

TEACHER QUEST TAMPA BAY PROGRAM

ACTION PLAN

Author: Stephanie M. Frost

Lesson Title: Dikes as a Method of Water Retention

Grade Level: 7, 8

Subject Area: Science

Date: 07/07/2010

Summer Work Experience

I was hired at Coastal Caisson Corporation as a Project Cost Estimator. Essentially, my function has been to assist Project Engineers and incumbent Project Cost Estimators in determining expenses associated with upcoming deep foundation construction projects and (more recently) to help facilitate the placement of engineering student interns into an ongoing summer program with Coastal Caisson. Coastal Caisson is a construction firm which specializes in deep foundation techniques, primarily for large-scale projects. My initiation into the field of deep foundation construction involved a significant amount of research and use of company resources to introduce me to the different construction methods that the firm offers. Some concepts which were already familiar to me were further clarified by this research (pressure grouting, sheet piles), while other methods were completely novel to me.

Coastal Caisson is currently under contract with the U.S. Army Corps of Engineers to install an impermeable wall in the existing earthen dikes that ring the perimeter of Lake Okeechobee in South Florida. Coastal Caisson has been a forerunner in the field of deep foundations design and their Cutter Soil Mixer technique actually uses existing soil as the aggregate in a process that creates seamless concrete walls. These walls are designed to reach from the top of the existing dike down through layers of earth to anchor in existing rock and prevent movement of water through the existing dikes. Although my job description at Coastal Caisson focused my efforts on in-house work related to pricing and bidding of jobs, I feel that the ongoing Okeechobee project lends itself particularly well to my students' interests and to our curriculum guidelines. It also offers the ability to team with teachers across curriculum if we consider the impact of dikes and water-controlling structures on human settlements and commerce.

Lesson Plan

Objectives

Research component (Primary): Students will identify reasons for and methods by which humans change our environment (particularly the control or relocation of water in low-lying environments). Students will research the history of dikes in the U.S., particularly in Florida, and they will identify impacts of altering water flow on the environment.

Hands-on (Experimental) component (Secondary): Students will design and conduct an experiment in keeping with the scientific method to compare the efficacy of basic types of dike construction. Emphasis will be placed on utilization and implementation of the scientific method, and they will collect and graph real data to develop conclusions about their experiment.

Sunshine State Standards

SC.6.E.7.2: Investigate and apply how the cycling of water between the atmosphere and hydrosphere has an effect on weather patterns and climate.

SC.7.E.6.6: Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water.

SC.7.L.17.3: Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites.

SC.7.N.1.1: Define a problem from the seventh grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions

Instructional Procedures

My Lesson will have two components, a primary student research component and a secondary hands-on/eyes-on component.

As a teacher, I find that my students have a natural interest in disasters. Because the project to improve the Herbert Hoover Dike around Lake Okeechobee was implemented during the same period of time in which Hurricane Katrina flooded New Orleans, Louisiana, I think that my experience at Coastal Caisson will help students better understand what they have heard about the failings of the levee system in Louisiana and the techniques that are in place today to help similar tragedies from occurring in South Florida. I am hopeful that my students will develop an appreciation for the different types of structures that can be used to alter the movement of water as well as the benefits and drawbacks of each. I intend to discuss related topics as well, including the environmental impact of dikes and dams that humans build

to protect our settlements. Emphasis will be placed on the historical accounts of 1928 flooding in Lake Okeechobee and 2009 Flooding in New Orleans, both caused by hurricanes and exacerbated by the failures of dikes.

Questions that will be assigned for student research and examination will include:

- How do dikes (and dams) affect the water cycle?
- How do they affect natural ecosystems?
- Why do we need these structures?
- What happens when these structures fail?
- What modern techniques and technology are changing the way humans design and build structures?
- Who pays for dikes and dams? How?
- Who is responsible for maintaining the quality and safety of dikes and dams? In the US? Elsewhere?

Students will produce visual support (PowerPoint, Poster, Model, etc) that summarizes their research and will present their findings to the class in a short presentation (3-5 minutes).

Hands-on component:

I plan to use a set of clear plastic storage containers (watertight) to allow the students an opportunity to test the performance and stability of simple earthen dikes compared to reinforced dikes. Students will work in groups to design an experiment which will compare the performance of traditional earthen dikes compared to reinforced dikes. Rigid plastic, concrete and metal components will be made available for student groups to use in their reinforced dike design.

Materials

- Clear plastic storage boxes (2 per group of 4 students)
- Modeling clay
- Soil and sand in equal portions
- Water
- Graduated cylinder for measuring volume
- Corrugated metal sheeting pieces

Students will work together to design an experiment which will test the question: Which dike is more effective in preventing flooding: simple earthen or reinforced? Emphasis will be placed on use of scientific method and development of a controlled experiment. The teacher will model the construction of a simple

earthen dike using lab materials (plastic container, clay, soil, sand), and then the student groups will design a second dike model using the same materials plus one type of reinforcing material (plastic/metal/concrete). This will reinforce students' understanding of the concept of a controlled experiment and will offer us the ability to examine the overall experimental design for potential flaws.

Student groups will test their dike for water tightness by pouring measured volumes (in increments from 15 to 5cm³) of water into each model reservoir until the dike can no longer effectively hold the water back. Data collected will be the maximum amount of water the dike held *before* failure. Students will graph the performance of their reinforced dike compared to their earthen dike and compile their results with other groups. The class will analyze the results to determine whether reinforced dikes are more effective than unreinforced dikes. We will review our experimental design to identify sources of error.

Integration of Summer Work Experience/Follow-up Activities

I will share digital photos of Coastal Caisson equipment and projects to build and repair existing dikes (currently underway and completed), including information regarding ongoing repairs to the Herbert Hoover Dike around Lake Okeechobee. I will invite a guest speaker to discuss the work involved in building and rehabilitating dikes.

Assessment Instruments

The student research project will be graded according to a rubric based on the presentation and the visual aid produced. Quality of factual information and source documentation will be considered. The hands-on component will incorporate reflective questions that will be graded for participation. Students will create a graph showing their group results as well as overall class results and then will develop conclusions based on data collected. Use of two separate storage tubs with identical contents will allow students to design a controlled experiment. Examination and critique of the students' experimental design will not affect the students overall grade, but will be used to reinforce the concept of controls and variables in a scientific experiment.