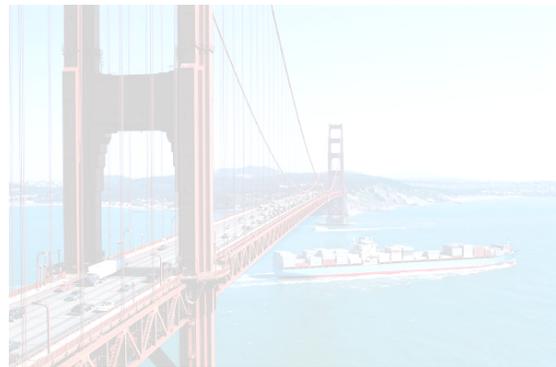


# Construction Systems

A Bridge Activity

# Problem Solving Workbook



**Team Members:** \_\_\_\_\_

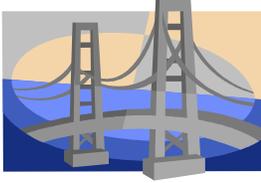
**Period:** \_\_\_\_\_

**Evaluation:**      /200

**Objective:**

To research, design, engineer, construct and test a model vehicle.

**Quote:** Dr. Seuss “Think left and think right and think low and think high oh, the thinks you can think up if only you try”



# Bridges



**Length of Lesson:** 6 class periods (introduction & construction)

**Testing:** 1 class period

**Objectives:** Students will understand the following:

1. The seven different types of bridges.
2. The principles for using each type of bridge.
3. How to design and construct a bridge to fit certain criteria.

**Instructions:**

You and a partner will design and construct a bridge using the criteria and procedures listed below. This group activity is designed to teach you how to use design as a problem-solving tool. The material provided in this PSW will greatly benefit your project, read through it carefully. The web sites at the end of this page will provide you and your partner additional information; use extra time in class to view the websites.

**Materials:** Balsa wood (192" total)  
 Glue  
 Construction board  
 Wax paper  
 Pins  
 Balsa cutter

**Procedures:**

1. Complete the West Point Bridge Building worksheet
2. Complete the questions in the PSW on page 5.
3. Start design work on your bridge, using the graph paper handed out with you PSW. Remember to keep your design within the measurements listed.
4. Layout your design on your construction board placing the wax paper on top. Secure the design and wax paper with pins.
5. Start work on your superstructure sides first. Measure the material to be cut and use the balsa cutters for cutting the material.
  - a. Max Length: 14" Min Length: 10"
  - b. Max Width: 2 1/2" Min Width: Go-No-Go must fit inside your bridge.
6. Begin combining your cut material on the wax paper over your design. Remember to use the pins to secure the material so it will not move while constructing your bridge.
7. Start construction on your roadway and connecting supports. Be sure to use the Go-No-Go gauge before cutting the roadway width.
8. Finally prepare your bridge for testing. Make sure all you glue joints are secure and all dimensions are within the criteria.

**Web Links:**

West Point Bridge Designer

This is a website that offers a great program for interactive bridge design and testing. The site also includes a cost analyses of each bridge designed.

<http://bridgecontest.usma.edu/overview.htm>

How Bridges Work (Webpage 1 of 7) by M. Morrissey at *How Stuff Works*

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

This website looks at the three major types of bridges so that you can understand how each one works. The type of bridge used depends on various features of the obstacle.

ABCD's Bridge Design Tips for Kids

<http://www.abcdpittsburgh.org/kids/kids.htm>

So, you've been given a project to design and construct a bridge that will hold the most weight for a given span. Now you are probably wondering where to start.

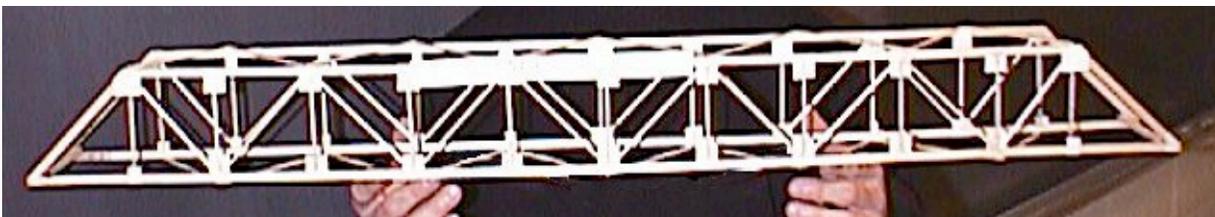
What type of bridge is the strongest?

PBS "Build a Bridge"

This website shows different types of bridges and links that provide more insight to bridges. You will want to check out the "Build a Bridge" link and play the game located at the bottom of the page. Shockwave is required to play. Play the game to figure out which type of bridge is used for different purposes. Click the shockwave version to download it.

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

**Example bridge:** This bridge is not built to our criteria.



# BRIDGE RESEARCH

## Questions:

Answer these with the information from class discussions, the information in this PSW and the information found on the websites provided in the PSW.

1. Suppose all the bridges in a large city (New York City, for example) were closed. What effect would that have on that city? What are some specific ways that people would adapt to not using bridges?
2. Describe where tension and compression occur on a bridge.
3. Many bridges are icons for their city or region. Why do you think people associate certain bridges with certain cities, while other bridges seem unremarkable?
4. What are the differences between a beam bridge and an arch bridge? List at least three ways they are similar and three ways they are different.
5. List 4 famous bridges and the year they were built in the United States.
  - a.
  - b.
  - c.
  - d.
6. What type of bridge would you use to cross a canyon?
7. What type of bridge would you use to cross a river?
8. What type of bridge would you use to cross over a road?

Date: \_\_\_\_\_

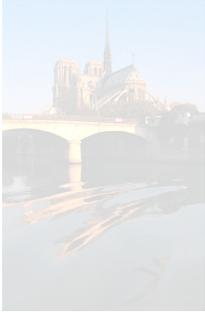
Day: \_\_\_\_\_

List the six types of bridges.

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Choose 3 different bridge types and write them in sections 1, 2 and 3. Research the 3 bridge types and find 2 of the most popular and write their names and location in sections A and B. For 'C' list the world's longest spanning bridge of that type.

1.
  - a.
  - b.
  - c.
    - i. length in feet: \_\_\_\_\_ length in meters: \_\_\_\_\_
2.
  - a.
  - b.
  - c.
    - i. length in feet: \_\_\_\_\_ length in meters: \_\_\_\_\_
3.
  - a.
  - b.
  - c.
    - i. length in feet: \_\_\_\_\_ length in meters: \_\_\_\_\_



# West Point Bridge Designing

West Point  
Bridge Designing



Name: \_\_\_\_\_

Period: \_\_\_\_\_

**Instructions:**

Using West Point Bridge Building software design bridges that meet the criteria listed below the instructions. You are required to design **3** bridges while constructing your bridge to be tested. Below you find 3 different sets of criteria for designing your bridge, along with the criteria is a place to record the cost for your design. Once you have met the criteria fill in your costs and ask your instructor to come over and verify your cost. **Subtract the site cost from the total cost and write in your material cost.** Once you have completed the bridge designs you can then figure out your grade.

**Bridge 1;**

Elevation: 24 meters  
 Arch Height: 20 meters  
 Template: Howe  
 Maximum Cost: \$225,000.00

Total Cost: \_\_\_\_\_  
 - Site Cost: \_\_\_\_\_  
 Material Cost: \_\_\_\_\_

**Bridge 2;**

Elevation: 16 meters  
 Standard Abutments  
 Pier: (two spans)  
 Height of Pier: 8 meters  
 Template: Continues deck truss  
**(last one selection)**  
 Maximum Cost: \$190,000.00

Total Cost: \_\_\_\_\_  
 - Site Cost: \_\_\_\_\_  
 Material Cost: \_\_\_\_\_

**Bridge 3;**

Elevation: 24 meters  
 Standard Abutments  
 No Pier: (one Span)  
 Template: Pratt through truss  
 Maximum Cost: \$250,000.00

Total Cost: \_\_\_\_\_  
 - Site Cost: \_\_\_\_\_  
 Material Cost: \_\_\_\_\_

**Evaluation:**

Add the total costs from all three bridges and subtract the maximum cost allowed from your total, write the difference in the space next to the grade scale. If your total is less than the total allowed than you automatic score 55 points. If your total is equal to or greater than the maximum total then see the score table below for your score on this assignment. Good luck and have fun!

<u>Grade</u>	<u>\$ Total Over</u>	<u>Grade</u>	<u>\$ Total Over</u>
50 --- A+	0	34 --- D+	7,500
49 --- A	500	33 --- D	8,000
48 --- A	1,000	32 --- D	8,500
47 --- A	1,500	31 --- D	9,000
46 --- A	2,000	30 --- D-	9,500
45 --- A-	2,500		
44 --- B+	3,000	29 --- F+	10,000
43 --- B	3,500		
42 --- B	4,000	28 --- F-	everything below
41 --- B	4,500		
40 --- B-	5,000		
39 --- C+	5,500		
38 --- C	6,000		
37 --- C	6,500		
36 --- C	7,000		

Your total cost: \_\_\_\_\_  
 - \$665,000.00: \_\_\_\_\_  
 Difference: \_\_\_\_\_

# How did Your Bridge Do?

## Instructions:

You will record information from the beginning of this project all the way through the end. Make sure you read through all the questions before you start construction. Unit purchase price is \$150,000. Use this price to calculate your total cost and waste material cost.

## Questions:

1. Record the number of units you buy, cross it off as you buy it.  
1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
2. Weight the one of the units you purchase and write it in the space below. Also write in the number of total units purchased.
  - a. Unit weight \_\_\_\_\_ g.
3. Write the total weight of all your waste material.
  - a. Waste material weight \_\_\_\_\_ g.
4. What is the weight of your finished bridge?
  - a. Bridge weight \_\_\_\_\_ g.
5. Number of side A rails \_\_\_\_\_
6. Number of side B rails \_\_\_\_\_
7. Number of roadway rails \_\_\_\_\_
8. What is the total cost to construct the bridge?      \$ \_\_\_\_\_
9. What is the cost of just the bridge?      \$ \_\_\_\_\_
10. What is the cost of just the waste material?      \$ \_\_\_\_\_

## Data Spreadsheet Creation: [Data Form](#)

Go to the data collection form at the link above and enter your information in the correct locations. After entering the information open the spreadsheet and see how your bridge compares to other bridges in your class and other classes.

Copy the information from the [spreadsheet](#) in columns E, H, I, J, K, and M for your bridge and 2 other bridges. Enter that data into the Comparison Spreadsheet to compare how your bridge did against other bridges. Link to [Comparison Spreadsheet](#)

# Daily Log

**Construction Technology**

**Developing a Bridge**

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**Day:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Daily Activities:**

Describe what your accomplishments were today, what did you do. Remember to detail **what worked** and **what did not work**. How did you improve your project and what did you learn. ***Include 1 "Input" in your description.***

**Daily Sketch:**

**Sketch** and **label** each part of any new construction completed on your project today. If no new construction was done then sketch your current project.

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**Construction Technology**

**Developing a Bridge**

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