

Activity 2: Investigation with a premade TI-Nspire file

# **Making Hay While the Sun Shines & Not Losing It in the Rain (The Geometry of the Big Round Bale)**



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(with special thanks to Jack Madding for the problem concept)**

This activity explores the volume of the hay bale and the percent of loss as the radius of the bale decreases. The extension collects data from the constructed cylinder in a spreadsheet and graphs it. The graphs are modeled with quadratic functions and transformations of quadratic functions can also be addressed. This version of the activity uses a premade TI-Nspire tns file to save classroom time. This version may also be used to accommodate struggling mathematics students allowing many more students to observe and learn about the behavior of the volume of a cylinder as the radius and height changes. Step-by-step instructions guide students through using the premade file. The activity is also posted in a form where the student creates the construction from the beginning. Students also benefit greatly from doing the entire construction, and there are step-by-step instructions for doing that as well.

# Making Hay While the Sun Shines & Not Losing It in the Rain

## (The Geometry of the Big Round Bale)

Much of the hay is baled in big round bales as shown in the picture above. Many of these bales can weigh as much as a ton. Also many of the bales are stored outside, and some of the hay on the outside of the bale deteriorates from the weather. Some of the bales are tied with baling twine, and others, like the one in the picture, are covered with a plastic netwrap to protect them from the elements. We are going to investigate what percent of the hay we might lose due to the weather if the bales are not protected by netwrap and how much that might cost us.

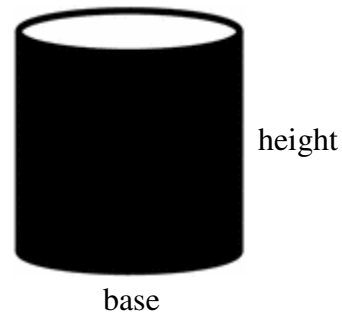


Figure 1

First we are going to sit the bale on its circular base so that we can apply the mathematics formula for volume. For our math purposes the height of the bale will be as shown in figure 1. (Farmers consider the height of the bale as it is laying in the field in the picture above.) Remember that to find the volume of prisms and cylinders, we multiply the area of the base times the height.

### Investigation

1. Open the *haybale.tns* document on your TI-Nspire handheld by pressing  $\text{Home}$  (the house icon) for Home, 7:Documents. Scroll to the file *haybale*, and press  $\text{Enter}$ . The first page of the document will open. (Figure 2)
2. Press  $\text{Ctrl}$   $\blacktriangleright$  on the NavPad to move to page 1.2 which is a blank calculator page. (Figure 3) Use this page to answer questions 1 – 5 on the answer sheet.
3. Next we will explore the volume of the bale as it changes dynamically with the diameter.



Figure 2

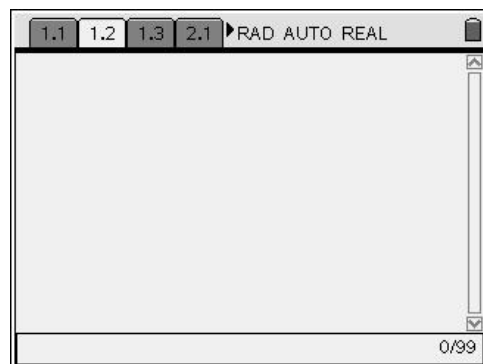


Figure 3

4. Press **ctrl** ► to move to page 1.3. Move the cursor to the radius point X until it becomes an open hand. Center click (Ⓞ) and hold until the hand closes. (Figure 4) Use the NavPad to vary the size of the radius and watch the volume change.

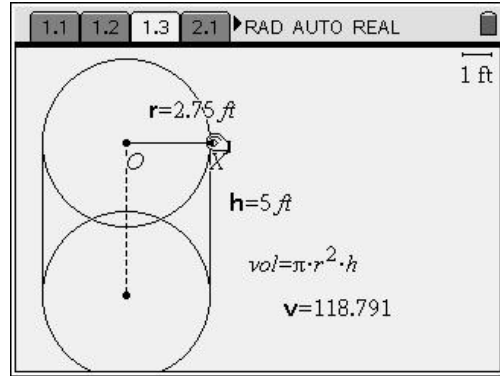


Figure 4

5. Adjust the radius to be 3 ft. Press **esc** to let go of the radius pt. Move to the center point of the bottom circle. Repeat the above procedure to adjust the height of the cylinder to 5 ft. (Figure 5) Does the volume agree with your answer to #1? Vary both the radius and the height of the cylinder, and observe how the volume changes. Answer questions 6 & 7 on the answer sheet.

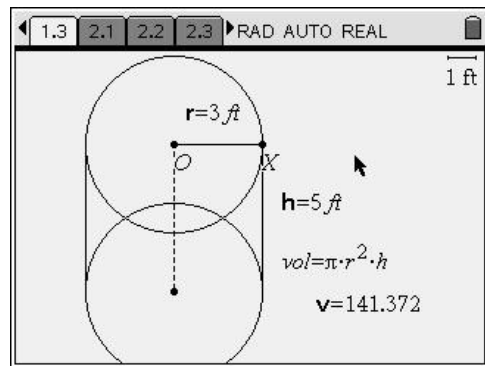


Figure 5

6. Press **ctrl** ► to move to page 2.1. There is a formula at the top of the page that computes the percent loss as the radius decreases from 3 ft. Under the formula the percent loss is shown as  $l =$ . Adjust the radius to 3 ft. and the height to 5 ft. Vary the radius and observe the percent lost. (Figure 6) Answer questions 8 – 11 on the answer sheet.

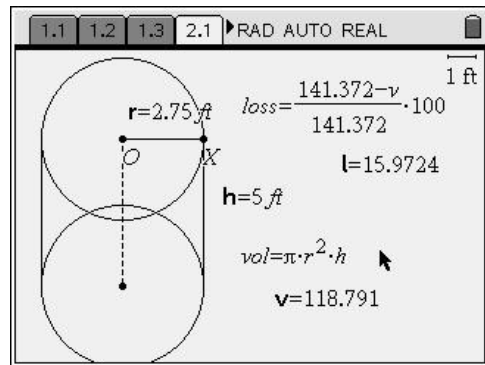


Figure 6

**Extension – Collecting Data in a Spreadsheet and Displaying it in a Graph.**

7. Press **ctrl** ► to move to page 2.2. This page is a spreadsheet set up to collect data from the cylinder as you vary the radius. (Figure 7)

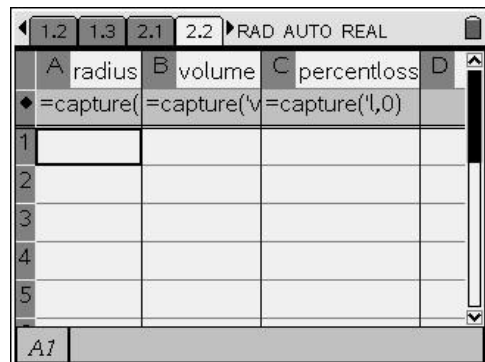


Figure 7

8. Page 2.3 is set up to graph radius and volume. (Figure 8)

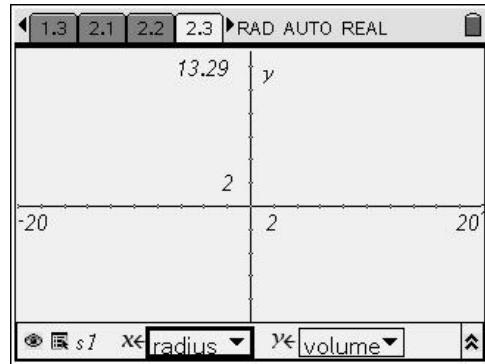


Figure 8

9. Page 2.4 is set up to graph radius and percent loss. (Figure 9)

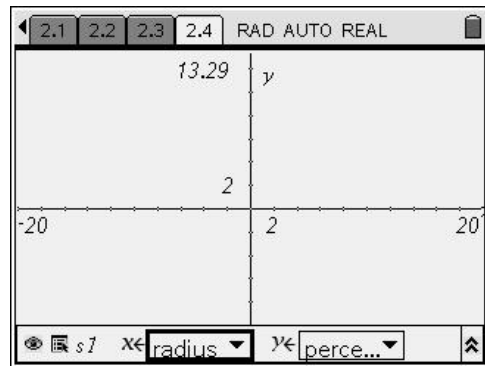


Figure 9

10. Now we are ready to collect some data from the cylinder. Press  $\text{ctrl} \leftarrow$  to navigate back to page 2.1. To begin the data collection, adjust the radius of the cylinder to 3 ft. and the height to 5 ft. To collect the first data point, press  $\text{ctrl} \cdot$ . Press  $\text{ctrl} \rightarrow$  to return to the spreadsheet on page 2.2 and observe the first collected data. (Figure 10)

A	B	C	D
radius	volume	percentloss	
=capture(	=capture(v	=capture('l,0)	
1	3	141.372	.000234
2			
3			
4			
5			
A7	=3		

Figure 10

11. Return to page 2.1 and collect several data points. Try to collect a data point about every .1 ft. Observe the collected data on page 2.2. (Figure 11)

A	B	C	D
radius	volume	percentloss	
=capture(	=capture(v	=capture('l,0)	
1	3	141.372	.000234
2	2.9	132.104	6.55577
3	2.8	123.15	12.8891
4	2.7	114.511	19.0002
5	2.6	106.186	24.8891
A7	=3		

Figure 11

12. Press  $\text{ctrl}$   $\blacktriangleright$  to move to page 2.3. Set the appropriate window for the collected data by pressing  $\text{menu}$   $\langle 4 \rangle$   $\langle 9 \rangle$  for Menu, 4:Window, 9:Zoom-Data. Press  $\text{ctrl}$   $\langle G \rangle$  to hide the entry line. (Figure 12)  
Repeat the above procedure for the graph on page 2.4.  
Answer questions 12 – 17 on the answer sheet.

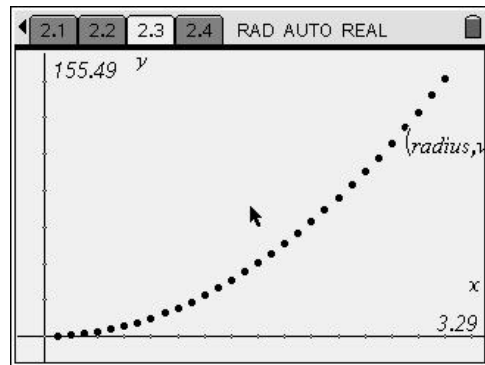


Figure 12

13. Return to page 2.3. Press  $\text{menu}$   $\langle 3 \rangle$   $\langle 1 \rangle$  for Menu, 3:Graph Type, 1:Function. This displays a function entry line. Using the work you have done in this activity, determine a function to model this data and enter it in the function entry line. Press  $\text{enter}$ .
14. Move to page 2.4. Display the function entry line as above. Using the work you have done in this activity, determine a function to model this data and enter it in the function entry line. Press  $\text{enter}$ . Answer questions 18 – 20 on the answer sheet.