

# Water Locks and the Panama Canal

## Civil Engineering

### Objective

- This lesson teaches students about civilization-changing engineering design: locks. The Panama Canal is a historical and impressive engineering feat. Discussing the Panama Canal and other lock systems (specifically the Columbia River System) teaches students about critical engineering design.
- Encourage students to think abstractly and develop their problem-solving skills.

### Standards and Objectives

- Earth Systems Standard 4, Objective 1

### Learning Outcomes

Students will learn:

- The impact engineering has on civilization
- How math is used to design locks
- To develop abstract thinking skills

### Essential Questions

- Why are locks such a critical part of our civilization?
- How do locks improve our shipping options?

### Time Required (Itemized)

- Topic Introduction Worksheet & discussion – 20 minutes
- Panama Canal Presentation & Columbia River Overview – 25 minutes
  - Give lock demonstration during presentation
- Assessment – 5 minutes

### Assessments

- Optional: students fill out multiple-choice assignment during presentation.
- Give students five minutes at end of lesson to write 1-2 paragraph summary of covered information.

### Materials

- See Lock demonstration construction sheet included in Water Unit

### Lesson Description

The Panama Canal is one of the greatest civil engineering feats of the 19<sup>th</sup> and 20<sup>th</sup> century. The Panama Canal saved thousands of lives and millions of dollars because the main shipping route around North America is now shorter and safer.

Questions to ask students:

- Show a map of North America and South America. On the map highlight the original shipping route before the Panama Canal. Ask students if they see a problem?
- What are the problems with sending ships around the tip of South America (Cape Horn)?
- What is a solution to this problem?

One of the greatest challenges with the Panama Canal is that the center of the Panama Isthmus is higher than sea level. The original Panama Canal plans called for laborers to dig out a sea level channel across the isthmus. This plan was extremely labor intensive as well as dangerous for laborers.

- What is another option for the Panama Canal construction besides the original plan of digging a sea level canal across the isthmus?
- How do you think a large lake in the middle of the isthmus would help engineers construct the Panama Canal?
- How would an engineer construct a man-made lake?
- If the lake is higher than sea level, then how would you elevate the boats to the height of the lake?

The gates of the Panama Canal must be very large and heavy in order to contain all the water in the lock channel. Lock gates frequently hold a large amount of water on one side of the gates, but have no water on the other side of the gate. This creates a large amount of water pressure. The sizeable water pressure is handled by constructing very large, thick gates.

- What forces are acting on a lock gate?
- How would you calculate the water pressure acting on the Panama Canal lock gates?
- How large are the Panama Canal lock gates?

The Columbia River in the Pacific Northwest is a major shipping route. The Tri-Cities area of Washington State is one of the largest wheat producing areas in the United States. Wheat is shipped throughout the west and Asia. Large freighter ships navigate the Columbia River between Portland, Oregon and the Tri-Cities area. Several dams are located along the Columbia River between Portland and the Tri-Cities area.

- How do large freighter ships navigate the dams?
- Why are there so many dams located along the Columbia River?

Procedure:

- The Topic Introduction Worksheet describes scenarios similar to the Panama isthmus before canal construction and the Columbia River System. The students are instructed to brainstorm engineering designs to solve the problems outlined in the worksheet.
- Give the students about 10 – 15 minutes to develop engineering solutions, and then have a discussion about the scenarios each group created. The worksheet is a tool to start having the students think about locks.

- Give the presentation. The presentation highlights the Panama Canal. Topics include: why there was a need for the Panama Canal, how locks work (see Lock/Dam demonstration construction sheet), and how to calculate water pressure on lock gates.
- The presentation also discusses the Columbia River System. The Columbia River contains several hydroelectric dams. Freight ships travel up and down the lower Columbia River, and locks are required to elevate and lower the freighting ships over the many dams.
- Note: the Columbia River discussion is an excellent seg-way into the Dam Lesson Plan.