

Transformation 2013

Design Challenge

Planning Form

Design Challenge Title: Bridge Challenge

Teacher(s): Vincent Wrencher

School: Manor New Tech High

Subject: Engineering Principles

Abstract: Small Town has hired the class to research, develop and build a bridge that meets their expectations. Student teams will present proposals for the bridges with pros/cons of the bridge type and their engineering recommendation for which bridge to build. The class will be divided into three groups: Beam Team, Suspension Team and Arch Team. Each team will research and present their bridge type and build a model.

MEETING THE NEEDS
OF STEM EDUCATION
THROUGH DESIGN CHALLENGES

Begin with the End in Mind

- Does this design challenge meet the criteria for STEM student needs (21st century skills, TEKS, TAKS)?

Summarize the theme or “big ideas” for this design challenge.

The student will work in three teams to research, design and build bridges that will meet the requirements of the Small Town community. After building the model and presenting their proposal, the student will be able to:

- Understand the engineering involved with the selection and design of a bridge design.
- Estimate the cost each type of bridge will require for completion
- The Pro’s and Con’s of each bridge
- Apply the mathematical and scientific principle we have learn to build the model

Identify the TEKS/SEs that students will learn in the design challenge (two or three).

- Engineering Principles: Students gain knowledge and skills in the application, design, production, and assessment of products, services, and systems.
- (15) The student applies his/her communication, mathematics, and science knowledge and skills to engineering activities. The student is expected to:
 - (A) use written, verbal, and visual communication techniques consistent with industry standards;
 - (B) locate relevant information needed to solve problems;
 - (C) use mathematics concepts to solve engineering problems;
 - (D) identify and apply science principles used to solve problems; and
 - (E) use the appropriate units of measure.

Identify key skills students will develop in this design challenge.

- Build a Scale-down model of a Bridge Proposal
- Teamwork
- Presentation skills
- Product Testing

Identify the 21st century skills that students will practice in this design challenge (one or two).
www.21stcenturyskills.org

- Communication
- Collaboration
- Critical Thinking and Problem Solving

Identify STEM outcomes to be included in this design challenge.

- Critical Thinking
- Problem solving
- Creativity
- Communication
- Collaboration
- Media Literacy

Craft the Driving Question

State the essential question or problem statement for the design challenge. The statement should encompass all design challenge content and outcomes, and provide a central focus for student inquiry.

In the past decade Small Town, Texas has double its population and its community leaders have decided that Small Town, Texas needs a new bridge across Small Town River. The river is 900 feet at the point the community identified. This bridge must be able to support two-way car traffic.

Small Town has hired the class to research, develop and build a bridge that meets their expectation. Student teams will present three proposals for a bridge with pro/con of the bridge, and the engineering recommendation for the bridge.

The class will be divided into three groups: Beam Team, Suspension Team and Arch Team. Each team will research and present their bridge type and build a model. The models will be based on a 30 centimeter clearance. Each model will be weight tested to a minimum 3 Kilograms. After presenting the three proposals, the team will decide on one type is the best choice for a bridge for Small Town which will be New Tech High engineering recommendation for the bridge.

Final the Assessment

STEP 1: Define the products and artifacts for the design challenge.

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Early in the challenge:

- Select from the three types of bridges
- Research the Pros/Cons, cost to build the bridge and materials
- Research possible model construction
- Brainstorm and research on how to build a model
- Gather materials for the presentation and model

During the challenge:

- Build the Model
- Prepare the presentation
- Write the proposal
- Decide as a group (all three teams) which of the bridge is best for Small Town, Texas

End of the challenge:

- Present the model
- Present the proposal
- Celebrate

STEP 2: State the criteria for exemplary performance for each product.

- *Do the products and criteria align with the standards and outcomes for the design challenge?*

Product: Model

Criteria: Student will create a grading rubric on an Exemplary-Quality Bridge Model. The rubric must include some reference to weight testing, design and craftsmanship

Product: Proposal

Criteria: Student will create a grading rubric on an Exemplary-Quality Proposal. The rubric must include some reference to cost to Build Estimate, Load Estimate and Time Estimate

Product: Presentation

Criteria:

- Organization
- Subject Knowledge
- Visual (the Model and the Poster board Layout)
- Mechanics
- Delivery

Product: Teamwork

Criteria:

Contribute

- Punctual
- Research & Gather Info

Take Responsibility

- In the planning and building of the model
- In the planning and building of proposal

Value Others' Viewpoint

- Listen to other teammates

Map the Design Challenge

Look at the major product for the design challenge and analyze the tasks necessary

to produce a high-quality product. What do students need to know and be able to do to complete the tasks successfully? How and when will they learn the necessary knowledge and skills?

Product: Bridge Proposal		(check appropriate)		
Knowledge and Skills Needed <i>Elaborate on the knowledge and skills (TEKS student expectations) required to accomplish each step of the task.</i>		Already Learned	before the project	during the project
1.	Teamwork/Collaboration			X
2.	Problem Solving			X
3.	Analyze, review, evaluate and make decision based on scientific data and/or processes			X
4.	Assembly Skills w/ creativity			X
5.	Communication Skills			X
6.	Computer Skills (PowerPoint)			X
7.	Media Research			X
8.	Proposal Writing			X
9.	Load Testing			X
10.	Brainstorming			X

What PBL tools will you use? (check appropriate box)

- | | |
|--|--------------------------------|
| <input type="checkbox"/> Know/need to know lists | <input type="checkbox"/> _____ |
| <input type="checkbox"/> Daily goal sheets | <input type="checkbox"/> _____ |
| <input type="checkbox"/> Journals | <input type="checkbox"/> _____ |
| <input type="checkbox"/> Briefs | <input type="checkbox"/> _____ |
| <input type="checkbox"/> Task lists | <input type="checkbox"/> _____ |
| <input type="checkbox"/> Problem logs | <input type="checkbox"/> _____ |
| <input type="checkbox"/> Project flow charts | <input type="checkbox"/> _____ |

Title: Bridge Challenge	
TEKS: Engineering Principles: 15ABCDE	
<p style="text-align: center;">Engage Activity (Time: 40 minutes)</p>	<ul style="list-style-type: none"> • Start the lesson by watching a video Understanding Bridges • Do we cross any of these bridges in Austin? • Which is most common bridge we have in Austin? • Why is it so common? • Do we have any family member who are or have built a bridge? • Was it easy or hard? • Why do we need bridges? <p>Introduce design challenge to the students:</p> <p>In the past decade Small Town, Texas has double its population and its community leaders have decided that Small Town, Texas needs a new bridge across Small Town River. The river is 900 feet at the point the community identified. This bridge must be able to support two-way car traffic.</p> <p>Small Town has hired the class to research, develop and build a bridge that meets their expectations. Student teams will present three proposals for a bridge with pros/cons of the bridge, and the engineering recommendation for the bridge.</p> <p>The class will be divided into three groups: Beam Team, Suspension Team and Arch Team. Each team will research and present their bridge type and build a model. The models will be based on a 30 centimeter clearance. Each model will be weight tested to a minimum 3 Kilograms. After presenting the three proposals, the team will decide on one type is the best choice for a bridge for Small Town which will be supported by the class engineering recommendation for the bridge.</p>

<p>Exploration Activity (Time: 20 Minutes)</p>	<ul style="list-style-type: none"> • Divide the class into groups of three • Give student twenty minutes to bring back to the class research on bridges and bridge constructions; provide resources including books, magazines and internet access
<p>Explanation (Time: 20 Minutes)</p>	<ul style="list-style-type: none"> • Each group present their research on the bridges • Each group discusses what they know about bridge construction or who they know in the bridge construction industry
<p>Elaboration (Time: 3 days)</p>	<ul style="list-style-type: none"> • What problems will we face if wanted to build a bridge? Students research the Pros/Cons of suspension, beam and arch support bridges, including cost to build the bridge and materials • How would you load test a bridge? • What resources are needed? • How long will it take? • Are there bridges being built in your community? • Is so, what have you observed about these bridges? • Assess what the student have learn • Clarify any concern and confusion • Review the design challenge expectations • Select from the three types of bridges • Research possible model construction • Brainstorm and research on how to build a model • Gather materials for the presentation and model • Build model in students teams, one bridge type per team • Prepare the presentation • Write the proposal
<p>Evaluation (Time: 2 days)</p>	<ul style="list-style-type: none"> • Present the models • Present the proposals • Decide as a group (all three teams) which of the bridge is best for Small Town, Texas Decide as a group (all three teams) which of the bridge is best for Small Town, Texas • Celebrate
<p>Materials/Equipment: Internet Access, construction materials as determined by students (toothpicks, craft sticks, wood glue, etc)</p>	
<p>Resources: http://en.wikipedia.org/wiki/Bridge</p>	

Internet webquest: <http://volweb.utk.edu/Schools/bedford/harrisms/teabridge.htm>
<http://library.thinkquest.org/J002223/types/types.html>