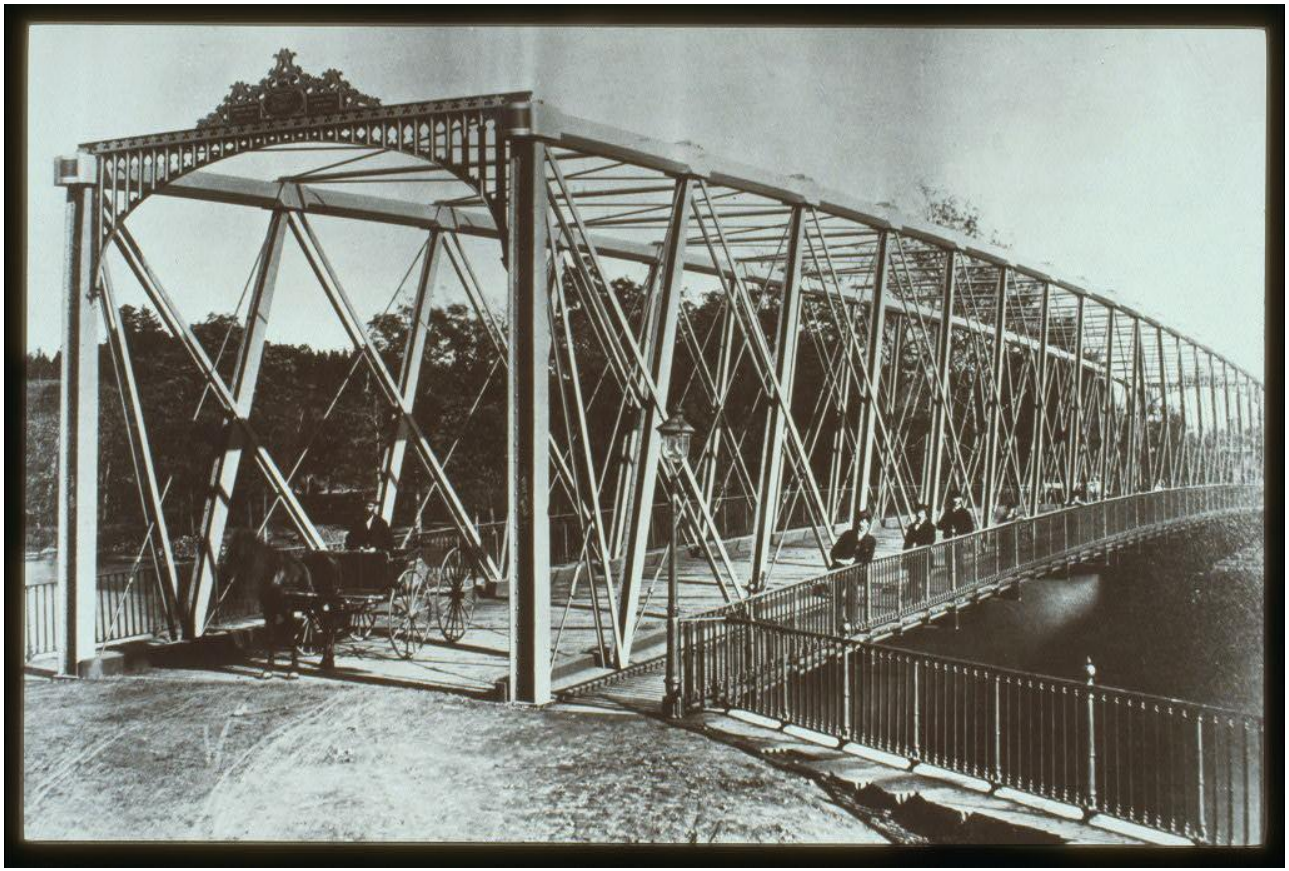
Truss Bridge

A truss can support from above



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Truss Bridge

A truss can also support from below

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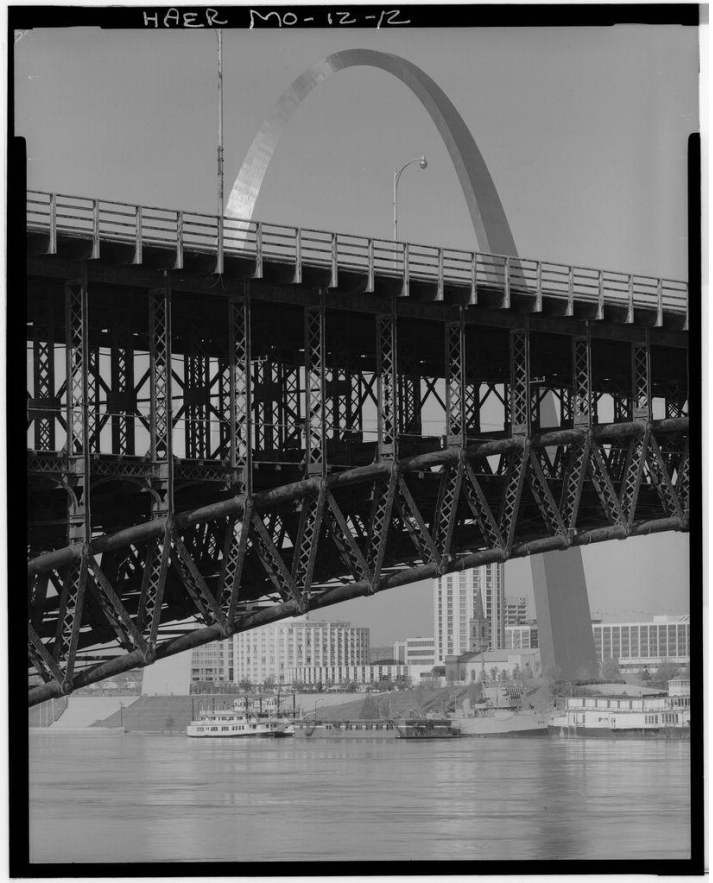
Truss Bridge

What do you know about this bridge?



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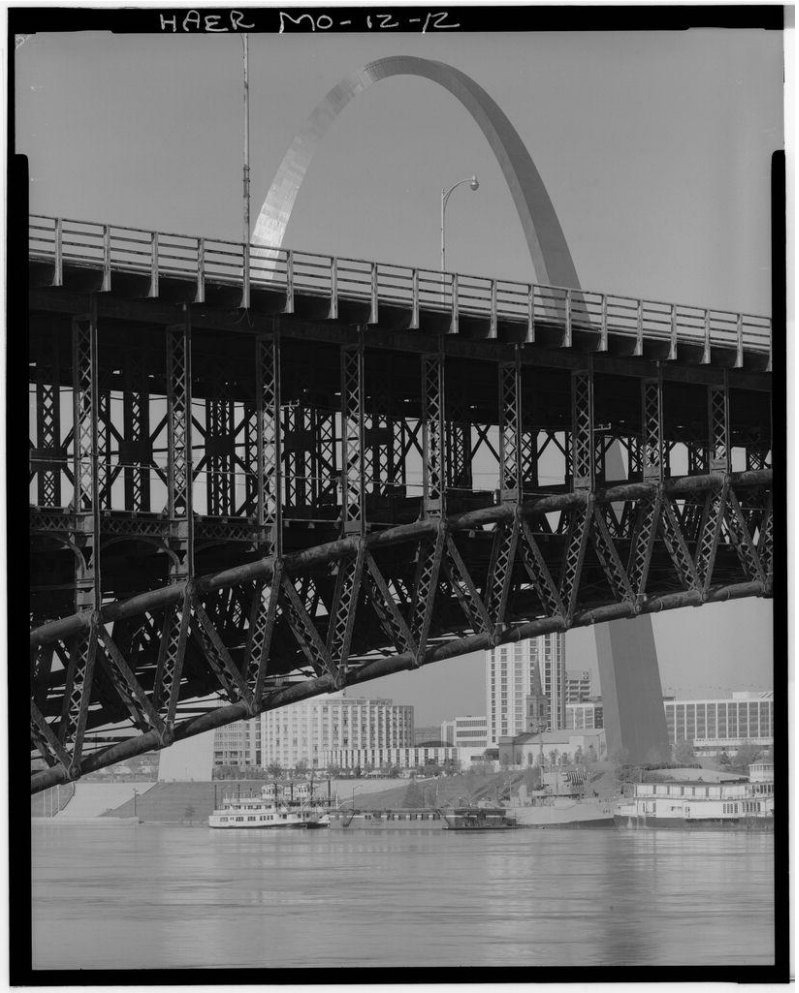
Eads Bridge
St. Louis, MO

Completed in 1874

American masterpiece



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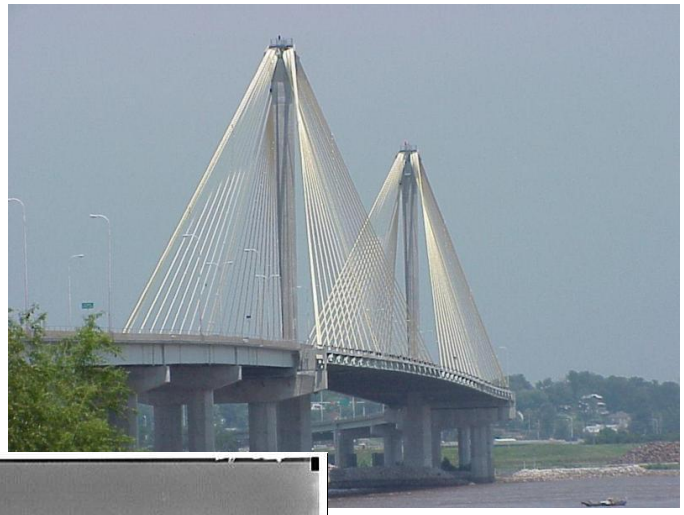
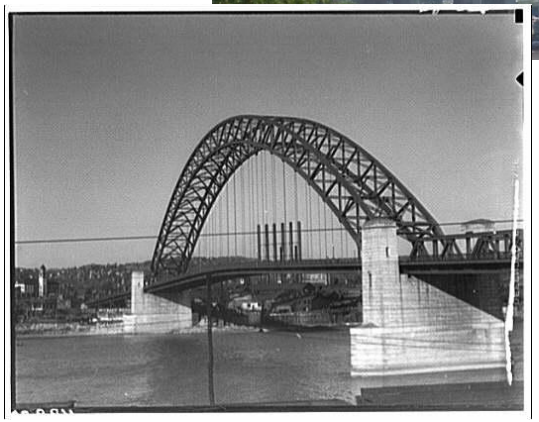
A quick review





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Covered Bridges

Makes use of local building supplies

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Covered Bridges

Interior truss makes it stronger than wood beam bridge

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Covered Bridges

Covering the timbers makes them last longer

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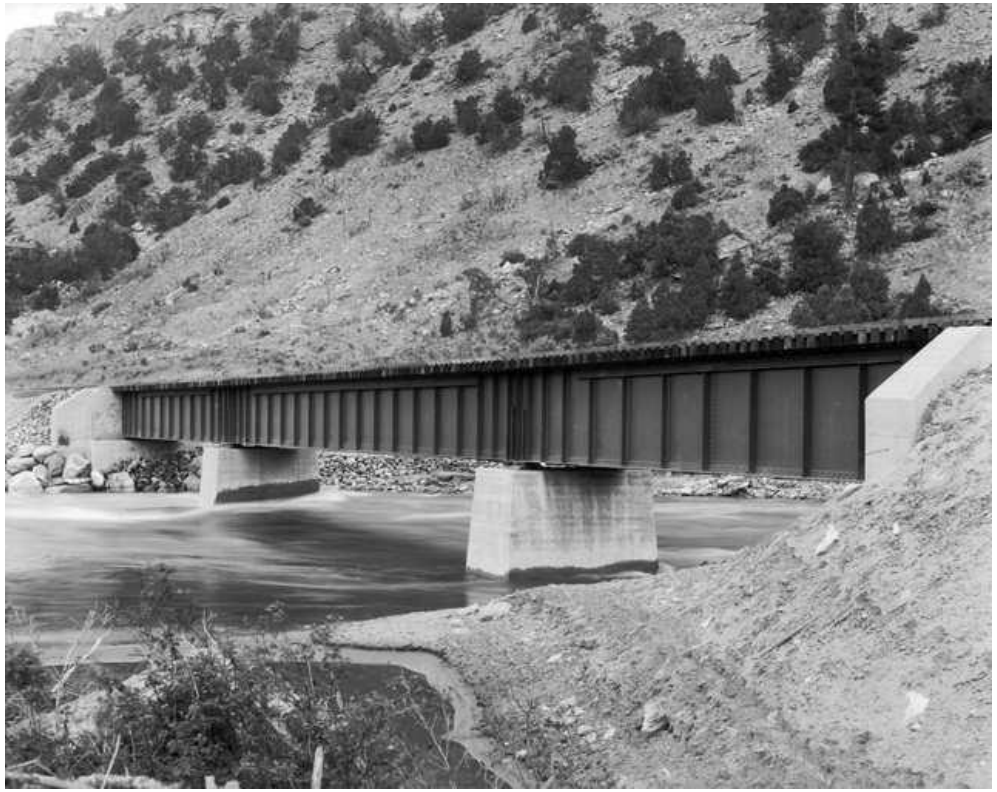
Beam Bridge

Easiest to build

Least expensive design



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Cable Stay Bridge

Less expensive to build than suspension bridges

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Cable Stay Bridges

Uses less material than suspension bridge

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Cable Stay Bridges

They look cool!

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Cable Stay Bridges

Requires the use of more modern materials

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Suspension Bridges

Longest unsupported spans

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Suspension Bridges

They look pretty cool too!

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Arched Bridges

Strong

Durable

Ancient/low tech building materials

Labor intensive

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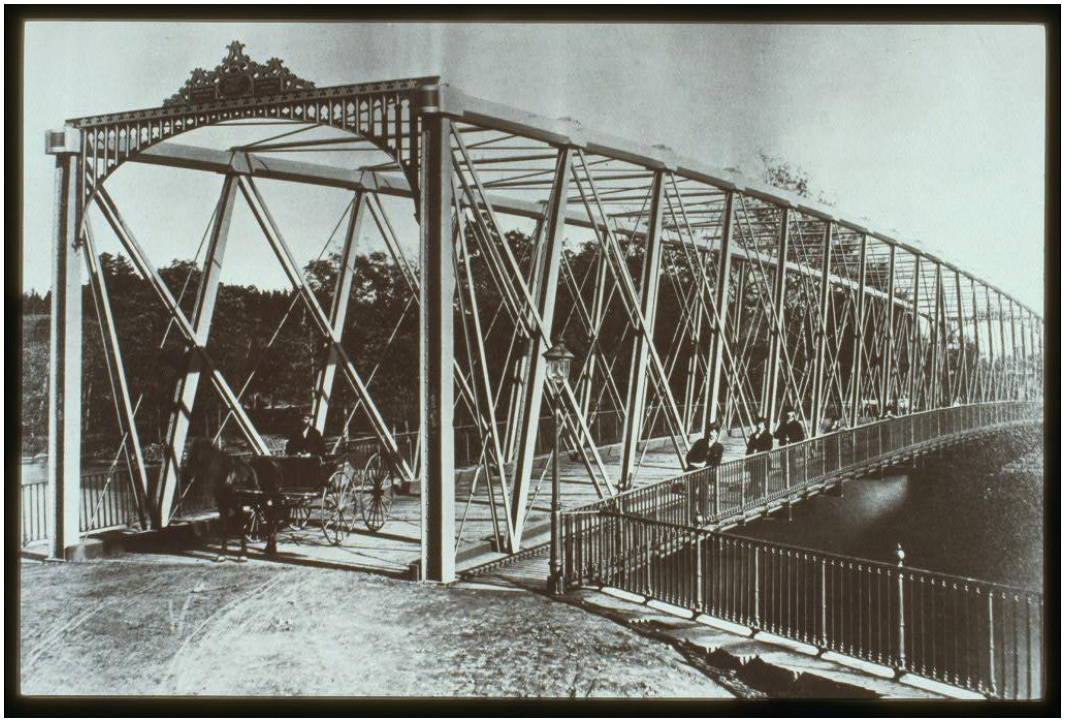
Truss Bridge

Stronger than beam bridge

Think Vectors!



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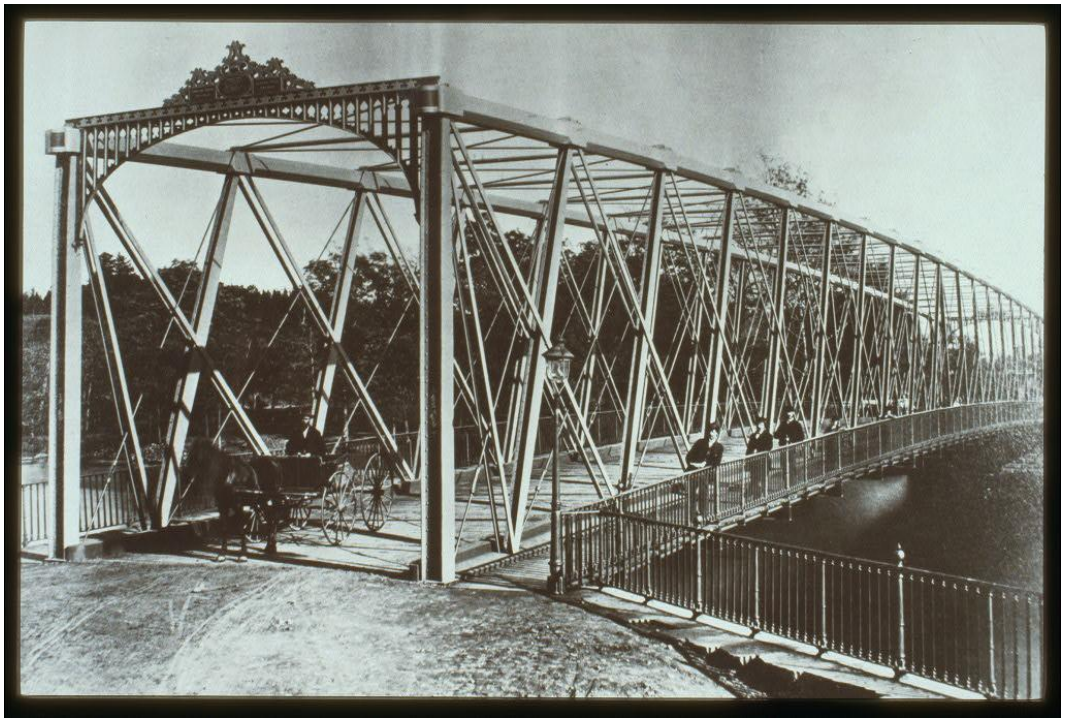
Truss Bridge

Can bridge longer unsupported spans than a beam bridge



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Lifting Bridge

Blocks trafic

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Lifting Bridge

Allows the passage of ships

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Lifting Bridge

Rather expensive

Subject to mechanical breakdown

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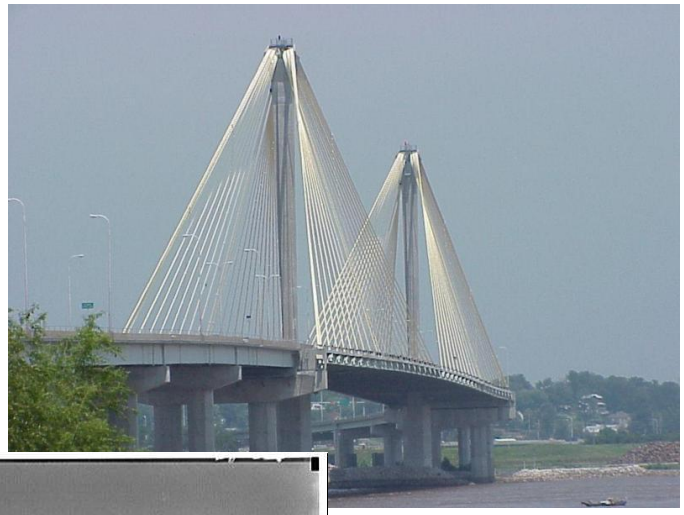
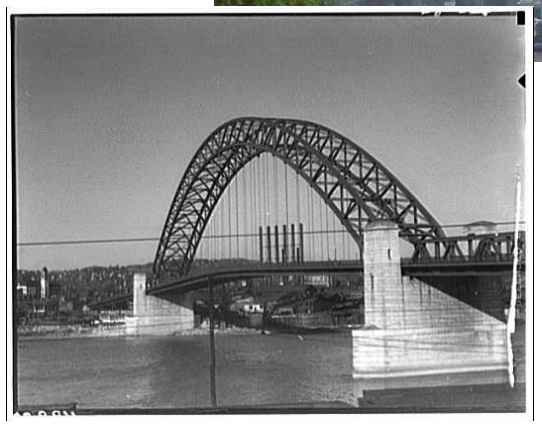
Many different bridges for many different jobs





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See these websites for more information on bridge design

http://www.howstuffworks.com/bridge.htm

http://www.pbs.org/wgbh/nova/bridge/

http://myron.sjsu.edu/romeweb/engineer/art2.htm

http://www.bardaglea.org.uk/bridges/welcome.html

http://education.sdsc.edu/enrich/downloadables/bridges.pdf

http://www.tfhrc.gov/pubrds/summer95/p95su23.htm

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Design Brief

What is a structure?

A structures is anything built out of a number of parts that work together and must resist forces such as gravity.

What is a bridge?

A structure that allows someone or something to pass over an obstacle.

The new school year is a river that you will cross. Your goal is to get safely to the other side. Design and create a bridge, using no more than 2 pieces of paper, which will take you safely across the year. On the bridge, write 3 person goals 5th grade. What do YOU want to accomplish or improve this year? The sky is the limit!

Challenge:

Design and create a bridge that can span 8 inches

List 3 appropriate personal goals for your 5th grade year

Your bridge must:

1. Be self supporting
2. Span a distance of at least 8 inches
3. Have 3 appropriate personal goals written on it

Materials:

2 pieces of white paper

tape, glue, brads

Tools:

scissors

ruler

Draw a picture of your design on the back BEFORE you build.

Evaluate:

My bridge

1. Is self supporting	Yes	No
2. Spans a distance of at least 8 inches	Yes	No
3. Has 3 appropriate personal goals written on it	Yes	No

What would you change about your bridge?

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Fifth grade design brief Name_____

Team mates _____, _____

Design a bridge

Background: We have been studying the different types of bridges, their strengths, and their weaknesses. We have looked at many types of bridges, including moving bridges. You have developed a scenario that describes a place where a new bridge is needed.

Challenge: You and your team are to design and build a model of a bridge that meets the needs of your scenario. The bridge must be a moving bridge using at least two components of the Hummingbird Robot kit.

Criteria:

Your bridge model must

- ❑ Fit the needs described in your scenario
- ❑ Move using at least two components of the hummingbird robot kit
- ❑ Span a minimum of 9 inches
- ❑ Hold at least 1 pound of live load (clay)

Materials:

Hummingbird robot kit-1 per team
Hot glue
Cardboard
Foam
Craft sticks, wood sticks, and dowels
Recycled and craft materials as available in the STEM lab/ classroom.

Tools:

Hot glue gun ruler writing/drawing instruments scissors
Saw drill
Other tools as available in the STEM lab/classroom

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5th grade Design Portfolio
Science SOL 5.1

Name _____

Challenge Title:

_____

Team members:

_____

_____

_____

1. Summarize the scenario whose needs your bridge will be designed to fill.

   _____

   _____

   _____

   _____

2. Brainstorm! On the back of this sheet, draw or describe possible solutions.

3. Create your favorite design.

4. Describe one problem you encountered and how you solved it.

   _____

   _____

   _____

   _____

   _____

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Name _____

5.<u>Test</u> your solution.

Does your bridge meet the needs described in the scenario? Yes No

How?

_____

_____

_____

_____

Does Your bridge span 9 inches? Yes No

Does your bridge support at least 1 pound? Yes No

Does your bridge move using at least 2 components of the hummingbird robot kit? Yes No

Describe how your bridge moves:

_____

_____

_____

_____

6.<u>Evaluate</u> your solution.

What would you do differently if you were building this bridge again? How would that make your bridge better?

_____

_____

_____

_____

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Bridge Investigation Worksheet
Beam Bridges

Look at the beam bridge images on posters, on-line and on the beam Bridges Information Sheet.

Answer the questions below using the resources listed above and any books, videos, or Powerpoints you have watched in class.

Over WHICH obstacles do you commonly find beam bridges? (Check as many as appropriate.) ❑ Roads/highways ❑ Canyons/valleys ❑ Creeks/streams ❑ Rivers ❑ Bays	HOW do beam bridges work? Draw a sketch of a beam bridge showing areas of compression and tension.
WHAT are 2 pros and cons of beam bridges? Pros (positive aspects of the bridge) 1._____ _____ 2._____ _____ Cons (negative aspects of the bridge) 1._____ _____ 2._____	WHY do architects and engineers build beam bridges? (Check as many as appropriate.) ❑ Easily span short distances ❑ Span long distances ❑ Sturdy ❑ Easy to build ❑ Engineering challenge ❑ Cost effective ❑ Allow large ships to pass underneath ❑ Appearance

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Name_____

Team mates _____, _____

Design a bridge scenario

Where is this bridge going to be built?
Over what obstacle must it pass?
Why is there a need for a bridge?
Who wants the bridge and why?
What do the people that want the bridge want to use it for?
Are there other buildings/ bridges nearby with which it needs to fit?
Who will use the bridge? Pedestrians? Bicycles? Cars? Trucks? Trains?
Who needs to go under the bridge?

There is a bridge needed in _____(City, town, state) to pass over _____.

The bridge has been requested by _____ because they need it to _____.

The bridge will be used by _____ and will cross from _____ to _____. It will go over _____.

Other factors to be considered in designing the bridge are:

_____

_____

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