

Concrete Product Design and Marketing

Grade Level 8 (7-10)

This unit is targeted for 8th grade technology class to correlate with the physical sciences curriculum taught in New York State. However, it could work for technology or pre-engineering classes for students in grades 7 through 10.

Summary

Students are provided with a real-world problem of selecting a suitable concrete mix for a client with a specific need. The students learn the basics of concrete mixtures and make a range of test samples including traditional mixes, concrete with solid waste as aggregate and porous concrete. They explore material properties, stresses and forces, and safety issues.

Using a weighted objectives table, students select the “best” mixture for their project and fabricate a sample. The students develop marketing information and strategies to persuade their client that their concrete product is most suitable for the given problem. The concrete applications include a sidewalk, a box retail store and a skate board park.



Figure 1: Students fabricate concrete samples for clients in real-world application of concrete material production and marketing.

Source: Clarkson University Office of Educational Partnerships

Unit Overview

This unit has three focuses: uses and properties of concrete, fabrication of samples to meet specific criteria, and product marketing. Students engage in numerous hands-on activities that demonstrate critical concepts and extend understandings. Although fully integrated and congruent, the three focuses can be adapted to be taught as separate strands or mini-units.

The Unit includes 13 basic lessons, each with background information for the instructor as well as suggested teaching schemes. Each lesson contains a number of associated activities, several of which are optional or interchangeable depending on specific classroom situations. The Unit is typically taught over 40-45 minute classroom periods. This timeframe can be adjusted depending on the specific goals of the particular class, and there are ample activities provided to extend the unit to a longer timeframe. Estimated teaching days are included in the outline of lessons and activities above. Note that the teaching days are based on including all activities listed in the lesson plan.

Unit Schedule

Day/ lesson #	Name	Importance:	Connectedness:
1/1	Introduction	Introduces topic and excites students, involves students in hands on exposure	Basis for concrete unit. All lessons are built from foundation.
2/1	Concrete Vocabulary	Introduces base of knowledge in vocabulary to be used throughout curriculum	Basis for concrete unit. All lessons are built from foundation.
3/2	Problem Solving	Introduce unit problem statement	Ties back to the concrete concepts discussed in the last class
4/2	Problem Solving - Activity	Hands-on activity to introduce students to problem solving spiral	Problem solving spiral is referenced throughout unit.
5/4	Material Properties	Understand characteristic properties of concrete – reinforce base knowledge for later analysis	Material properties will be used to select proper concrete for problem solving.
6/4	Types of Concrete	Establish concrete types; set up for scenarios	The types of concrete explored in lesson 1 are identified.
7/5	Making Concrete & Safety	Safe concrete practices enforced, tactile learning achieved in making process	Ties all concrete concepts and vocabulary together
8/6	Forces and Stresses- lecture	Introduces strength vocabulary, develops understanding of tension and compression	Knowledge of strength and stress allows for understanding the testing process
9/6-7	Forces and Stresses – brainstorm Foam Bridge Exp.	Brainstorming design of a bridge – increase level of thinking	Can use knowledge from lecture, Preparation for Foam Bridge Exp.
10/7	Forces and Stresses – Foam Bridge	Design is implemented in bridge	Design process will be used in the problem statement.
11/8-9	Concrete Testing – Infiltration rate	Knowledge of porous concrete instilled	Samples from Making Concrete are tested.
12/8-9	Graphing Data Activity	Problem-Based activity to increase level of thinking	Data will be used in selecting solution to problem scenario.
1/8-9	Testing Data Analysis	Strength of concrete is found, proper data representation is developed.	Concepts from forces and stresses are exemplified in testing results.
14/10	Weighted Objectives Table (superhero demo)	Prioritizing and evaluation skills developed	Basis for introducing problem scenarios
15/10	Weighted Objectives Table (Problem Intro)	Specific problem scenarios are introduced, supports analysis and evaluation of problem statements	Problem scenarios evaluated. Solution to scenario defined. Problem scenarios are the basis for the rest of the unit.
16/11	Making Samples – Part I	Tactile learning achieved in concrete making process	. Optimized solution implemented. Ties together the entire curriculum.
17/11	Making Samples – Part II	Tactile learning achieved in concrete making process	. Optimized solution constructed. Ties together the entire curriculum.
18/12	Marketing – Part I	Introduces marketing strategies – includes relevant/bigger picture	Solution to scenario will be emphasized.
19/12	Marketing – Part II	Reinforces computer and design skills	Solution to scenario will be emphasized .
20/13	Final Assessment	Evaluates student understanding of concepts	Ties together the concrete unit

Engineering Connection

In a broad sense, engineers solve problems, often through the design and construction of a prototype. In this concrete product design and marketing unit, students are modeling what engineers “do.” Engineering brings science and math to life, largely through applications toward problem solving. Students apply scientific concepts (forces, stress, compression) and mathematical tools (basic grade-level appropriate math skills - unit conversions, ratios, percentages and graphing) to analyze information and results in order to solve their problem. Students test two basic properties of concrete and use the test results in a logical, systematic manner to evaluate which concrete mixture is most suitable for the construction application they are assigned. The Concrete Product Design and Marketing Unit follows a widely accepted problem solving method that is based on a fundamental process used by practicing engineers (Figure 2). Students start by defining their problem, brainstorming and exploring potential solutions, test and evaluate their ideas, and ultimately choose the optimum solution. The final stage is communication of their results, a skill that is of ultimate importance to practicing engineers and scientists. Through every step of the problem solving process students are applying the math skills and science content that they are learning.

Subject Area(s)

Technology, Physical science

Keywords

General: Concrete, cement, construction materials, forces, stress, compression, engineering problem solving, porous concrete, aggregate, solid waste, prototype (additional specific key words are included with each lesson plan)

Educational Standards

New York Integrated Math, Science, and Technology Standards:

2.1, 2.2, 3.1, 3.2, 3.3, 3.4,
3.5, 3.6, 5.2, 5.3, 5.5, 6.6,
7.1, 7.2

US Math: 4.1, 4.2, 5.1, 5.2, 5.3

US Technology: 2.2, 3.3

US Science: 1.1, 1.2, 2.2

Related Lessons & Activities

1. Introduction
2. Concrete Vocabulary
3. Problem Solving
4. Material Properties
5. Types of Concrete

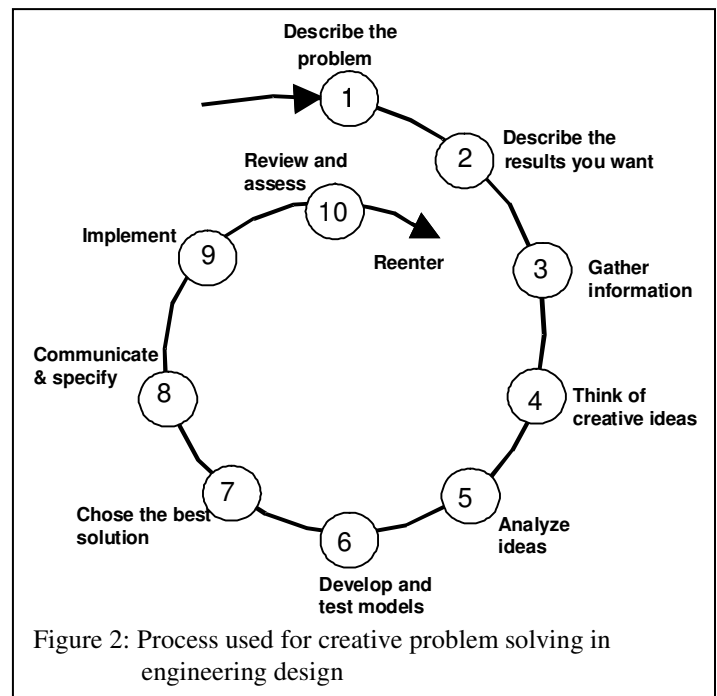


Figure 2: Process used for creative problem solving in engineering design

6. Making Concrete & Safety
7. Forces and Stresses
8. Concrete Testing – Infiltration rate and graphing
9. Testing Data Analysis
10. Weighted Objectives Table - Problem Scenario Introduction
11. Marking Samples
12. Marketing
13. Final Assessment

Time Required : twenty forty-five minute lessons (15 hours)

Summary Assessment

Formative assessment is provided through worksheets and homework assignments. A paper and pencil final exam and the final project that includes a product evaluation document provide summative assessment. Details for the assessment are provided within each lesson plan and at the end of the Unit Plan..

URL

The complete lesson plans and activities are included as pdf files from the web site:
<http://www.clarkson.edu/highschool/k12/project/concretedesign.html>

This website is also included through the Engineering Pathways database (key word: concrete)
<http://www.engineeringpathway.com/ep/index.jhtml>

Owner

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Contributors

Diane Brouwer, Mary Margaret Small, Sarah French, Narayanan Neithalath, Susan Powers and several other students involved in Clarkson University's K-12 Project-Based Learning Partnership Program.

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