Volume Relationships

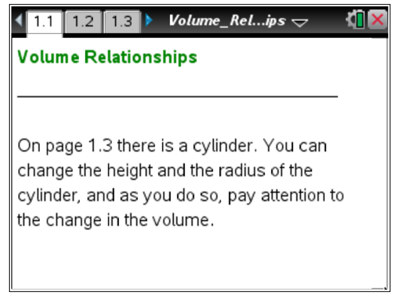
Student Activity

Name ______________

Class ______________

Open the TI-Nspire™ document *Volume_Relationships.tns.*

In this activity, you will determine the formula for the volume of a cylinder and then use that formula to determine the formulas for the volumes of both a cone and a sphere.



Move to page 1.3.

Tech Tip: Move the cursor to a point near an open circle, and press ctrl . You will see the closed hand. Use the NavPad to change the radius or height.

1. On Page 1.3, a cylinder is shown.
   a. The first row of the table below has been completed for you. Complete the rest of the table by:
      - changing the radius and height,
      - recording the corresponding volume, and
      - completing the calculation.

Radius	Height	Volume	Volume $\div$(Height x π)
2	3	12π	$\frac{12\pi}{3\pi} = 4$
2	4		
2	5		
3	3		
3	4		
3	5		
4	3		
4	4		
4	5		

   b. Look for a pattern in the table from part a. Using your findings, predict what you think the volume of a cylinder is with a radius of 5 and a height of 3. Explain your reasoning.

c. Change the radius to 5 and the height to 3. How does your prediction for the volume of this cylinder compare to the actual volume of the cylinder? If your value is different, explain why you think your value is different.

d. Look back at the table, and review your findings. Based on your data, predict the volume of a cylinder with radius 5 and height 4. Record your prediction. Check your prediction by changing the dimensions. Was your prediction correct? If not, explain why your prediction is different than the correct value.

e. Use your pattern to write the formula for the volume of a cylinder with radius *r* and height *h*.

Move to page 2.2.

2. On Page 2.2, a cylinder with a cone on top is shown. Notice that the cylinder and the cone have the same radius and height. Grab the open circle, and move it in the direction of the arrow until all of the water has been drained from the cone into the cylinder.
   a. The first row of the table below has been completed for you. Complete the rest of the table by:
      - changing the radius and height,
      - recording the filled height of the cylinder, and
      - completing the calculation.

      To change the height, grab the solid dot next to the words *adjust height*. To change the radius, grab the solid dot on the end of the radius.

Total Height of the Cylinder and Cone	Radius of the Cylinder and Cone	Filled Height of the Cylinder	Filled Height ÷ Total Height (as a simplified fraction)
18	9	6	$\frac{6}{18} = \frac{1}{3}$
15	9		
15	10		
21	12		

   b. Look for a pattern in the table in part a. If a cone has radius 12 and a height of 18, predict the filled height of the cylinder and the quotient of the filled height and the total height of the cylinder.

c. Check your prediction in part b by changing the dimensions of the cylinder. How did your prediction compare with the actual volume of the cylinder? If you prediction is different than the actual value, explain why.

d. Look back at the table, and review your findings. Predict the filled height and the quotient of the filled height and the total height of a cylinder with radius 11 and height 21. Write your predictions below.

e. Using the pattern you found for the filled height divided by the total height, what do you think is the relationship between the volume of the cone and the volume of the cylinder?

f. What do you think the volume of a cone is with radius 11 and height 18?

g. Click Show **cone vol** to see if your prediction in f is correct. Were you correct? If not, explain why.

h. Use your findings about the relationship between the volume of a cone and the volume of a cylinder to write a formula for the volume of a cone with radius *r* and height *h*.

Move to page 3.2.

3. On Page 3.2, there is a cylinder with a sphere above it. Notice that the cylinder and the sphere have the same radius and height. Grab the open circle, and move it in the direction of the arrow until all of the water has been drained from the sphere into the cylinder.
   a. The first row of the table below has been completed for you. Complete the rest of the table by:
      - changing the height,
      - recording the corresponding volume, and
      - complete the calculation.

      To change the height, grab the radius of the sphere, and drag it left or right.

Total Height of the Cylinder and Sphere	Radius of the Cylinder and Sphere	Filled Height of the Cylinder	Filled Height ÷ Total Height (as a simplified fraction)
18	9	12	$\frac{12}{18}=\frac{2}{3}$
24			
30			
12			

b. Using the pattern you found for the filled height divided by the total height (note: this is the same as the height or diameter of the sphere), what do you think is the relationship between the filled height of the cylinder and the height of the sphere?

c. Using your answer from part b and the formula for the volume of a cylinder from Question 1e, write a formula for the volume of the sphere in relationship to the formula for the volume of a cylinder.

d. The height of the sphere is actually defined to be the diameter of sphere. Using this definition and the relationship between the diameter and the radius, rewrite and simplify the formula for the volume of a sphere in terms of only the value of the radius.

e. Using your formula from d above, determine the volume of a sphere of diameter 36.

f. Check your answer in part e above, by changing the diameter of the sphere to 36 and clicking on the Show **sphere vol** arrow. Was your answer correct? If your calculation for the volume of the sphere is different, explain why.