

# Settle for Less

By Ana Marie R. Nobleza

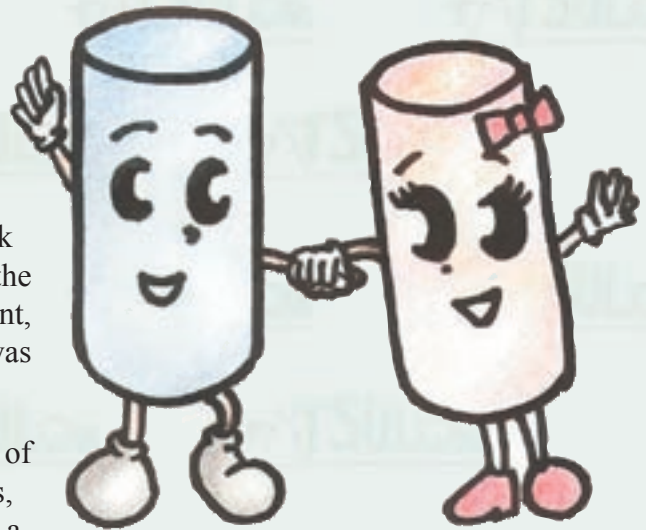
**T**he Sta. Barbara Villas Home Owners Association Board of Directors started to debate over the proposed construction of a new water storage tank. The new water tank would replace the old and small one to meet the demands of the growing community. At present, there are 100 households in the village, and it was expected to increase in a year's time.

Director Mac proposed the construction of a 14-meter tank with a diameter of 19 meters, while Director Joe favored the construction of a 23-meter tank with a diameter of 9 meters. The old tank was only 7 meters in diameter and 11 meters in height.

Hearing about the dispute over the water tank, the *Sangguniang Kabataan Officers* led by Matt offered to help. Matt proposed to the board that the old tank be only refurbished and a similar one be constructed next to it. He claimed that this would be cheaper than demolishing the old tank and constructing a larger one.

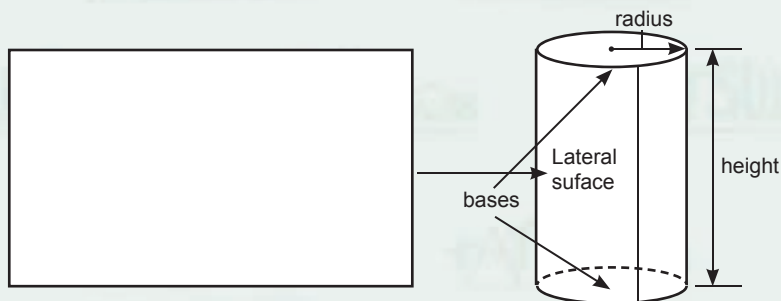
The tank, which would be cylindrical and made of stainless steel would cost P200.00 per square meter. The refurbishing would only require sealing small holes with adhesive and repainting, which would cost P30.00 pesos per square meter.

Is the SK Officers' proposal indeed cheaper? Will it suffice for the need of the villagers averaging about 10 cubic meters per household monthly?



## Cylinders and Their Surface Area and Volume

The cylinder is somewhat like a prism, except for its bases. It has parallel congruent bases that are not polygons. In real life, cylinders always have circular bases and are standing upright. They can be created by rolling a piece of rectangular paper and making both ends meet. See the figure below.



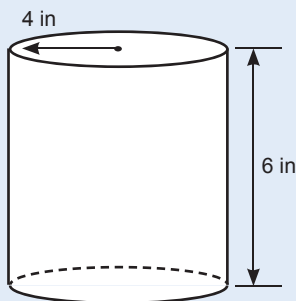
This makes finding the surface area of the cylinder easy. The rectangular piece makes the lateral surface, while the circular rings produced by the top and bottom edges make the outline of its circular bases. Its surface area  $SA$  is therefore the sum of the areas of the lateral surface  $L$  and the areas of the two bases  $B$ :  $SA = L + 2B$ . Since we know that the bases of our cylinder are circular, the lateral surface would be the product of the circumference of the base and the height of the cylinder. The surface area can therefore be computed as follows:  $SA = 2\pi rh + 2\pi r^2$ .

We find the volume of a cylinder in the same way that we find the volume of a prism: it is the product of the *base area*  $B$  and the *height*  $h$  of the cylinder:  $V = Bh$ .

And since the base of a cylinder is a circle, we can substitute the formula for the area of a circle into the formula for the volume, thus we get:  $V = \pi r^2 h$ .

### DO THIS!

Can you find the surface area and volume of this can?



Did you get a surface area of 251.33 square inches and a volume of 301.59 cubic inches?

## Which Is Less Pricey?

Now let us find out if Matt's proposal is indeed the least expensive. Complete the following table first and see for yourself.

Proposal	Diameter	Height	Surface Area	Volume	Total Cost of Construction
Director Mac's	19 m	14 m			
Director Joe's	9 m	23 m			
SK's	7 m	11 m			
	refurbishing the old tank				

Applying the formulas above, you must have obtained the following figures:

Proposal	Diameter	Height	Surface Area	Volume	Total Cost of Construction
Director Mac's	19 m	14 m	1 402.72 m <sup>2</sup>	3 969.40 m <sup>3</sup>	P280 544.00
Director Joe's	9 m	23 m	777.54 m <sup>2</sup>	1 463.20 m <sup>3</sup>	P155 508.00
SK's	7 m	11 m	318.87 m <sup>2</sup>	846.66 m <sup>3</sup>	P63 774.00 +
	refurbishing the old tank				P9 566.10

It looks like the SK's proposal is the cheapest, but don't be deceived. Try computing for the cost per cubic meter of water. Which gives the cheapest result?

You shall see that Director Mac's proposal is still the cheapest. Besides, it can accommodate the needs of the increasing population.



# Activity

During their club recruitment day, Matt and Geo decided to give the applicants a challenge ...

Geo and I will give each one of you a piece of short sized bond paper, measuring 8.5 inches by 11 in. Geo, tell them the goal of this challenge.



Did you get it? Start doing your stuff now.

It's simple. Using the piece of bond paper that you have, you make a cylinder or more cylinders that would accommodate the most stuff. Meaning, you have to create cylinder/s with the highest total volume.



I will make one tall cylinder with this piece of paper rolled lengthwise.



I will make a short cylinder with this piece of paper rolled crosswise.



I will cut this piece of paper crosswise and make two short cylinders. I'm sure I would get the highest total volume because I have two cylinders now.

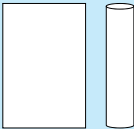
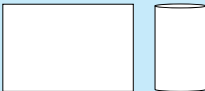
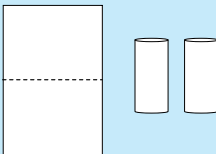
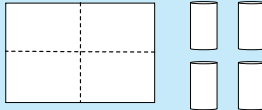


Will you really get the highest total volume?



Matt, let's make our readers work too. Let us make them find out which of the applicants would be able to make the highest volume.



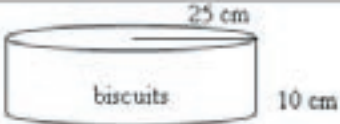
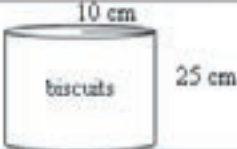


# Activity

Applicant	
1 (tall)	
2 (short)	
3 (2 short)	
4 (4 short)	
5 (8 short)	
...	

Applicant	Circumference of the Base (1 cyl)	$r$	$h$	Volume of 1 cyl(in <sup>2</sup> )	Quantity	Total Volume
1 (tall)						
2 (short)						
3 (2 short)						
4 (4 short)						
5 (8 short)						
...						

# WORKSHEET

A. Each row below contains same types of goods sold at a grocery presented in different cylindrical packaging. Compute for the volume and surface area, and then write them on the blanks under each item. Write the symbol  $<$ ,  $=$ ,  $>$  in the blanks in the middle for the quantities being compared.

	A		B
			
volume	_____	_____	_____
surface area	_____	_____	_____
			
volume	_____	_____	_____
surface area	_____	_____	_____
			
volume	_____	_____	_____
surface area	_____	_____	_____

B. Answer each of the following.

- An 8-cm-by-10-cm piece of rectangular cardboard is to be rolled to create a cylindrical tube. How should it be rolled so that:
  - Its volume is greater?
  - Its total surface area is greater?
- A gasoline storage tank is to be constructed using stainless steel in an oil depot. One engineer suggests that a 10-meter tank with a diameter of 10 m be constructed. Another engineer contradicts this idea since the lot area where the tank will be erected is only enough for a tank with a diameter half as long. If the second engineer's idea will be followed, how tall should the tank be? If the cost of steel per square meter is P200.00, which idea will cost less?

Answers to Activity

Applicant	Circumference of the Base (1 cyl)	$r$	$h$	Volume of 1 cyl(in <sup>3</sup> )	Quantity	Total Volume
1 (tall)	8.5"	1.35"	11"	62.98	1	62.98
2 (short)	11"	1.75"	8.5"	81.78	1	81.78
3 (2 short)	8.5"	1.35"	5.5"	31.49	2	62.98
4 (4 short)	5.5"	0.88"	4.25"	10.34	4	41.36
5 (8 short)	4.25"	0.68"	2.75"	3.99	8	31.96
...						

The second applicant got the highest volume. In fact, this would be the highest volume anyone could get. The notion that if the piece of paper is divided into several pieces would give the highest volume is not true.

Answers to Worksheet

A.

1	V	4772.03	<	4865.33
	SA	1589.40	<	1589.57
2	V	19634.95	>	7853.98
	SA	5497.79	>	2199.12
3	V	235.62	=	235.62
	SA	227.77	<	251.33

B.

- To get both greater volume and surface area, the piece of paper must be rolled crosswise to create a short fat cylinder.
- The height of the proposed tank of the 2<sup>nd</sup> engineer must be 40 m. The 1<sup>st</sup> engineer's proposal is cheaper.