Build a Bridge

Background: All over the world, people have built bridges to connect one bit of land to another and make travel easier. Bridges have joined communities, allowed armies to invade, and helped towns to prosper. Some terrible disasters in human history have involved poorly designed bridges, such as the collapse of the Verrazano-Narrows Bridge and the unexpected movement of the London Millennium Footbridge also known as the Wobbly Bridge in London, England.

Design Challenge: Design and build a model bridge to span a river. Complete research about bridge building techniques and bridge styles using appropriate non-fiction books, encyclopedias, and Internet resources. Each partner should sketch at least one idea for your bridge. After sketching some ideas, choose one to build with your partner.

Criteria: Your bridge must

☐ be at least 12 inches long	☐ hold the weight for at least five minutes	☐ feature two elements of design
☐ support two pounds (or equivalent metric weight)	☐ be made with recycled materials	☐ have a way to get onto and off of the bridge.

Materials: Select from the list below.			**Tools:** Select from the list below.
• cardboard • cardboard tubes • construction paper • craft sticks	• egg cartons • glue • paper clips • pipe cleaners • poster board	• straws • Styrofoam • string (1 yard) • tape (1 foot) • toothpicks	• ruler • scissors • stopwatch • weight for testing

Targeted Standards of Learning: English 5.6
Supporting SOL: English 5.1, 5.3, 5.5, 5.9; Science 5.1

Targeted Standards for Technological Literacy: 18, 20
Supporting STL: 1, 9

Tips for Teachers

Targeted Standards of Learning:

English 5.6 The student will read and demonstrate comprehension of nonfiction texts.
a) Use text organizers, such as type, headings, and graphics, to predict and categorize information in both print and digital texts.
b) Use prior knowledge and build additional background knowledge as context for new learning.
c) Skim materials to develop a general overview of content and to locate specific information.
d) Identify the main idea of nonfiction texts.
e) Summarize supporting details in nonfiction texts.
f) Identify structural patterns found in nonfiction.
g) Locate information to support opinions, predictions, and conclusions.
h) Identify cause and effect relationships following transition words signaling the pattern.
i) Differentiate between fact and opinion.
j) Identify, compare, and contrast relationships.
k) Identify new information gained from reading.
l) Use reading strategies throughout the reading process to monitor comprehension.
m) Read with fluency and accuracy.

Supporting SOL: English 5.1, 5.3, 5.5, 5.9; Science 5.1

Targeted Standards for Technological Literacy:

18 Students will develop an understanding of and be able to select and use transportation technologies.

20 Students will develop an understanding of and be able to select and use construction technologies.

Supporting STL: 1, 9

Tips for Teachers, continued

Prior Knowledge & Skill	Materials & Preparation	Safety Issues	Class Management	Materials Provided	Design Process
• Some under-standing of the design process • Some background research and knowledge of bridges	• See Design Brief for recommended materials. Teachers may substitute materials. • Two-pound weight or metric equivalent • Reference materials on bridges	• Ensure cleanliness of found and recycled materials • Use of tools	• Works best in groups of two but no more than four	• Design Brief • Guided Portfolio (adapt as appropriate/ optional) • Rubric Assessments • KWL	Follow the Design Process: • Restate the problem. • Brainstorm solutions. • Create the best solution. • Test the solution. • Evaluate the solution.

Differentiation Option: For students with more advanced reading skills, the following page is provided as an alternative to page 1.

Build a Bridge

Background: All over the world, people have built bridges in order to connect one bit of land to another and make travel easier. Bridges have joined communities, allowed for armies to invade, and helped towns prosper. Some terrible disasters in human history have involved poorly designed bridges, such as the collapse of the Verrazano-Narrows Bridge and the unexpected movement of the London Millennium Footbridge also known as the Wobbly Bridge in London, England.

Design Challenge: You need to build a model bridge to span a river. First complete research about bridge building techniques and bridge styles using appropriate non-fiction books, encyclopedias, and Internet resources. Each partner should sketch at least one idea for your bridge. After sketching some ideas, choose one to build with your partner. Your bridge must be at least 12 inches long and support two pounds (or equivalent metric weight) for at least five minutes. It should be made with recycled materials and feature two elements of design. There must be a way to get onto and off the bridge.

Materials: Select from the list below.			**Tools:** Select from the list below.
• cardboard • cardboard tubes • construction paper • craft sticks	• egg cartons • glue • paper clips • pipe cleaners • poster board	• straws • Styrofoam • string (1 yard) • tape (1 foot) • toothpicks	• ruler • scissors • stopwatch • weight for testing

Targeted Standards of Learning: English 5.6

Supporting SOL: English 5.1, 5.2, 5.3, 5.5, 5.9; Science 5.1

Targeted Standards for Technological Literacy: 18, 20

Supporting STL: 1, 9

Guided Portfolio

Name _____

Group Members_____

1. **What is the problem?** State the problem in your own words.

_____

_____

_____

_____

_____

_____

_____

Name _____

2.   Research bridges, and describe each of the following types.

Beam bridge: _____

_____

Suspension bridge:_____

_____

Cantilever bridge:_____

_____

Arch bridge: _____

_____

Other notes about bridges: _____

_____

Name _____

3. **Brainstorm solutions.** Sketch and/or describe some possible solutions.

Guided Portfolio, p4

Name _____

4. Planning: Choose one of the ideas to build. Draw a final sketch of the bridge you plan to make. Make sure you label all the parts with materials you think you will use.

Guided Portfolio, p5

Name _____

5. Create the solution you think is best.

Keep notes about your problems and how you solve them. Make sketches if they help.

Name _____

6.   Test your solution.

Is your bridge at least 12 inches long?	YES	NO
Does your bridge support at least two pounds or the metric equivalent?	YES	NO
Does your bridge hold this weight for at least five minutes?	YES	NO
Is there a way to get onto and off of your bridge?	YES	NO
Does your project feature two elements of design?	YES	NO

Guided Portfolio, p7

Name _____

7. Evaluate your solution.

Was it the best solution? Would one of your other ideas have been better? Why, or why not?

_____

_____

_____

What would you have done differently?

_____

_____

_____
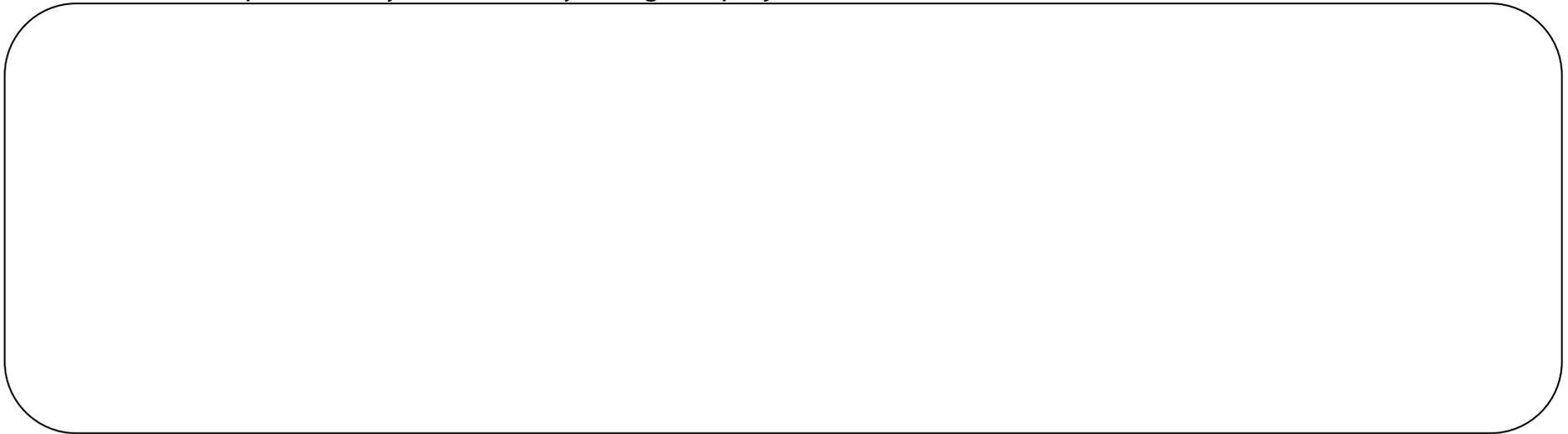
Could you add to it to make it better? What would you add to it?

_____

_____

Name _____

8. My Bridge

Draw a picture of your completed bridge, or take a digital picture of it, and include the picture in your portfolio.

Reflect and explain what you learned by doing this project.

_____

_____

_____

_____

Name _____

KWL: Build a Bridge

What we **K**now	What we **W**ant to know	What we **L**earned
	Sample Questions What are some different kinds of bridges? What materials are used to build bridges? What are the names of several famous bridges?	

Rubric for Build a Bridge

Name_____   Date _____

0—no evidence; 1—limited understanding; 2—some understanding with room for improvement; 3—good understanding with room for improvement; 4—substantial understanding

Design Brief Rubric	0	1	2	3	4
The student restated the problem in his/her own words.					
The student conducted research and recorded information.					
The student brainstormed more than one idea.					
The student drew a plan and labeled materials.					
The student kept notes and/or made sketches while creating a solution, to include problems and how they were solved.					
The student tested the model to make sure					
• it is at least 12 inches long					
• it supports at least two pounds (or metric equivalent) for at least five minutes					
• it has a way to get onto and off of your bridge					
• it features two elements of design.					
The student evaluated how he/she could make it better next time.					

Rubric for Build a Bridge

Name_____   Date _____

0—no evidence; 1—limited understanding; 2—some understanding with room for improvement; 3—good understanding with room for improvement; 4—substantial understanding

Communication: Speaking, Listening, Media Literacy Rubric	0	1	2	3	4
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 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.					
a) Maintain eye contact with listeners.					
b) Use gestures to support, accentuate, and dramatize verbal message.					
c) Use facial expressions to support and dramatize verbal message.					
d) Use posture appropriate for communication setting.					
e) Determine appropriate content for audience.					
f) Organize content sequentially around major ideas.					
g) Summarize main points as they relate to main idea or supporting details.					
h) Incorporate visual media to support the presentation.					
i) Use language and style appropriate to the audience, topic, and purpose.					

Standards of Learning

English (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.
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   d)   Use posture appropriate for communication setting.
   e)   Determine appropriate content for audience.
   f)   Organize content sequentially around major ideas.
   g)   Summarize main points as they relate to main idea or supporting details.
   h)   Incorporate visual media to support the presentation.
   i)   Use language and style appropriate to the audience, topic, and purpose.

5.3   The student will learn how media messages are constructed and for what purposes.
   a)   Differentiate between auditory, visual, and written media messages.
   b)   Identify the characteristics and effectiveness of a variety of media messages.

Reading

5.5   The student will read and demonstrate comprehension of fictional texts, narrative nonfiction, and poetry.
   a)   Describe the relationship between text and previously read materials.
   b)   Describe character development.
   c)   Describe the development of plot and explain the resolution of conflict(s).
   d)   Describe the characteristics of free verse, rhymed, and patterned poetry.
   e)   Describe how an author's choice of vocabulary contributes to the author's style.
   f)   Identify and ask questions that clarify various points of view.

g) Identify main idea.
h) Summarize supporting details from text.
i) Draw conclusions and make inferences from text.
j) Identify cause and effect relationships.
k) Make, confirm, or revise predictions.
l) Use reading strategies throughout the reading process to monitor comprehension.
m) Read with fluency and accuracy.

5.6   The student will read and demonstrate comprehension of nonfiction texts.
a) Use text organizers, such as type, headings, and graphics, to predict and categorize information in both print and digital texts.
b) Use prior knowledge and build additional background knowledge as context for new learning.
c) Skim materials to develop a general overview of content and to locate specific information.
d) Identify the main idea of nonfiction texts.
e) Summarize supporting details in nonfiction texts.
f) Identify structural patterns found in nonfiction.
g) Locate information to support opinions, predictions, and conclusions.
h) Identify cause and effect relationships following transition words signaling the pattern.
i) Differentiate between fact and opinion.
j) Identify, compare, and contrast relationships.
k) Identify new information gained from reading.
l) Use reading strategies throughout the reading process to monitor comprehension.
m) Read with fluency and accuracy.

Research
5.9   The student will find, evaluate, and select appropriate resources for a research product.
a) Construct questions about a topic.
b) Collect information from multiple resources including online, print, and media.
c) Use technology as a tool to research, organize, evaluate, and communicate information.
d) Organize information presented on charts, maps, and graphs.
e) Develop notes that include important concepts, summaries, and identification of information sources.
f) Give credit to sources used in research.
g) Define the meaning and consequences of plagiarism.

Science (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
   a) items such as rocks, minerals, and organisms are identified using various classification keys;
   b) estimates are made and accurate measurements of length, mass, volume, and temperature are made in metric units using proper tools;
   c) estimates are made and accurate measurements of elapsed time are made using proper tools;
   d) hypotheses are formed from testable questions;
   e) independent and dependent variables are identified;
   f) constants in an experimental situation are identified;
   g) data are collected, recorded, analyzed, and communicated using proper graphical representations and metric measurements;
   h) predictions are made using patterns from data collected, and simple graphical data are generated;
   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.

Standards for Technological Literacy

Standard 1:   Students will develop an understanding of the characteristics and scope of technology.

Standard 9:   Students will develop an understanding of engineering design.

Standard 18:   Students will develop an understanding of and be able to select and use transportation technologies.

Standard 20:   Students will develop an understanding of and be able to select and use construction technologies.

Please give us some feedback.

Complete the form below to let us know how this design brief worked for you and your students. Please be specific so that we might use your suggestions to improve the activity. *You can fill this out on your computer, or you can print it, fill it out manually, and scan it.*

Teacher: _____

School: _____

School division: _____

Design brief title: _____

Background *Put an X in the appropriate column:*	Needs to be rewritten	Needs minor adjustment	Is ready for classroom use
Does it set the context for the activity?			
Is it age-appropriate in language, length, and complexity?			
Does it reference prior learning and/or research that the students did that will facilitate designing a solution to a problem?			
Is it detailed enough that an adult will understand the purpose for the design brief?			
COMMENTS. *If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.*			

Design Challenge	Needs to be rewritten	Needs minor adjustment	Is ready for classroom use
Does the challenge support your curriculum?			
Is it age-appropriate in language, length, and complexity?			
Is it detailed enough that an adult will understand the purpose for the design brief?			
COMMENTS. *If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.*			

Criteria Criteria are part of the challenge. They set the limitations for the design. They are not directions.	Needs to be rewritten	Needs minor adjustment	Is ready for classroom use	N/A
Are the limitations age-appropriate?				
Do the limitations encourage critical thinking?				
Is the application of mathematic knowledge/skills integrated into the criteria? If not, should the skill area be addressed?				
Is the application of science knowledge/skills integrated into the criteria? If not, should the skill area be addressed?				
Is the application of social studies knowledge/skills integrated into the criteria? If not, should the skill area be addressed?				
Are language skills integrated into the criteria? If not, should the skill area be addressed?				
COMMENTS. *If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.*				

Materials Materials help set the limitations for the design. The list should include materials that might work.	Needs to be rewritten	Needs minor adjustment	Is ready for classroom use	N/A
Does the materials list encourage a variety of design solutions?				
Does the materials list include a variety of choices for joining items?				
Does the materials list include materials that force students to make decisions?				
COMMENTS. *If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.*				

Tools Tools can be used in the construction of the designed product. They are used to manipulate materials. They cannot become part of the product.	Needs to be rewritten	Needs minor adjustment	Is ready for classroom use
Are the tools listed age appropriate?			
Are all tools needed for the activity included?			
COMMENTS. *If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.*			

Standards of Learning	Yes	No
Does the design brief reinforce the targeted Standard of Learning(s)?		
Are the supporting Standards of Learning appropriate?		
What Standards of Learning would you add or remove?		

Standards for Technological Literacy	Yes	No
Does the design brief reinforce the targeted Standard(s) for Technological Literacy?		
Are the supporting Standards for Technological Literacy appropriate?		
What Standards for Technological Literacy would you add or remove?		

Tips for Teachers	Yes	No
Are the tips listed in the chart helpful for a first-time teacher?		
What tips would you add?		

Guided Portfolio	Needs to be rewritten	Needs minor adjustment	Is ready for classroom use
Are the instructions and questions age appropriate and clear?			
In the "Test your solution" section, do the questions force students to thoroughly test their solutions?			
In the "Evaluate your solution" section, do the questions force students to honestly evaluate their solutions			
COMMENTS. *If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.*			

Additional Comments
Please use this area to provide general suggestions for improving this design brief.