

### **Ancient Indian Gravity Sewers**

(Students prefer to fondly call this experiment...“The Pee Experiment!”)

“Why do we need to know this?” This question is the most frustrating question for both students and teachers. When a lesson does not show its practicality and usage in the real world, students have a tendency to lose focus and interest, which then demoralizes the teacher.

In my sixth grade self-contained class, I strive to make ancient history relevant and science “hands-on” and the ultimate goal is show how all subjects are interrelated. This cross-curriculum experiment combines information on the creation of sewers in the Ancient Indus Valley with the hands-on experience of a science experiment dealing with gravity.

## **Ancient Indian Gravity Sewers Lesson Plan**

**Teacher Name:** Mr. Michael Ryan

**Subject/Grade:** 6<sup>th</sup> Grade/Social Studies (Ancient India) & Science (Physical & Environmental)

**Content:** Ancient Indus Valley and gravity and sewers

**Length of Lesson:** 120 Minute Block or two 60 minute periods

**Material/Equipment:** Computer/Projector or Smartboard with Internet access, For each team: tin foil, masking tape, beakers/cups of water, food dye, levels, measuring tape, protractors, lots of paper towels, sponges, student's books/notebooks/folders etc, calculator, garbage bag

**Costs:** Initial one time cost: levels (\$2 each), measuring tape (\$4) Recurring costs: paper towels, tin foil, food dye, masking tape

**NJ Requirements:** **6.1 A, 6.3 A, 6.6 A, 5.7 A**

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**PURPOSE:** To explore how sewers, which were contributed to civilization by ancient cities in the Indus Valley, work with gravity.

**OBJECTIVE:** Each student will be able to identify the civilization that is credited with giving us sewers. Each student will be able to identify how sewers work. Each student will utilize a level. Each student will work as a member of a team.

**HOOK:** Ask students... "Do we use things today that were developed and created 5,000 years ago?" Allow students to discuss as a class for 3-4 minutes.

**BRIDGE:** Inform the class that we are going to learn about something that was created 5,000 years ago and that we use it today...in fact...each student uses it everyday!

### **DEVELOPMENT:**

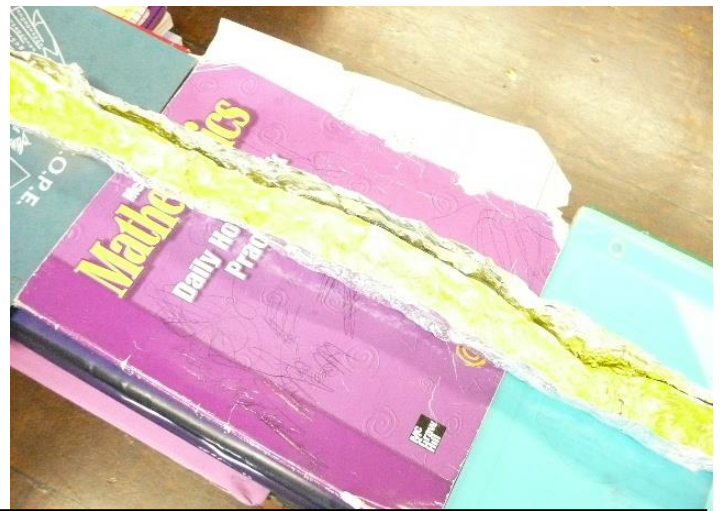
- 1.) Using Google 3D Maps and projector/SmartBoard, (or a map handout) have students identify India and the countries around it. Have students identify physical features (Himalayan and Hindu Kush Mountains, Ganges and Indus River, New Delhi, and Focus in on the ancient cities of Harappa and Mohenjo-daro...which are in present day Pakistan.) (10 minutes)
- 2.) Have students view photos of Harappa and Mohenjo-daro (10 minutes).  
<http://www.harappa.com/har/har0.html>
- 3.) Emphasize that the ancient cities of the Ancient Indus Valley gave us something that we can't live without and that we use it everyday. (Allow students to guess.) Then inform them that they gave us the idea for "sewers". Ask students to imagine what their town would look and smell like without sewers!
- 4.) Ask students if they ever wondered where did "it" go when they flushed the toilet? Allow for brief discussion and then go through virtual slide show on projector/Smartboard (20 minutes):  
<http://www.sandiego.gov/mwwd/kids/learnit/virtualsewage.shtml> After briefly discussing the topic, the slide show can be visually reinforced via a brief video. (Make sure videos are unblocked on school filters or download them.)  
<http://www.youtube.com/watch?v=ZCWG6U6J41Q&feature=related> or  
[http://www.dailymotion.com/video/x8f1he\\_steps-in-the-treatment-of-wastewater\\_tech](http://www.dailymotion.com/video/x8f1he_steps-in-the-treatment-of-wastewater_tech)
- 5.) Inform the students that they have been transported back 5000 years to the city of Harappa. They must create a sewer system to remove waste to prevent people from getting sick. There are no pumps or electricity, so they must focus on gravity! Review with students the concept of gravity.
  - a. Separate students into teams of 3 or 4 and have them select a "chief architect". Give each group a level and roll of tin foil (35 feet).

- b. Have students move desks to side of room to create a large working area. Using masking tape measure 20 feet ©, 25 feet (B), and 30 feet (A). Explain to the students that their grade is based off how far their sewage goes without leaking and on teamwork. Demonstrate how to fold the tinfoil in half 3 times and to twist up the sides and ends. Then demonstrate how to use a level. (15 minutes)
- c. Explain to the students that they will have to make a gravity working sewer using the tinfoil and the goal is to get the sewage to go from one side of the classroom to the other. Students CANNOT tear the tinfoil because then the “waste” will leak. The students can use all their textbooks, folders, notebooks etc. to raise the sewers high enough. They cannot raise the sewer more than 12 inches off the floor. The sewer (tinfoil) is to be folded three times evenly and then the edges & ends should be bent up to make a “canal like structure”. So each group will have a 30 foot piece of tinfoil that is folded three times in half (must fold it as a group so it doesn’t rip) and then bend up the edges and ends (so water doesn’t leak out from the sides or at the end.) Then using the level, students will raise/lower their sewer by adding their books under the sewer. (Emphasize teamwork, consistent use of the level and to avoid gaps under the sewer because it will collapse. Remind them that they will get only ONE shot to make it work.) Put a 25-30 minute time limit on this section.
- d. Give each of the 5 groups a sponge, lots of paper towels, stop watch, measuring tape, protractor and a beaker of yellow colored water (400 ml). Each team will go one at a time, the other teams will watch and help dry up spills. No one is allowed to touch the sewers unless it spills! One student will pour a steady flow of water from the beaker into the sewer until the beaker is empty while a second person is timing the sewage movement and the third is ready to soak up any spills immediately, so the books don’t get ruined. Stop the watch if the water spills or stops flowing. Record the time and distance (use measuring tape) and calculate the sewage’s speed in feet per second. (Optional, have students use a protractor to record the angle of the sewer to the floor at 3 different locations.) (15 minutes for about 6 groups).
- e. Grades are given on a basic rubric that is based on the masking tapes on the floor with a bonus to the group whose sewage flow rate was the fastest.
- f. Have students clean up everything. (15 minutes)

**CLOSURE**: Review what made a successful sewer and the historical context of sewers.



Fold tinfoil in half 3 times as a team. Teamwork is key, especially for this part. Be gentle...tinfoil rips easily.



Students use their books to raise the sewer and levels to get the right angle. Note how sides of tinfoil are bent up to keep water from spilling out.



Here students are observing how far the “sewage” travels (note masking tape lines on floor for grades). No one is allowed to touch the sewers and note students have paper towels handy. Yellow food dye makes the sewage realistic.