

Design Challenge Facilitation Guide

Challenge Topic

The challenge topic is 'Build a Water Channel'. Write the challenge topic on the board or on a display board that all students can view.

Goal of the challenge

Students will engage in a hands-on design challenge to explore and experience potential and kinetic energy, gravity, and practice the engineering design process (Ideate -> Design-> Build->Test -> Improve)

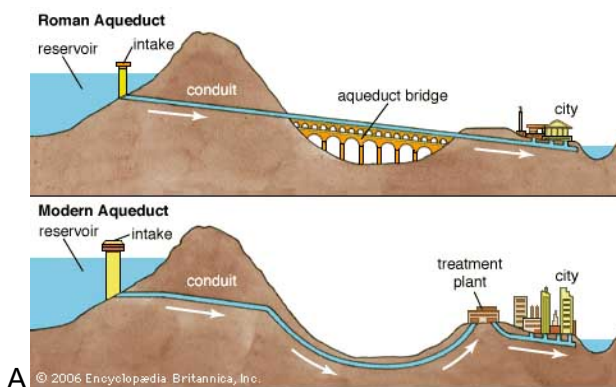
Students share their solutions at the end of the challenge

Estimated Time - 1 hour

Background -

Read out the following narrative script to all the students and show students the images.

What inspired the water management systems that exist today? In history, Romans started at a water source that was at a higher elevation than the town or village and the water basically “fell” down a super long water slide to get to the village. Ancient water pipes also called “aqueducts” or “water channels” were able to “carry” and move water because of gravity! The first roman aqueduct, Aqua Appia, was 16.4km long. Can you imagine how tired you would be if you had to carry water over that distance?



Story Narrative for the challenge

Read out the following story narrative script to all the students.

Due to severe drought in a town, the town inhabitants face water scarcity. However, there is a water source far away, for which there is no water management system in place. So a water channel needs to be built to draw water from this water source. The water channel has to span mountains and valleys and make it to the town. You will take the role of “Civil Engineers” to build the water channel and help the situation.

Challenge Details

Write the challenge description and constraints on the board or on a display board that all students can view.

Description - Create a water channel (using cardboard tubes/foam tubes) that transports water (marble) that starts from the top of a water source(reservoir). Your water channel will span over two mountains (cardboard boxes or bins), and will cross one valley (space between bins or boxes) and take a turn to reach the town(cup)

Constraints -

1. The water channel should be stable and well supported.
2. No human help to push the marble or hold the water channel
3. Once the marble is dropped at the start of the water channel, it should make its way to the town on its own through the channel
4. The marble(s) should land safely and definitely not go off track on the way

Materials -

Provide the following materials that can be shared among team members

- Scissors, Marker, Glue stick / liquid glue

Every team receives the following materials -

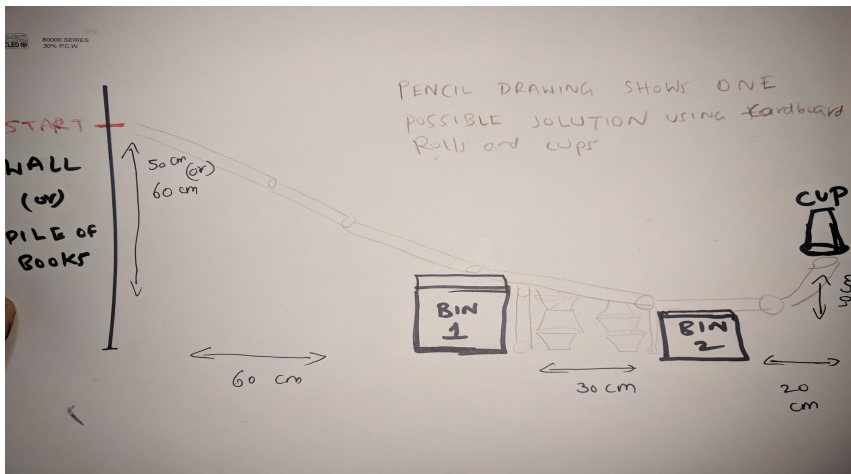
6 thin cardboard rolls cut in half (to make pipes/channels) (OR) 4 foam tubes 4 feet of masking tape 6 dowel rods 6 popsicle sticks 2 bins or cardboard boxes (one should be taller than the other)	1 large paper cup (town) 3 marbles(water) 2 feet long string 6 small styrofoam cup (to support pipes in valleys, like bridges) 4 thick cardboard rolls (to support pipes in valleys, like bridges)
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Test Rig Set up

Set up the test rig by following the steps below. Reference images are shown to support setting the test rig. The test rig will be used by the teams to test their design and make fixes to their design. Teams can be allowed to the test rig a number of times, as decided by the facilitator.

1. Mark the start point (60 cm high) for water source on the wall using tape. Or pile up books/bin to give a starting point.
2. Keep 1st tall bin 60 cm away from the marked starting point
3. Keep 2nd short bin 30 cm away from 1st bin
4. Keep the cup 20 cm apart from the 2nd bin and then 10 cm to the right (like an 'L' shape)

The image below shows the test rig setup. The pencil sketch shows one possible solution (for facilitator reference only)



Challenge Extensions

Provide the following extension activities for students who are early finishers

- Build a water channel to transport water in 2 seconds
- Build a water channel that travels even further to a second town
- Make changes to the location or height of the bins and move towns further to make it more challenging

Reflection

Gather students and assemble at one place. Encourage students to share and talk about their engineering creations. Prompt students with the following questions to reflect on their experiences.

1. What was the hard part of the challenge and how did you solve it? *Answers vary*
2. What was your biggest learning or discovery from this experience? *Answers vary*
3. How many times did you have to reiterate your design? Why did that happen? *Answers vary*
4. Can you point out where there is potential energy and kinetic energy in the marble?
Answer- Potential energy is stored energy and is at the highest point when the marble is at rest. Kinetic energy is moving energy when the marble is rolling through the tubes,