Dams: Controlling and Capturing the Power of Water
Lesson Outline

## General Lesson Information

Title: Dams: Controlling and Capturing the Power of Water

Overview/Annotation- *A short summary or description of the lesson including activities and science concepts.*
This lesson plan introduces students to the concept of dams, emphasizing the benefits that they provide to our communities through flood prevention, water capture, and energy generation while also discussing the negative impacts it could have on our environment and ecosystems. This plan culminates in a hands-on activity where students will be able to engineer their own dams with a controlled release feature to better understand the engineering design process behind these structures.

Setting or format (outdoors, in groups, lab, etc.): In groups in standard classroom or lab

Intended group size (if groups are used): Groups of 3-4 students

Intended grade level(s):
Social Studies: 7th grade Geography

Approximate Time of Lesson (*Ideally break down into 20-50 minute periods*):
Four 50 minute periods

## Researcher Biography

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https://www.youtube.com/@trainthetrainers5857/videos

Brief Description of Research Interests:
Through our program "Train the Trainers," we aim to educate local teachers and students in the Tuscaloosa/Northport area about the importance of Environmental Engineering to bring awareness to its concepts and provide opportunities for K-12 students to engage with S.T.E.M. concepts at this critical learning period. We create videos, lesson plans, and activities to allow students to connect and learn about our water quality and filtration research at an approachable and engaging level.

## Associated Standards and Objectives

Content Standards- *List Alabama Course of Study Standards that connect to lesson*

SS10.7G.9 - Explain how human actions modify the physical environment within and between places, including how human-induced changes affect the environment. *Examples: within--construction of dams and downstream water availability for human consumption, agriculture, and aquatic ecosystem between--urban heat islands and global climate change, desertification and land degradation, pollution and ozone depletion*

Primary Learning Objectives- *Sentences beginning with "Students will be able to…" that describe what students will do in the lesson that relates to how students will be assessed.*
See attached lesson plan below.

Additional Learning Objectives- *Any learning outcomes that are not directly related to the content standards but may relate to other local or national standards*
See attached lesson plan below.

## Preparation Information

Total Duration- *How many minutes will the lesson last?*
Four 50 minute periods – 200 minutes of instruction/activities

Materials and Resources- *List of materials teacher will need to gather or prepare for lesson*
**Required Materials:**
9" x 13" Aluminum Baking Dish – one per group to build in
Clean Water – can store in a bucket/cooler or get from a science lab
Scissors
Sharpies – to label the dams
Paper Towels
PowerPoint – see attachments below

**Materials you can choose from based on availability, budget, and scale:**
Gravel
Sand
Cardboard – recommended
Tape – recommended
Aluminum Foil
Plastic Wrap
Plastic Cups
Bendy Straws – recommended
Binder Clips – recommended
Wooden Dowels
Cotton Balls
Hard Plastic Sheets
PVC Pipes

Clothespins
Wire
Wire Cutters
String
Metal Springs
Measuring cups – to standardize materials like gravel/sand between groups

Technology Resources Needed- *What technology will teacher and students need for the lesson?*
Smart board/projector for the attached PowerPoint and online stopwatch to track the time that each dam is able to hold 6 cups of water.

Background and Preparation- *Description of information (science content, use of materials, etc.) teacher and/or students will need to know prior to this lesson; list steps for any preparation prior to the lesson*
Review the resources provided and become familiar with the different types of dams, how they are constructed, what impacts a dam could have on civilizations and the natural geography of the area, and what local dams are in your area that your students may be able to connect with.

1. **Gather all materials your students will need from the list above.**
2. **If you'd prefer to have kits for each group instead of a general materials table that students can access, prepare these kits ahead of time. Example kit:**
   - 1 Aluminum Baking Tray
   - 1 piece of cardboard
   - 1 roll of tape (scotch magic tape)
   - 2 feet of aluminum foil
   - 1 hard, craft plastic sheet
   - 1 plastic cup
   - 2 bendy straws
   - 2 binder clips
   - 2 clothespins
   - 5 cotton balls
   - 2 feet of wooden dowels
   - 2 small metal springs
3. **Locate a place to store dams between days 3 and 4 so students can continue building and can make changes to their design.**

## Procedures and Activities

*Step-by-step description of lesson that would allow another teacher to successfully complete the lesson (suggest possible reflection or comprehension questions along with examples of correct answers or common misconceptions)*
See attached lesson plan and PowerPoint below.

*Engagement* (sparking interest, introducing phenomenon, engage students' everyday experiences)
See attached lesson plan below.

*Main activity* (suggest possible reflection or comprehension questions along with examples of correct answers or common misconceptions)
See attached lesson plan below.

*Wrap up and Reflection* (wrap up activity, reflecting on learning, informal assessments of student learning)
See attached lesson plan below.

*Final product/Summative evaluation* (e.g. quiz, presentation, essay, etc., may occur during a later class period)
See attached lesson plan below.

Attachments- *Any materials for the lesson such as video links, worksheets, etc., listed here*

SciREN Dams – Controlling and Capturing the Power of Water – Lesson Plans

SciREN Dams – Controlling and Capturing the Power of Water - PowerPoint

# Day 1: Introduction to Dams and Their Importance

## Objective:

- Understand the role of dams in society.
- Learn the different types of dams and their functions.
- Explore the materials used in dam construction.

## Materials:

- Whiteboard & markers
- Slideshow on types of dams
- Short video about famous dams (e.g., Hoover Dam)
- Images of real dams

## Lesson Plan:

1. **Engage (10 min)**

- **Cool short video on dams**
- Show slideshow of famous dams (Hoover, Three Gorges, Aswan).
- Ask: "What do you think dams do? How do they help people?"
- Discuss students' prior knowledge.

**2. Explain (15 min)**

- Brief history of dams:
  - **Ancient Dams** (Sadd-el-Kafara, Egypt, built ~2600 BC).
  - **Modern Dams** (Hoover Dam, built for hydroelectric power & water supply).
- Why dams are important: [ask students to list reasons. Also have listed in slideshow].
  - Control floods
  - Store water for agriculture and drinking
  - Generate hydroelectric power
  - Provide recreation (lakes and reservoirs)
  - Impact the environment (both positive and negative- examples?).

**3. Explore (20 min)**

- Introduce the **model dam challenge**:
  - Students will build small-scale dams that can **hold back water and control its flow**.
  - Discuss the **design constraints**: must be stable, limit water seepage, and control water release.
- Introduce the available materials and their purpose:
  - **Gravel & Sand** – Represents natural soil and sediment layers.
  - **Cardboard** – Base for dam structure.

- **PVC Pipes & Straws** – act water outlets (simulating spillways and turbines).
- **Tape & Foil** – Seals and strengthens dam structure.
- **Aluminum Baking Pan** – Acts as the riverbed to hold water.
- **Plastic Wrap & Plastic Sheets** – Waterproofing to prevent seepage.
- **Wooden Dowels & Clothespins** – Provide structural support.
- **Wire & String** – Reinforce the dam walls.
- **Paper & Cotton Balls** – Represent vegetation or absorbent layers.
- **Binder Clips** – Hold components in place during construction.

**4. Wrap-up (5 min)**

- Ask students to **sketch a simple dam design** [individual work to compare with group on day 2]

# Day 2: Designing and Planning the Dam

## Objective:

- Apply engineering and problem-solving skills to dam construction.
- Create a blueprint of a functional model dam.

## Materials:

- Whiteboard & markers
- Graph paper for sketches
- Rulers
- The same materials introduced on Day 1

[brainstorm best way for students to store materials]

## Lesson Plan:

**1. Review (5 min)**

- Recap key functions of dams.
- Discuss local dams and their purpose- [lake Tuscaloosa dam and spillway]

**2. Explain (10 min)**

- Discuss dam engineering:

    - **Gravity Dams** – Heavy and strong, rely on their weight.
    - **Arch Dams** – Curved shape directs pressure to strong canyon walls.
    - **Embankment Dams** – Built with earth materials, more flexible.
- Explain **spillways** (controlled water release areas). *Optional

**3. Explore (30 min)**

- **Student Teams (3-4 students per group):**
    - Sketch a blueprint of their model dam [they can compare drawings from day1]
    - Label materials and explain their function.
    - Consider water flow, strength, and erosion control.

**4. Wrap-up (5 min)**

- Groups present their designs briefly [turn and talk with neighboring group if short on time]
- Homework: consider possible **challenges** in building the dam and ways to overcome them.

# Day 3: Building the Model Dam

## Objective:

- Construct the dam according to the blueprint.
- Problem-solve during construction.

## Materials:

- Pre-cut materials (cardboard, PVC pipes, foil, etc.)

- Scissors & rulers
- Measuring cups for water testing
- Towels for spills

## Lesson Plan:

### 1. Review & Plan (5 min)

- Each group reviews their blueprint.
- Quick discussion: What **challenges** might arise while building? How can we overcome/ work around these challenges?

### 2. Build (35 min)

- Students construct their dams using:
  - **Cardboard & plastic wrap** for the main structure.
  - **Gravel & sand** for added stability.
  - **Foil & plastic sheets** to prevent leaks.
  - **PVC pipes & straws** for controlled water flow.
  - **Binder clips, string, and wire** for reinforcement.

### 3. Initial Testing (5 min)

- Carefully pour small amounts of water behind the dam.
- Observe and **adjust** any weak spots.

### 4. Wrap-up (5 min)

- Each group describes their dam's strengths and weaknesses.
- Homework: Predict how well their dam will hold water overnight.

# Day 4: Testing, Evaluating, and Improving

## Objective:

- Test the effectiveness of the dam.
- Adjust for improvements.
- Discuss real-world dam failures and successes.

## Materials:

- Completed dams
- Measuring cups
- Water
- Timer (to test how long the dam holds)
- Whiteboard for results

## Lesson Plan:

### 1. Review & Discuss (5 min)

- Ask: "How do engineers know if a dam will work?"
- Explain how real-world **dam failures** (St. Francis Dam disaster) helped improve engineering practices.

### 2. Testing Phase (25 min)

- **Water Release Test:**
  - Slowly pour water into each team's dam structure.
  - Observe and measure **how much water leaks through**.
  - Use timers to measure **how long the dam holds** before failure.
- **Erosion Test:**
  - Increase water volume to simulate heavy rain or flooding.
  - Observe if the dam **withstands pressure or erodes**.

### 3. Redesign & Improve (15 min)

- Based on test results, groups modify and reinforce weak areas.
- Retest with new modifications.

### 4. Final Discussion (5 min)

- Which designs worked best? Why?
- What real-world factors might have impacted a real dam?
- Something to consider: how do engineers balance the benefits and risks of dams?