

## Mathematics Objectives

- Students will analyze the relationship between the area and perimeter of a square.
- Students will graph functions to model the area and perimeter based on the length of a square.
- Students will graph a piecewise function to model choosing the larger number (perimeter or area) for a given length of a square and then connect the piecewise function to “if-then” statements.
- Students will graph functions, including piecewise functions, to fit a scatterplot.

## Applications and Skills

### Graphs and Geometry

- Grabbing points
- Dragging points

### Data and Statistics

- Entering functions
- Hiding functions
- Using trace

### Lists and Spreadsheets

- Automatic data capture

## Materials

- TI-Nspire handheld
- TNS file: lesson06.tns
- *Booth Space* (pages 87–89; page087.pdf)
- *Designing Your Bedroom* (page 90; page090.pdf)
- centimeter graph paper

## Starting the Lesson

After loading the TNS file (lesson06.tns) on each handheld, begin the exercise by instructing students to do the following:

1. Turn on the TI-Nspire by pressing **(on)**.
2. Press **(on)** and choose **My Documents**.
3. In the folder *Geometry TCM*, choose *lesson06*.
4. Remind the students how to navigate through the TNS file. To move forward through the pages, press **(ctrl) ▶**. To move backward through the pages, press **(ctrl) ◀**. To choose a particular page, press **(ctrl) ▲**, position the cursor on the desired page, and press **(enter)**. To undo previous steps, press **(ctrl) [Z]** or **(ctrl) (esc)**. Show students that any time they are using a menu that they wish to exit, they should press **(esc)**.

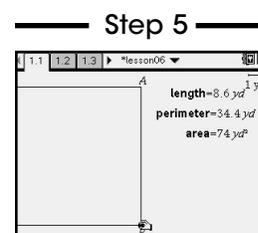
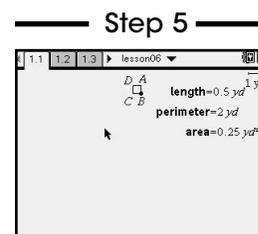


**Note:** Page numbers refer to the TI-Nspire file lesson06.

### Explaining the Concept

#### Problem 1—Booth Space

- Step 1** Distribute copies of *Booth Space* (pages 87–89) to students, and have them open to page 1.1.
- Step 2** Explain to students that the sketch on this page shows square ABCD along with the measurements of its length, perimeter, and area.
- Step 3** Allow students to observe the measurements and answer question 1 on their activity sheets. Remind students to pay special attention to the unit for each measurement.
- Step 4** Lead a discussion about the relationship among side length, perimeter, and area. Allow students to answer questions 2 and 3 on their activity sheets.
- Step 5** Now, have students grab point B, drag it straight down to the bottom of the screen, and let it go. Remind students to press **(esc)** to release the point. (See page 194 for more detailed directions on grabbing and dragging points.)
- Step 6** Have students discuss with partners the results of manipulating the sketch in this way. Discuss the change in magnitude of the numbers and the units in each measurement. Then, give students time to answer question 4 on their activity sheets.
- Step 7** Instruct students to press **(ctrl) ▶** to tab to page 1.2. Tell students that this spreadsheet automatically collected the length, perimeter, and area of the square in Columns A, B, and C respectively. Tell them that initially the perimeter was larger in magnitude than the area. Have students examine the data in the spreadsheet to find at what length the magnitude of the area becomes larger than the magnitude of the perimeter. Then, have students record those measurements on their activity sheets in question 5.
- Step 8** Instruct students to press **(ctrl) ▶** to tab to page 1.3. Tell them that this page shows two scatterplots. As a class, discuss the relationship that is shown by the scatterplot with white points. Then discuss the relationship that is shown in the scatterplot with dark points.



**Step 7**

	l	p	a
1	0.5	2	0.25
2	0.60208	2.40832	0.3625
3	1.88215	7.52861	3.5425
4	4.30174	17.207	18.505
5	6.69496	26.7798	44.8225
Av	=4.3017438324475		

**Note:** Page numbers refer to the TI-Nspire file lesson06.

## Explaining the Concept *(cont.)*

### Problem 1—Booth Space *(cont.)*

**Teacher Note:** The graph on page 1.3 is set up to automatically use the spreadsheet to create two scatterplots. The white points represent perimeter versus length for the squares. The dark points represent area versus length for the squares. Students will be asked to graph several functions on this screen.

**Step 9** Allow students to record their thoughts from the discussion in question 6 on their activity sheets as well as answer the last part of that question.

**Step 10** Tell students that the function entry line is visible at the bottom of the graph on page 1.3. For  $f1(x)$ , have students enter the function for perimeter as a function of length ( $x$ ). To do this, have students put their cursors into the function entry line and press  $\left[\frac{\square}{x}$ . Have students type the function that they think represents the perimeter as a function of length ( $x$ ), and then press  $\text{enter}$ . The graph will appear, and the entry line will change to  $f2$ .

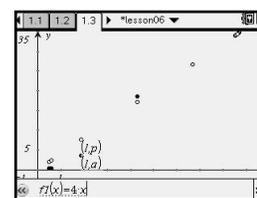
**Step 11** Now, have students repeat this process for  $f2(x)$  by entering the function for area as a function of length.

**Step 12** Ask students what functions they entered and where the two functions intersect. Allow them to record their answers in question 7 on their activity sheets. Then, instruct students to prove algebraically where these two functions intersect, and have them write the proof in question 8 of their activity sheets.

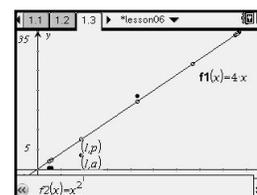
**Step 13** Instruct students to hide functions  $f1(x)$  and  $f2(x)$ . To do this, have students put their cursors back into the entry line and press  $\text{tab}$   $\blacktriangle$  on their ClickPads. Have students press  $\text{enter}$  or  $\left[\frac{\square}{x}$  to display the list of functions graphed on the page. Instruct students to press  $\blacktriangle$  to function  $f2(x)$  and then press  $\blacktriangle$  until a box appears around the “eye,” which is the symbol for hide/show. Once students press  $\text{enter}$  or  $\left[\frac{\square}{x}$ , the line will be hidden. Instruct students to repeat these steps to hide  $f1(x)$ .

**Step 14** Then, for  $f3(x)$ , instruct students to enter a piecewise function that graphs the larger number (perimeter or area) for each length. To access the template for entering a piecewise function, press  $\text{ctrl}$   $\left[\frac{\square}{x}$ , and select the appropriate template (top row, seventh from the left).

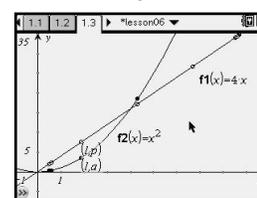
Step 10



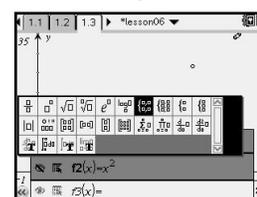
Step 11



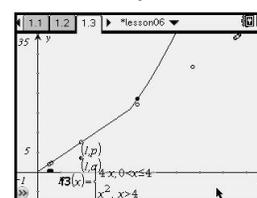
Step 11



Step 14



Step 14



**Note:** Page numbers refer to the TI-Nspire file lesson06.

### Explaining the Concept *(cont.)*

#### Problem 1—Booth Space *(cont.)*

**Step 15** Have students record their piecewise functions in question 9 on their activity sheets.

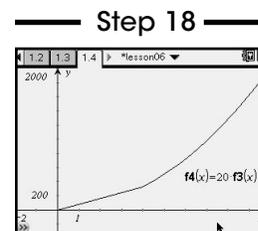
**Step 16** Write the statement below on the board or overhead 3 times:

If the length of a square is \_\_\_\_\_, then the magnitude of its area is \_\_\_\_\_ the magnitude of its perimeter.

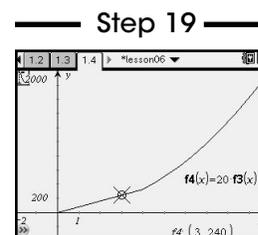
As a class, discuss three different ways to complete this statement to make it true. Allow students to record all three possibilities on their activity sheets in question 10. (*4, the same as; greater than 4, is more than; less than 4, is less than*)

**Step 17** Write the following problem on the board or overhead and read it together as a class: A convention center sells square spaces for vendors to set up their booths during conventions. They charge \$20 per yard of perimeter or \$20 per square yard of area, whichever is greater.

**Step 18** Now, have students press **(ctrl)** **▶** to tab to page 1.4. Explain to students that the graph on this page is set with an appropriate window to examine the price of a vendor area. For  $f_4(x)$ , have students enter the function that defines the cost of a vendor space based on the results of  $f_3(x)$ . Have students answer question 11 on their activity sheets.



**Step 19** Instruct students to use the trace feature to determine the cost of a vendor space that has a length of 3 yards. To do this, have students press **(menu)**, select **Trace**, and then select **Graph Trace**. Then, a tracker appears on the  $x$ -axis that can be moved with the arrows on the ClickPad. (See page 206 for more detailed directions on using the trace tool.)



**Step 20** Have students repeat the process discussed in step 19 using lengths of 4 yards, 5 yards, and 8 yards. Then, have them record their findings in question 12.

**Step 21** Conduct a class discussion of the problem and the mathematics being explored. Be sure that students know how to define functions for finding perimeter and area of squares and how to find the point of intersection algebraically. Help students connect the “language” of piecewise functions to the phrasing of “if-then” statements.

**Note:** Page numbers refer to the TI-Nspire file lesson06.

## Applying the Concept

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### Problem 2—Designing Your Bedroom

- Step 1** Distribute copies of *Designing Your Bedroom* (page 90) to students, and have them press  $\text{ctrl}$   $\blacktriangleright$  to tab to page 2.1.
- Step 2** As a class, read the scenario at the top of the page. Then, allow students to begin working the problem.
- Step 3** Once students are finished, invite several students to share their designs with the class.

### Differentiation

- **Below Grade Level**—Allow students to complete the activity sheet as a group or in pairs. Allow students to draw squares on centimeter graph paper and find their areas and perimeters.
- **Above Grade Level**—Allow students to complete this activity independently. Then, have students decide what size rug they could put on the floor. Depending on the ability level of the students, you may choose to have them design a rectangular or circular rug. Have students construct the rugs of their choice in their TNS files and on their activity sheets. Remind students to accurately label either the side measurements or the diameter, depending on the shape of their rugs.

## Extending the Concept

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- Examine the volume of cubes compared to their surface areas.