

# Civil Engineering

## Building Bridges into Engineering

Subject Area: Civil engineering  
Date: August 1, 2012

Grade Levels: Middle school

### Lesson Overview

Students work in groups to design, draw, price, bid and build a two lane bridge across a 12” gap.

### Materials

- CalTrans Project slideshow and Video (<http://www.ecs.csus.edu/ce/about.html>)
- Materials pricing list
- Cost Analysis Worksheet
- Inspection Sheet
- Materials for sale: paper, toothpicks, popsicle sticks, glue, tape, rubber bands, thin gage wire, cardstock, wooden dowels...

### Skills the Students will Learn

Draw a design for a bridge  
Budget for materials  
Present a bid as a team  
Build a bridge  
Problem solving with a group

### Student Deliverables

Bridge Design Bid: Drawing of Bridge with Initial Cost Analysis  
Final Bridge with Final Cost Analysis  
Inspection Sheet  
Project Summary/Learning Reflection

### Length of Lesson: 6 Days

#### Activity Day One:

#### The Challenge

Objective: Students form groups and begin to design bridge drawing.

Activity: Students presented with Challenge and shown materials available. Teams begin to discuss possible designs and draw preliminary sketches.

Challenge: Two matchbox cars need to get from one table to another. There is a 12” gap between them. Your mission is to work as a small group to design and build a bridge to get the cars across the gap.

#### Preparing the Bid

Objective: Students evaluate the cost of the project and revise drawings.

Activity: Students begin to tally cost of materials used.

### Activity Day Two: Presenting the Bid

Objective: Students will prepare a proposal to present to class including total materials cost, time needed for building and detailed drawing of plan.

Activity: Groups present to the class their design proposal and cost of their project.

### Day Three: Building Phase

Objective: Groups follow a plan to build a bridge design.

Activity: Groups build the design that they made the bid for. They keep track of actual costs from materials used and make any modifications needed on plan.

### Activity Day Four: Final Inspections

Objectives: Groups inspect other bridges to make sure they are up to “code” on plans.

Activity: Each group is assigned to inspect another group’s bridge. They must check that the bridge meets the specifications of the plan.

### Prepare Final Presentation

Objective: Students present their final product to the class.

Activity: Students prepare a Poster presentation that includes their final bridge design, final costs, inspection results, triumphs, and difficulties of the project.

### Activity Day Five: Final Presentation

Activity: Students present their results

### Activity Day six: Information about Civil Engineers and Summary

Objective: Learn more about civil engineering and reflect on their experience.

Activity: Caltrans slideshow and Video of Emergency Ramp Replacement Project. Students summarize their learning about the processes they went through and compare it to civil engineers requirements.

## Enrichment Suggestions

- Civil Engineer Guest Speaker
- Have each have a stock of one supply. Each group has a different supply that they already have in stock. Groups can trade supplies to get extra materials. This will emphasize the networking skills needed with the building industry.

## Student Resources

Initial Cost Analysis Worksheet  
 Final Cost Analysis Worksheet  
 Inspection Sheet

## CTE Pathway Standards

### **Arts, Media, and Entertainment Industry Sector**

- 5.1 Apply appropriate problem-solving strategies and critical thinking skills to work-related issues and tasks.
- 5.3 Use critical thinking skills to make informed decisions and solve problems.
- 7.3 Understand the need to adapt to varied roles and responsibilities

### **Building Trades and Construction Industry Standards**

- B1.1 Identify design solutions to engineering and heavy construction problems.
- B1.2 Calculate the required materials, such as soils, aggregate, asphalt, concrete, and pipe, for engineering and heavy construction applications.
- B4.1 Know how to read, understand, and construct projects accurately from commercial specifications and blueprints, ensuring compliance with state and local building codes.
- B4.2 Understand how to estimate the cost of supplies and materials for an engineering and heavy construction project
- B6.1 Understand the development of building plans and schedules using processes common to engineering and heavy construction.

## Lesson Plan Relevance to Externship

I shadowed two civil engineers in the externship, each in the middle of a construction project. One person was working with a bridge expansion project and the other making a new dam for Folsom Dam. The civil engineers described the process they undergo from the beginning to end of any given project. The project takes students through an entire project as if they are civil engineers.

## Rubric for the Building Bridges into Engineering Project

Student Deliverables	1 Exceeds Expectations	2 Meets Expectations	3 Approaches Expectations	4 Fails to meet Expectations
Bridge Design Bid	Includes detailed plans with cost estimate that includes all expected materials. Can easily be build with few to no modifications.	Includes detailed plans with cost estimate that can be built. May need some modifications.	Includes a plan and includes some of the cost estimate. May need to make a lot of modifications to build, but uses similar structure.	Drawing does not have enough detail to be drawn from. No cost estimate.
Final Bridge	Final Bridge includes few modifications from original plan. The modifications included were necessary for the safety of the design. Final cost analysis includes all materials.	Final Bridge mostly follows the design. Final cost analysis includes most or all materials	Final bridge complete. Bridge resembles original design. Some cost analysis.	Bridge incomplete or no cost analysis.