Water Distribution Design Competition

Sponsored By:
Engineers Without Borders at the University of Tennessee, Knoxville

Description:
This challenge has students design a small-scale water distribution system inspired by a real-world Engineers Without Borders project in Rwanda. Students will work on designing and preparing their system before Engineers Day. On Engineers Day, students will have 10 minutes to construct their water pipeline using the approved materials provided and then test the performance of their design.
The goal of the challenge is to create a water system that can efficiently and reliably transport water from a designated water source to a community. Students will need to consider factors such as water flow, distance, elevation, structural stability, material usage, cost, and reliability when developing their design.
This challenge can be completed individually or in teams of up to 5 students.

Materials:
Students will be provided with materials on competition day but are free to bring any tools needed (i.e. scissors, craft knife). Teams may not include any tools or materials brought from outside the competition. Materials can be purchased at any time during the construction period. Students may modify their design during the 10 minute construction period, if they remain within the material and time constraints. Below is a list of approved materials and the cost of each:

Material	Quantity	Cost
Large straws	2	$100
Popsicle sticks	2	$150
Tape (Duct Tape)	2 inches	$200
Cups	1	$300
Cardstock	1 half sheet (8.5"x5.5")	$400
String	6 inches	$200

Building:
Students will have 10 minutes total to construct their water pipeline using only the materials provided. The 10-minute period includes assembly, adjustments, and any practice tests needed. When time is called, all construction must immediately stop. Once the construction/testing period has ended, no additional materials or modifications may be made.

The initial water source will be placed 3 feet above the tabletop. Two designated water collection areas will be positioned on the table, 6 feet from the water source, with the collection areas separated by approximately 90°.

Testing:

Each team will receive the same starting amount of water and will be tested under the same general conditions. The pipeline must transport water from the designated water source to the designated collection areas. Students are not allowed to hold, support, or manually operate their pipeline during official testing. Water lost through leaks, spills, or other failures will not count toward the team's successfully delivered water. Each team will be given 5 minutes to transport all water from the source to the designated collection areas. Teams will be cut off at the 5 minute mark, even if all water has not been transported.

Scoring:

The challenge will be scored based on both the performance of the completed system and the engineering decisions made by the students.

Criteria				
Water Delivery: The percentage of supplied water that successfully reaches the destination.	5 points: All the water reaches the collection areas	3 points: At least 70% of the water reaches the collection areas	2 points: At least 30% of the water reaches the collection areas	0 points: No water reaches the collection areas
Flow Rate: How quickly the system is able to transport water.	5 points: Fastest third (33%) of teams to empty the source	3 points: Second-fastest third of teams to empty	2 points: Slowest third of teams to empty	0 points: Water source not emptied after 5 minutes
Cost: Teams that effectively complete the challenge while using fewer materials will receive a higher score.	5 points: Lowest-cost quartile (25%) of teams	3 points: Second lowest-cost quartile of teams	2 points: Third lowest-cost quartile of teams	0 points: Highest-cost quartile of teams
Bonus Criteria				
Reliability: How well the system continues to function when a portion of the system	5 points: Full functionality after failure	3 points: Partial functionality after failure	--	0 points: No functionality after failure

fails or conditions change.				
Total:				

Engineering Failure Challenge:
Following the initial test, if teams would like, they may be given a surprise engineering scenario. Students will have a limited amount of time to adapt their system to the new conditions. This portion of the challenge is intended to simulate the unexpected problems engineers may encounter when designing and maintaining real-world infrastructure. If teams would like to try the challenge, it must be stated prior to the initial 10 minute construction period. Teams will have 10 minutes to construct and test their water pipeline design. After the construction period is over, normal testing will be done for 5 minutes. The challenge will be given after the 5 minute testing period, and teams will then have 3 minutes to redesign their system. Pipelines will then be tested for 2 minutes. There is no penalty for trying the challenge.

Important:
A design does not have to work perfectly on the first attempt! Students are encouraged to learn from failures and think critically about how their system could be improved. The most complicated design is not necessarily the best design. The goal is to create a solution that is effective, reliable, efficient, and cost conscious.

Contact:
Any questions should be directed to Shachi Shyam at sshyam@vols.utk.edu