# Understanding Bridge History: Weather Effect on Bridge Design

## Aligned Lesson
**Science Lesson 1 for Unit: Weather and Climate Overall Effect on Bridge Design.**

| Cristina Geisler  
Grades 11-12  
Physics | **About the author/teacher:**  
Science Teacher: Physics  
cgeisler@sd206.org  
Bloom Township District 206  
Chicago Heights, Illinois |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Related Unit:</strong> Bridges and Weather</td>
<td><strong>Lesson Length:</strong> 3-4 Class Period</td>
</tr>
</tbody>
</table>
| **NGSS Standards:** ESS2-1, ESS2-2  
**HS-ETS1-2.** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. | **Cross-Curricular Standards**  
SS.G.1.9-12: Use maps (created using geospatial and related technologies, if possible), satellite images, and photographs to display and explain the spatial patterns of physical, cultural, political, economic and environmental characteristics. |
### Framework Reference: ESS2.D.

**HS-ESS3-1 Earth and Human Activity**

Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

**Performance Expectation**

**Grade: High School (9-12)**

**HS-ESS3-4 Earth and Human Activity**

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

<table>
<thead>
<tr>
<th>Library of Congress Primary Sources</th>
<th>Materials/Supplies/Resources</th>
</tr>
</thead>
</table>
| ![Image of the burning of the Columbia-Wrightsville Bridge](http://lancasteronline.com/columbia/news/pictorial-history-of-columbia-s-six-bridges-connects-the-) | - Projector  
- Student access to computers and the internet  
- Poster, markers.  
- Primary Source Analysis Tool  

<table>
<thead>
<tr>
<th>CCSS.Math.Practice.MP4</th>
<th>Model with mathematics.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCSS.Math.Practice.MP3</td>
<td>Construct viable arguments and critique the reasoning of others.</td>
</tr>
<tr>
<td>CCSS.ELA-Literacy.WHST.11-12.2</td>
<td>Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</td>
</tr>
</tbody>
</table>
### Enduring Understandings
- History of bridges and their importance. (SS.G.1.9-12)
- A variety of hazards result from natural processes; humans cannot eliminate hazards but can reduce their impact. (ESS2-2)
- Structures can be designed to serve particular functions by taking into account properties of

### Essential Questions
- Why are bridges necessary?
- How bridges managed to influence our culture and improve the way we travel, do business and forge policies?
- How have bridge building techniques changed over time?

[https://www.loc.gov/resource/hhh.mo0361.photos?st=gallery](https://www.loc.gov/resource/hhh.mo0361.photos?st=gallery)
[https://cdn.loc.gov/master/pnp/habshaer/mo/mo0300/mo0361/data/mo0361data.pdf](https://cdn.loc.gov/master/pnp/habshaer/mo/mo0300/mo0361/data/mo0361data.pdf)
[https://www.loc.gov/search/?q=history+of+bridges+pictures&sp=2](https://www.loc.gov/search/?q=history+of+bridges+pictures&sp=2)
[https://www.loc.gov/resource/cph.3a46846/](https://www.loc.gov/resource/cph.3a46846/)
[https://www.loc.gov/item/today-in-history/june-12/](https://www.loc.gov/item/today-in-history/june-12/)
[https://www.nps.gov/glca/learn/historyculture/navajobridge.htm](https://www.nps.gov/glca/learn/historyculture/navajobridge.htm)

Additional teacher’s resources.

[https://www.youtube.com/watch?v=sUzZkuUg9ZY](https://www.youtube.com/watch?v=sUzZkuUg9ZY)
<table>
<thead>
<tr>
<th>different materials, and how materials can be shaped and used. (HS-ETS1-2)</th>
<th>How bridges constantly change, responding to weather patterns, different loads, and other types of stress in order to function?</th>
</tr>
</thead>
</table>

**Transfer Goals**

- Asking questions (for science)
- Obtaining, evaluating, and communicating information
- Constructing explanations (for science)
- Identifying Patterns and Causes/Effects to make future predictions

**Learning Objective**

- Students will be able to list three facts about the history of bridges. (Social Studies: SS.G.1.9-12, **CCSS.ELA-Literacy.WHST.11-12.2**)
- Students will be able to describe three of the social, economic and cultural impacts of bridges. (Social Studies: SS.G.1.9-12, **CCSS.ELA-Literacy.WHST.11-12.2**)
- Students will be able to connect changes of weather events to changes in bridge design. (HS-ETS1-2, ESS2-1, ESS2-2)
- Students will be able to write informative and technical texts about bridges structures.

**Engage:** How can I get students interested in this? (30 minutes-40 minutes)
Show the portion of the video on “Lighthouses and bridge” book lunch (watch from 31-50 minutes).


Individually, students are to use the above resources and answer the following questions in their science journal:

1. Give an example of a bridge that you have crossed while traveling. What is the purpose of the bridge?
2. The author mentioned that a 20% of the bridges across the nation have disappeared in the past five to ten years. What are some causes that made the bridges "disappear"? What are some effects?
3. The author discusses the "human element" in the design and construction of bridges. What is the author referring to? What are two bridges that he gives as examples?
4. What are some historical events mentioned by the author, that are commemorated by bridges? Give three examples.
5. What are some materials that are used for building bridges? (Give 4 examples).
6. What are the types of bridges that the author mentioned in his book? Give four examples.

Pause video as necessary to reinforce the concepts. Collect answers at the end of class.

**Explore:** What tasks/questions can I offer to help students puzzle through this?

To start, ask the following questions:

- How bridges managed to influence our culture and improve the way we travel, do business and forge policies?
- What weather related factors contribute to the replacement of some historical bridges?

Individually, students use internet resources in order to explore bridge history and reasons for why we build bridges.

**Differentiated Instruction:**

For students that need more structure with history of bridges use the following resources:
● Show https://www.loc.gov/search/?q=history+of+bridges+pictures&sp=2
● Additional Resources: https://www.youtube.com/watch?v=sUzZkuUg9ZY
● http://www.historyofbridges.com/

Example Questions:

Analyze the bridge pictures from the primary resources. What are some differences/ similarities about the bridges? (Give three examples).

Why are bridges necessary?

When bridges first begun to be used?

What were the first types of structure and resources used for building bridges?

How bridges managed to influence our culture and improve the way we travel, do business and forge policies?

Name three famous bridge designers?

What bridges are the most famous in the world and why?

When in history was the first “revolution in the bridge construction”?

For students that need more structure with the social, economic or cultural impact of bridges use the following example.

Burning of Bridges in the Civil War. Use Teacher resource to refer to the burning of the Columbia - Wrightsville Bridge


Example questions: How did the burning of Columbia - Wrightsville Bridge affected the Northern ground of Pennsylvania and the Confederate advancement? (Example answer: It was invaded by the South, but the burning of
the bridge kept the Confederate advancement from continuing because the Confederates had to take time to extinguish the fire).

Individually students research on factors that affect bridges. To help students with their research on weather related factors that affect bridges, use the following primary resources:

- As an example use [https://www.nps.gov/glca/learn/historyculture/navajobridge.htm](https://www.nps.gov/glca/learn/historyculture/navajobridge.htm) to show students that historical Navajo Bridge had to be replace after 66 years of usage due to weather and human impact.

- Example Question:
  - What do you see in the picture?
  - What are some differences/similarities about the bridges? Give three examples.
  - What are some facts about the Navajo Bridge?
  - What weather related factors contribute to the replacement of the Navajo bridge?
  - What weather related factors contribute to the replacement or design change of some other bridges?

**Explain:** How can I help students make sense of their observations?

- Have students work in pairs.
- Allow each pair 15 minutes to discuss their findings about bridge history and weather-related factors that affect bridges.
- Allow students the opportunity to argue and compare their claims with their classmate.
- **How has bridge building techniques changed over time**

**Extend/Elaborate:** How can my students apply their new knowledge to other situations? (one hour)
Students will work in pairs to design a poster on their findings about bridge history and weather-related factors that contribute to the replacement of some historical bridges.

The poster must include the following:

**History and facts about bridges. (three facts)**

Why are bridges necessary?
When bridges first begun to be used?
What were the first types of structure and resources used for building bridges?

**Facts about how Bridges influence our culture. (three facts)**

How bridges managed to influence our culture and improve the way we travel, do business and forge policies?
What are some of the most important bridges built in the world?

**Facts about weather patterns affecting bridge structure (three facts)**

**Evaluate:** How can I help my students self-evaluate and reflect on the learning?

- Check for understanding questions will be utilized during large group instruction. Students will be asked open-ended questions during small group and individualized instruction to check for understanding.
- Self-evaluate: Students will have multiple opportunities to self-evaluate their progress during the class discussions.
- Formative Assessments: The student discussion of the material is an important aspect of the learning. Be sure that all students participate. Listen to individual responses. Evaluate if the student can make sense of the information.
- Summative Assessment: Student will present their poster and answer questions about their findings. Rubric provided.

Differentiated instructions: Students can write a report on their findings. Add to the rubric:
Report – Spelling and punctuation

Paragraph form, well-written with proper sentence and grammatical form. Create a presentation in: PPT or Prezi.
See following rubric.
<table>
<thead>
<tr>
<th>History and facts about bridges</th>
<th>Distinguished:</th>
<th>Proficient:</th>
<th>Unsatisfactory:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why are bridges necessary?</td>
<td>All 3 facts about history of bridge are listed with clear examples and explanations. Some diagrams/pictorials are present.</td>
<td>Some facts and examples about history of bridges are present, no diagrams/pictorials are used.</td>
<td>Missing facts about bridge history, no examples or pictorials are present.</td>
</tr>
<tr>
<td>Facts about how Bridges influence our culture.</td>
<td>Clear three examples and facts on bridges' influence on society are present. Some diagrams/Pictorials are present.</td>
<td>Some facts about are presents. No diagrams or pictures are present.</td>
<td>Missing facts, and diagrams.</td>
</tr>
<tr>
<td>Facts about weather patterns affecting bridge structure.</td>
<td>Clear 3 examples of how weather patterns, loads and other types of stress affect bridge structure, are present. Diagrams/pictorials are used.</td>
<td>Some examples of how weather patterns, loads and other types of stress affect bridge structure, are present. Diagrams/pictorials are not used.</td>
<td>Examples of how weather patterns, loads and other types of stress affect bridge structure, are not present. Diagrams/pictorials are used.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>How bridges constantly change, responding to weather patterns, different loads, and other types of stress in order to function?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bibliography with wide selection of references from books, periodical and internet sites</th>
<th>All bibliography with wide selection of references from books, periodical and internet sites</th>
<th>Some bibliography with wide selection of references from books, periodical and internet sites</th>
<th>Bibliography with wide selection of references from books, periodical and internet sites is missing.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>/10</td>
</tr>
</tbody>
</table>