



## Middle School Green Career Awareness Modules

### Clean Water ▾

Segment	The Nature of Water
Lesson # and Title	Lesson Five ▾ Where Bay Area Water Comes From
Duration	45 minutes (+ 45 Minutes for Dam Forces Activity (optional))

#### Lesson Overview

Did you ever wonder where we get our water from? In the Bay Area, we primarily get our water from a water infrastructure system that includes the Hetch Hetchy Reservoir and the O'Shaughnessy Dam. During this lesson, students learn about this water infrastructure system, focusing on how water is collected in the reservoir to how it is distributed to our homes. Students can go more in depth by learning about different types of dam structures by building models of them.

#### Learning Objectives

By the end of this lesson, students will be able to:

1. Describe the components of the regional water infrastructure system

If completing the Dam Forces Activity:

2. Construct one of four types of dam
3. Understand that water acts as a force on a dam and that the dam must respond with an equal force to hold back the water.
4. Name four different types of dams.
5. List some advantages and disadvantages of the different types of dams.

### Content Standard(s)

- NGSS ▾ MS-ESS3-4: Earth and Human Activity: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems, including water resources.
- NGSS ▾ MS-ETS1-1: Define the criteria and constraints of a design problem
- NGSS ▾ MS-ETS1-2: Evaluate competing design solutions using a systematic process
- NGSS ▾ MS-ETS1-5: Construct a prototype to test a design

### Equipment, Instructional Resources, and Materials

Dam Forces Activity: [https://www.teachengineering.org/activities/view/cub\\_dams\\_lesson02\\_activity1](https://www.teachengineering.org/activities/view/cub_dams_lesson02_activity1) and [Four Types of Dams Worksheet](#)

1. Each group needs:

- water, 2 gallons (7.6 liters)
- 1 large waterproof bin, to catch any spilled water
- 4 small disposable plastic containers (available at grocery stores, or cut bottoms off milk jugs/ juice cartons, or use very thin Tupperware containers from a thrift store)
- scissors for cutting plastic containers
- [Four Types of Dams Worksheet](#), one per person

2. Embankment dam materials for each group:

- course sand, 1 cup (play sand works, but tube sand or sand for concrete works best)
- plastic wrap, 1 x 12 in (2.5 x 30 cm) strip, for waterproofing; foil or paper also work
- 1 tsp (5 ml) modeling clay, for the spillway

3. Gravity dam materials for each group:

- 10-15 small dominoes, wood or metal blocks (blocks should be close to domino size)
- 1 tsp (5 ml) modeling clay, for the spillway, to secure blocks, and as grout between blocks; can substitute tape and plastic wrap for clay

4. Arch dam materials for each group:

- modeling clay, one large handful

5. Buttress dam materials for each group:

- modeling clay, half a handful

- 5 small (1-3 in, or 2.5-7.6 cm) dowel pieces (or straws or popsicle sticks), for dam support

### Key Vocabulary and Terms

1. Reservoir
2. Infrastructure
3. Dam

### Teacher Preparation

1. Familiarize yourself with slide deck

If the teacher chooses to have students engineer dams:

2. Familiarize yourself with the Teach Engineering: Dam Forces activity
3. Collect all materials for the Dam Forces activity

\*\*\*Teacher Note: Please note that some of these materials were used during Lesson 3 (Wetland in a Pan)\*\*\*

\*\*\*Teacher Note: You can modify this activity in any way you see fit or teach it to fidelity. For example, you can have groups of students build different types of dams, or have them build the O'Shaughnessy Dam (Gravity-Arch Dam) as a model.\*\*\*

### Lesson Procedure

Slide Deck:  **Clean Water: Lesson 5: Where Bay Area Water Comes from.pptx**

Segment Title	Activity/Task, Student Grouping, Special Accommodation, Related Career(s), and Assessment	Time
Our Regional Water Infrastructure System: From the Hetch Hetchy to our Homes	<p>Activity/Task:</p> <ol style="list-style-type: none"> <li>1. Discuss with students, "What is a reservoir?" and that our reservoir is called the Hetch Hetchy Reservoir.</li> <li>2. Guide students through all slides.</li> </ol> <p>Student Grouping: <b>Whole Group</b> ▾</p>	45 minutes

	Related Careers: Water Resource Management, Water Treatment and Quality, Water Conservation, Water Policy and Planning	
<a href="#">Teach Engineering: Dam Forces</a>	<p>Activity/Task: Students learn how the force of water helps determine the size and shape of dams. They use clay to build models of four types of dams, and observe the force of the water against each type. They conclude by deciding which type of dam they, as Splash Engineering engineers, will design for Thirsty County.</p> <p>Dam Forces Student Instructions:</p> <ol style="list-style-type: none"> <li>1. Hand out the <a href="#">worksheet</a>. Review with the students some details about each type of dam (see the Introduction/Motivation and Vocabulary/Definition sections).</li> <li>2. Divide the class into four groups (about 3-4 students per group), and assign each team a type of dam. For larger classes, if needed, assign more than one group the same dam type.</li> <li>3. Have each group create a design. This should include: 1) a list of the materials they will receive, 2) a drawing of the tub and their idea for their dam, and 3) dimensions of key features (such as the tub, dam length, dam thicknesses) and 4) all group members must sign the bottom of the design write-up. The teacher should initial when all four steps are complete.</li> <li>4. Have each team of students use the materials provided to build their type of dam. Remember the key concepts from each dam!</li> <li>5. For testing, direct students to place their entire model (plastic container and clay) into a waterproof bin so as to catch any leakage.</li> <li>6. Have students fill their small containers with water to test its force on their clay dam (see Figure 1). Wait one minute and record your observations. How is it working? Any leaks? Is the dam able to withstand the force of the water?</li> <li>7. Have students walk around the room to examine the dams created by other teams.</li> <li>8. Have students complete the worksheet.</li> <li>9. Conclude by conducting a class discussion, comparing team experiences, and how forces are kept back by the different dam types.</li> </ol> <p>Related Careers: Civil Engineer, Structural Engineer</p> <p>Student Grouping: <b>Small Group</b></p> <p>Related College Major and Career(s):</p>	45 minutes