Western Engineering Outreach

Follow The Flow

Grade 3-5

Meet Today's ENG HERO!

Hassan Peerhossaini - Professor with Western Engineering

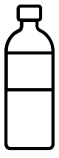
In January 2018, Dr. Peerhossaini joined Western Engineering's Department of Civil & Environmental Engineering, with a cross-appointment with the Department of Mechanical & Materials Engineering, as the Western Research Chair in Urban Resilience and Sustainability. Dr. Peerhossaini's research interests lie in interdisciplinary approaches to energy systems and their social and economic impacts, with a focus in areas such as the physics of turbulence, heat transfer, fluid mechanics, and the dynamics of active matter. *To learn more about Dr. Peerhossaini visit:* https://www.eng.uwo.ca/civil/faculty/peerhossaini_h/index.html

Learning Goal:

- Students will act as civil engineers as they design and build irrigation systems to withstand the forces of flowing water
- Students will understand that some shapes increase a building's stability
- Curriculum Connections: Grade 3 -Strong and Stable Structures, Forces Causing Movement; Grade 5- Forces Acting on Structures and Mechanisms.

Materials Needed:

- 10 Large paper or plastic cups (approx.. 18 oz)
- 20 small paper or plastic cups (approx.. 9 oz)
- 20 pieces of aluminum foil (10.75 inches by 12 inches)
- 50 popsicle sticks
- 10 beads
- Water bottle (1 L)
- Tap water
- ruler
- Large, shallow plastic tub
- tape



Engineering and Science Connections:

Students will act as Civil and Structural Engineers as they design and build irrigation systems to withstand the forces of flowing water and transporting necessary items to lower levels but not allowing these items to flow too far.

What is a Terrace?

- It is a leveled section of a hilly cultivated area, designed as a method of soil conservation to slow or prevent the rapid surface runoff of irrigation water.
- They were created over 2000 years ago and the technique was very advanced
- The design of these terraces allows for an elaborate irrigation system to be created.
- An irrigation system is a system created to ensure crops are getting just enough water, which can be a tricky balance and can cost hundreds of thousands of dollars to install.

How to irrigate land?

- To irrigate the land, the system channeled water from mountain springs and streams down through the layers. This means the irrigation systems were powered entirely by gravity (the force that pulls things down towards the earth) as the water flowed down the mountainside.
- These days, hours and hours and accurate calculations must be done to ensure that engineers got everything right. The rice terraces were also believed to be built entirely by hand. If people had not built these terraces, the slopes would have been far too steep to cultivate.
- By building these terraces, they were able to stabilize the slopes and reduce soil erosion.

What is Buoyancy?

- The ability of an object to float over a fluid like water.
- A buoyant object is an object that floats in water (ex. Beads)
- The beads get dragged along because water is viscous, meaning it exerts friction (a force that resists motion) when it flows past or around an object.

Video Recommendation: Banaue Rice Terraces

https://www.youtube.com/watch?v=7LqAJoD-PpA&t=42s

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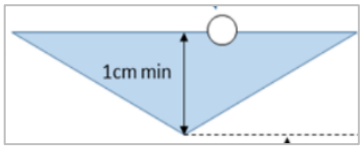
Challenge:

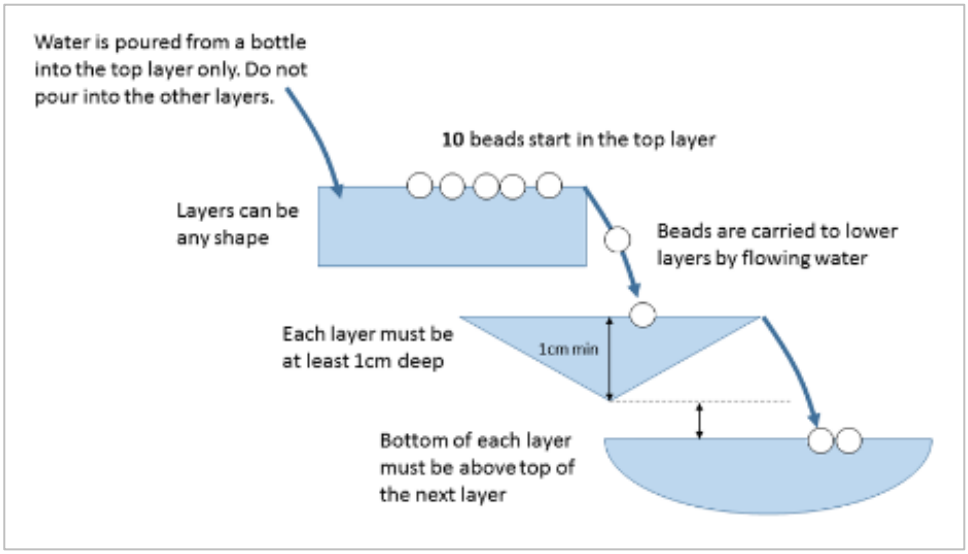
- In this project, your goal is to build a model of the Banaue Rice Terraces using some common household materials.
- You will design your terrace structure so plastic or wooden beads will be carried down from the top layer by running water, simulating the irrigation system in the real rice terraces.
- Optional: You will be using a scoring system to see how successful your design is.

Rules:

1. Your model can only be built from items listed in the Materials section. No other materials are allowed.
2. There are no restrictions on the shape of your layers, and layers do not have to be the same shape. However, each layer must hold at least 1 cm of water at its deepest point (as shown on the right)



3. Your model must have a minimum of 2 and a maximum of 10 layers.
4. The bottom of each layer must be higher than the top of the next layer down (like a staircase).
5. All ten beads must start from rest in the top layer, with no water already in the model.
6. You can only pour water into the topmost layer. There are no limits to how quickly or slowly you pour the water.
7. You cannot touch the model or any of the beads during operation. However, there is no limit to the number of attempts you can use to try and get a high score. If your model breaks or doesn't behave as expected, you can reset it (pour out all the water and put the 10 beads back in the top layer) and start again.



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Scoring:

Bead points: each bead is worth 100 points *per layer that it moves down*.

- For example, a bead that moves from layer 0 to layer 2 (counting from the top, so the uppermost layer is layer 0) is worth 200 points because it moved two layers.
- Beads that fall out of the model are not worth any points; even beads that roll out of the last layer.

Example Model:

What Did You Learn?

- What are some examples of buoyant objects?
- What materials worked the best? Why?
- What would you do differently next time?

Future Learning

- For an even harder challenge, now knowing that the items you use are costing you points, try and build a new model following the same rules set before except you will lose points whenever you choose to use the following items:

Item	Maximum Quantity	Material Points (each)
Large plastic/paper cup. (18 oz)	10	100
Small Plastic/paper cup (9 oz)	20	50
Aluminum foil, 10.75in by 12in max sheets	20	50
Popsicle Sticks	50	10
Masking Tape	unlimited	free

- Calculate your Final Score using this equation: *Total Score = Bead Points - Material Points*

Share your creations!

We would love to see what you made. Email as at discover@uwo.ca or tag us on social media.

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Thanks for discovering with us!