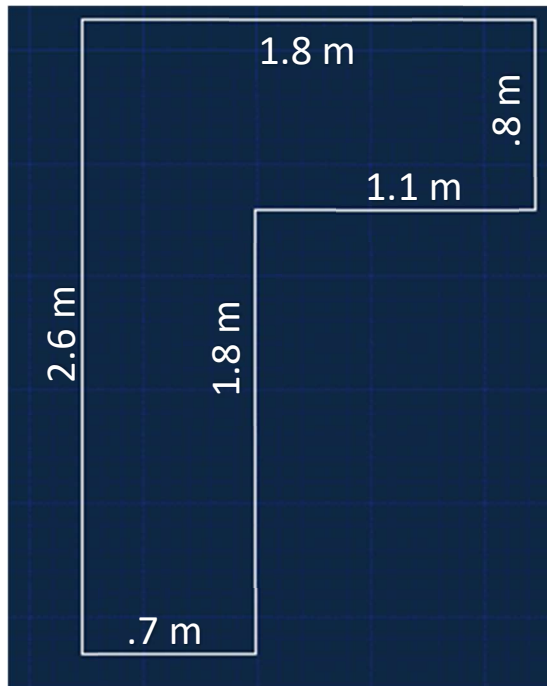


Science Bite Sandy's Sandy Touch Tank



Sandy the Aquarium Manager transformed one of the three meso-touch tanks into a sandy intertidal environment. It currently showcases an eel grass bed, and will house some sand dollars (perhaps even a burrowing anemone) in the future! Sandy researched that a uniform depth of 3 inches is required to cover the entire tank bottom with sand to create a healthy substrate. Given the dimensions of the touch tank below (in meters), about how much **volume of sand** did Sandy need?



Hints

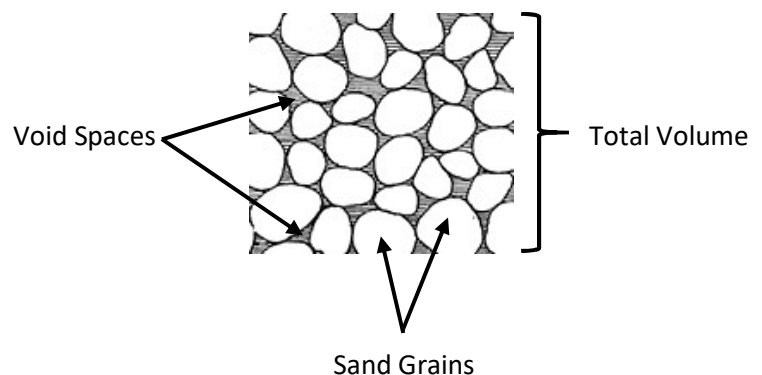
- Work in the same units!
1 inch = 2.54 centimeters
(What would this be in meters?)
- Volume = Area X Depth

Extension:

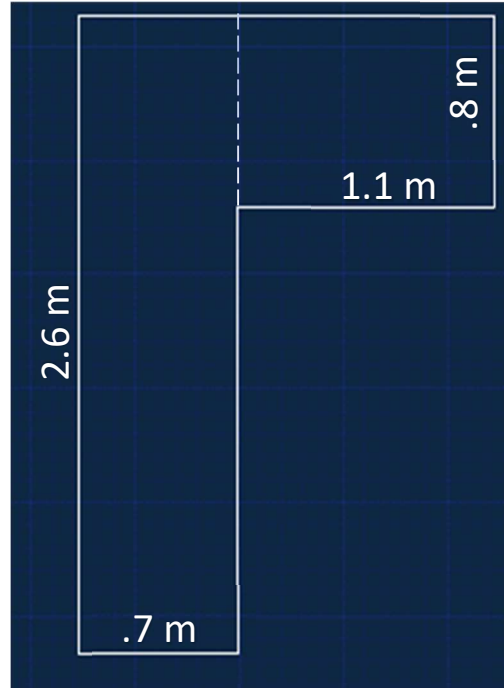
This touch tank can hold a total volume of 160 gallons. Assuming the *porosity* of the sandy substrate is **0.40** (or 40%), calculate how much water is needed to fill the entire tank to the brim using your calculated volume of sand from the previous exercise. The porosity is the *ratio* of the volume of the void spaces to total volume:

Hints

- $1 \text{ m}^3 = 264.2 \text{ gallons}$
- Porosity = $\frac{\text{Void Space Volume}}{\text{Total Volume}}$



Answer Key:



1. Break up the tank into two easily calculable areas and sum them to find the total area:
Area₁: (2.6 m)(.7 m) = 1.82 m²
Area₂: (1.1 m) (.8 m) = 0.88 m²
Area_{total}: 1.82 m² + 0.88 m² = 2.7 m²
2. Convert 3 inches to meters:
 $(3 \text{ in})\left(\frac{2.54 \text{ cm}}{1 \text{ in}}\right)\left(\frac{1 \text{ m}}{100 \text{ cm}}\right) = 0.0762 \text{ m of sand}$
3. Calculate volume of sand:
(0.0762 meters of sand)(2.7 m²) = **About 0.2 cubic meters of sand!**

Extension:

1. Convert cubic meters of sand to gallons of sand:
 $(0.2 \text{ m}^3 \text{ of sand})\left(\frac{264.2 \text{ gal}}{1 \text{ m}^3}\right) = 52.84 \text{ gal of sand}$
2. Multiply the given porosity with the gallons of sand to calculate the total void space:
 $(0.40 \frac{\text{void space volume}}{\text{total sand volume}}) (52.84 \text{ gallons of sand}) = 21.14 \text{ gal of void space}$
3. Subtract the void space volume from the total sand volume to get the volume of only sand grains:
52.84 gal of sand – 21.14 gal of void space = 31.70 gal of sand grains
4. Subtract the sand grain volume from the tank's total volume to get the water volume:
160 gal – 31.70 gal of sand grains = **About 128 gal of water!**



Steps 2 & 3 in the Extension can be reduced to a single step if you take the complement ratio for porosity (0.6)!