WHY ARE WATER WELLS MOSTLY CYLINDRICAL?

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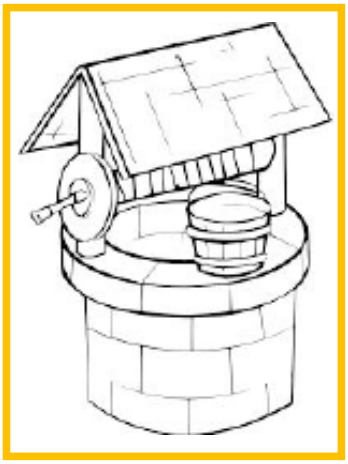


Time frame for the activity: 3 hours

Tags: Geography, Mathematics, Technology, Coding

Grade Level: 7 - 9

App/Tech Tools: Google docs, CoSpaces, device (phone/tablet)
Additional material: CleverBooks

Learning Objectives:

Find a possible answer to the proposed question:

WHY ARE WATER WELLS MOSTLY CYLINDRICAL?

A huge amount of water exists in the ground below your feet and people all over the world make necessary use of it. Building wells are one way of accessing this valuable life sustaining resource.

Through their work, in small groups, to find a possible answer to the posed question, students will be encouraged to work collaboratively to present their steps of working/ thinking processes towards their final conclusion.

Lesson Activity: Part 1

Divide the class into small groups and have the students engage with a given resource and encourage them to communicate their findings that are relevant to answering the posed question.

A website that will provide information that will help understand the different types of ground water available and the different types of wells that can be built to utilise this invaluable basic need.

SEE A WEBSITE

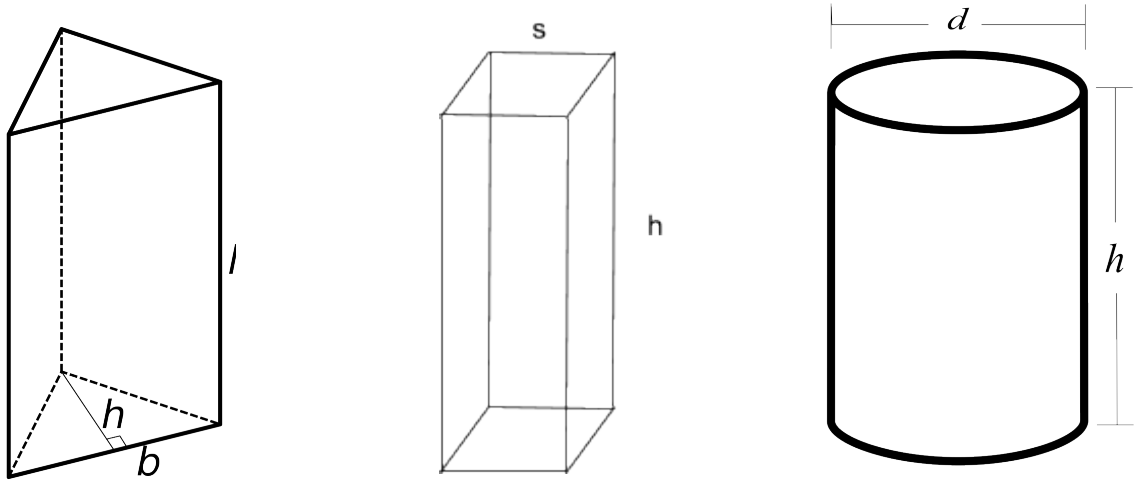
Lesson Activity: Part 2

A revision Mathematics lesson presented by the teacher.
Topics covered:
2D and 3D geometric figures
Area of 2D figures and Total surface area of 3D solids
Volume
using Clever Books Geometry Marker - triangle, square and circle

CleverBooks
STEAM Augmented Reality for Education

Lesson Activity: Part 3

Again in their groups, students will investigate the mathematical properties of a triangle based, square based and circle based prism.
In order to make a comparison students will be encouraged to standardise the measurements of the 3 different prisms.



For the purposes of this investigation the bases of the prisms will be an equilateral triangle, a square and a circle and the well will be defined to a specific depth and a limited surface area at ground level.
Using the diagrams of the 3 prisms provided, provide the formulas for calculating the total surface area and the volume of each prism.

TSA (total surface area) = *2 × area of base + perimeter of base × height of prism*

The students should be allowed to write the formula of the Total surface area (TSA) of all the 3D solids by unwrapping the 3D models.
Unwrapping the 3D models can be visualised byusing.

For Geogebra 3D app follow the steps to unwrap the cylinder

1) Open up GeoGebra 3D app on your device.
2) Go to the MENU (horizontal bars) in the upper left corner.
   Select OPEN.
   In the Search GeoGebra Resources input box, type rCxXxFhE
3) In the resource that uploads, zoom in/out if needed.

The r slider adjusts the radius of the cylinder.
The h slider adjusts the height of the cylinder.
Drag the slider named i to wrap/unwrap.
Other solid objects can be unwrapped by checking the following link

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VOLUME = *area of base × height of prism*

PRISM	TSA (total surface area)	VOLUME
Equilateral triangle based prism:	$= 2 \times \frac{b \times h}{2} + 3 \times b \times l$	$= \frac{b \times h}{2} \times l$
Square based prism:	$= 2 \times s^2 + 4 \times s \times h$	$= s^2 \times h$
Cylinder:	$= 2 \times \pi(\frac{d}{2})^2 + \pi d \times h$	$= \pi(\frac{d}{2})^2 \times h$

Investigate the ideal shape for a well that will be drilled to a depth of 120m in order to comfortably reach the water table and that can occupy an area of up to 4m² . The well wall will be 20 cm thick.

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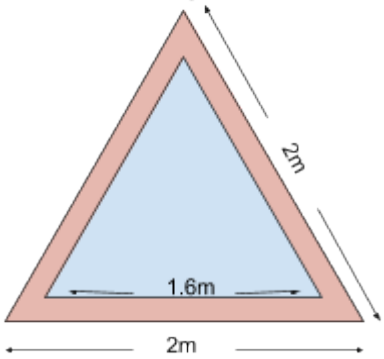
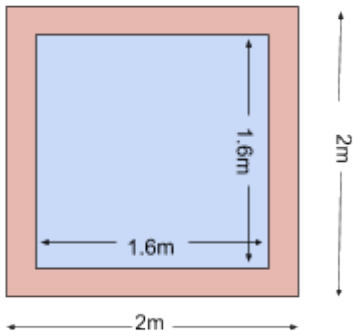
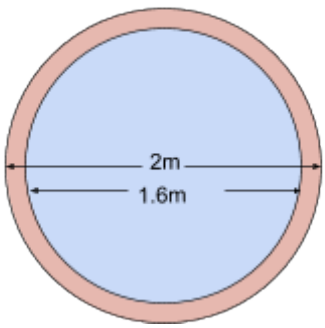
PRISM	TSA (total surface area)	VOLUME
Equilateral triangle based prism:	$= 2 \times \frac{b \times h}{2} + 3 \times b \times l$	$= \frac{b \times h}{2} \times l$
cross section of triangle base well wall.  	Height of triangle base calculated using pythagoras $= \sqrt{1,6^2 - 0.8^2} = 1,4m$ $= 2 \times \frac{1.6 \times 1.4}{2} + 3 \times 1.6 \times 120$ $= 2.24 + 576m^2$ $= 5768.24m^2$	$= \frac{1.6 \times 1.4}{2} \times 120$ $= 1.12m^2 \times 120m$ $= 134.4m^3$

PRISM	TSA (total surface area)	VOLUME
Square based prism:	$= 2 \times s^2 + 4 \times s \times h$	$= s^2 \times h$
cross section of square base well wall.  	$= 2 \times 1.6^2 + 4 \times 1.6 \times 120$ $= 5.12 + 768$ $= 773.12\ m^2$	$= 1.6^2 \times 120$ $= 256 \times 120$ $= 307.2m^3$

PRISM	TSA (total surface area)	VOLUME
Cylinder:	$= 2 \times \pi(\frac{d}{2})^2 + \pi d \times h$	$= \pi(\frac{d}{2})^2 \times h$
cross section of circle based well wall.  	$= 2 \times \pi\ 0.64 + \pi 1.6 \times 120$ $= 607.2m^2$	$= \pi 0.64 \times 120$ $= 241.3m^3$

Lesson Activity: Part 4

Using the knowledge that they have gained ,students will be required to create an AR model to compare the total surface area of different types of wells, using CoSpaces that represents their learning.

The following cospace AR model calculates the volume of different types of wells with different bases like square, triangle and circle. Students can further create the AR model taking help of this AR model.

Lesson Activity: Part 4

Each group of students will be required to present their answer to the posed question (their Conclusions).

Economical Structure

A cylindrical water tank has the least possible ratio of circumference to area i.e. less surface area than a box-shaped water tank that holds the same amount of water. For this reason, a spherical water tank requires less building material than its box-shaped equivalent and is consequently more economical to build.

Structural Strength

A round structure is the strongest geometric structure and is stronger than box-like alternatives, according to Monolithic. Therefore, a round structure will more successfully withstand the outward-directed force of the water stored within and the force of wind and rain that impinges upon the structure from without.

Constant Heat Level

Because round structures minimize the surface area through which heat can radiate, they keep the enclosed water at a more constant temperature than box-like structures. As a result, the water is less affected by ambient temperature fluctuations and also loses less heat in winter and gains less heat during the summer.

Cleaning and Hygiene

Round tanks are much easier to keep clean than those with corners. Corners are known to harbour microbes.