



Math Objectives

- Students will investigate side length and area in a rectangle with a fixed perimeter.
- An algebraic or geometric approach is used so that students can generalize their findings to other rectangles.
- Communicate mathematical ideas, reasoning, and their implications using multiple representations.

Vocabulary

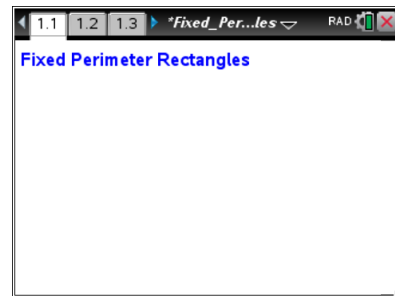
- area
- perimeter

About the Lesson

- The estimated time for this activity is 30 to 45 minutes.
- If you are planning for students to create this file, take time to follow the directions before facilitating the process with students. Otherwise, send the file *Fixed_Perimeter_Rectangles.tns* to student handheld devices.
- This activity is designed to be student-centered, with the teacher acting as a facilitator while students work cooperatively. The student worksheet is intended to guide students through the activity and provide a place to record their answers.

TI-Nspire™ Navigator™ System

- Use Class Capture to observe students' work as they proceed through the activity.
- Use Live Presenter to have a student illustrate how he or she used a certain tool.



TI-Nspire™ Technology Skills:

- Download a TI-Nspire™ document
- Open a document
- Move between pages
- Grab and drag a point

Tech Tips:

- Make sure the font size on your TI-Nspire™ handheld is set to Medium.
- Once a function has been graphed, the entry line can be shown by pressing **ctrl** **G**.

Lesson Materials:

Create Instructions

- Fixed_Perimeter_Rectangles_Create.pdf

Student Activity

- Fixed_Perimeter_Rectangles_Student.pdf
- Fixed_Perimeter_Rectangles_Student.doc

TI-Nspire™ document

- Fixed_Perimeter_Rectangles.tns

Visit www.mathnspired.com for lesson updates and tech tip videos.



Discussion Points and Possible Answers

Tech Tip: If students experience difficulty dragging a point, check to make sure that they have moved the arrow until it becomes a hand (☞). Press

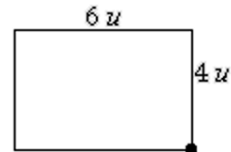
ctrl



to grab the point and close the hand (☜).

Part 1—Exploring a rectangle with a perimeter of 20 units

1. The rectangle at the right has dimensions as shown, where the base (length) = 6 units and height (width) = 4 units.



a. What is the perimeter of the rectangle?

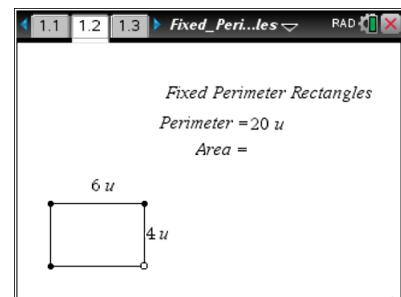
Answer: 20 units

b. What is the area of the rectangle?

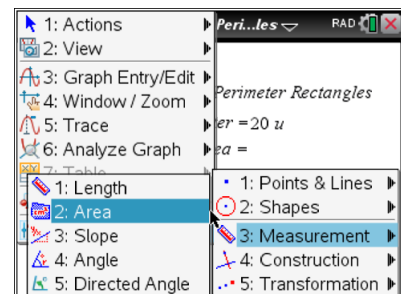
Answer: 24 square units

Move to page 1.2.

The rectangle on page 1.2 of the TNS document should have the same dimensions as the rectangle in problem 1. If necessary, move the point at the lower-right vertex to make the rectangle match the one shown above.

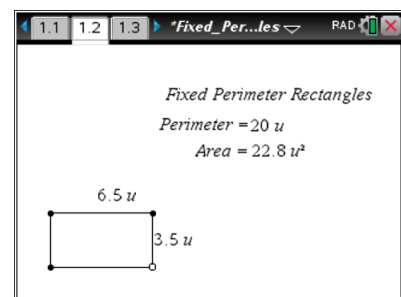


2. Press **Menu > Geometry > Measurement > Area**. Move the cursor near the rectangle until the word **polygon** is displayed. Press . Move the measurement and place it to the right of “Area =.” Press **enter**. Press **esc**. Does the measurement match your answer to question 1b?



Answer: Yes, the measurement for area is $24 u^2$.

3. Grab the point at the lower-right vertex of the rectangle and change the dimensions so that the rectangle is 6.5 units by 3.5 units.



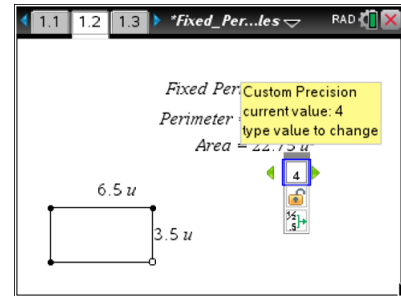
a. What is the displayed area for this rectangle? Is the area measurement correct? Why or why not?

Answer: $22.8 u^2$. The area measurement is not correct because $6.5 \cdot 3.5 = 22.75$.



- b. Move the cursor over the area measurement of 22.8 u^2 until the word **text** is displayed. Right-click (**ctrl** **menu**), and choose **Attributes**. Press **►** to increase the displayed measurement to 4 digits. Press **enter**. Is the new area measurement correct?

Answer: Yes.



4. Record data for four different rectangles. Grab the point at the lower-right vertex of the rectangle to change its dimensions. Record the data in rows 1–4 in the table. Use the last row in the table to generalize the relationships.

Sample Answer:

	Base (units)	Height (units)	Perimeter (units)	Area (sq. units)
Rectangle 1	8	2	20	16
Rectangle 2	2.5	7.5	20	18.75
Rectangle 3	5	5	20	25
Rectangle 4	9.5	0.5	20	4.75
Rectangle n	n	$10 - n$	20	$n(10 - n)$

Teacher Tip: It is possible that students may drag the vertex to a location that causes the rectangle to disappear. This is because the rectangle was created to have a perimeter of 20 units and the base, n , must have values such that $0 < n < 20$.

5. Examine the data in the table. Describe your observations. What patterns or relationships do you observe?

Answer: The sum of the base and height is always 10 (half the perimeter).

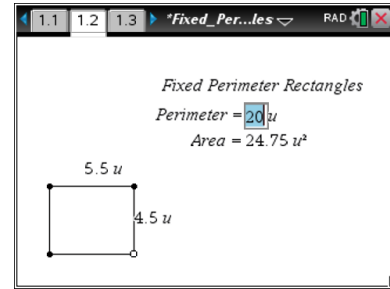
6. Grab the point at the lower-right vertex of the rectangle to change its dimensions. Watch the measure of the area as you change the rectangle. What are the dimensions of the rectangle with the greatest area with a fixed perimeter of 20 units?

Answer: base = 5 units, height = 5 units, area = 25 square units



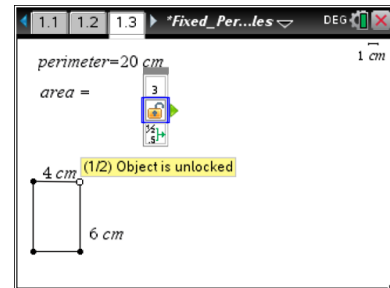
Part 2—Exploring rectangles with a different perimeter

To change the perimeter of the rectangle, move the cursor over the value 20 until you see a hand (☞) and the word **text**. Press twice to open the text box. Press to delete the current value. Type in a new perimeter value, and then press . (Choose a perimeter value between 8 and 35 units for best viewing on the screen.) **Note:** When the perimeter value is changed, the rectangle may disappear. Grab the open point and slide it until a rectangle appears.



Note: If the second construction method described in the Fixed_Perimeter_Create document is used, the following procedure should be used to change the value of the perimeter.

Unlock the perimeter measurement by changing its attribute to unlocked. Change the measures of the length and width to appropriate values and relock the perimeter value.



- Grab the point at the lower-right vertex of the rectangle to change its dimensions. Record the data in rows 1–4 in the table. Use the last row of the table to generalize the relationships.

Sample Answer:

	Base (units)	Height (units)	Perimeter (units)	Area (sq. units)
Rectangle 1	3	6	18	18
Rectangle 2	2.5	6.5	18	16.25
Rectangle 3	8	1	18	8
Rectangle 4	4.5	4.5	18	20.25
Rectangle n	n	$p/2 - n$	p	$n(p/2 - n)$

- Examine the data in the table. Describe your observations. What patterns or relationships do you observe?

Answer: The sum of the base and height is always half the perimeter.



9. A rectangle has a perimeter of p units and a base of b units.
- a. Write an expression to represent the height, h , of the rectangle.

Answer: $h = \frac{P}{2} - b$

- b. Write an expression to represent the area, a , of the rectangle.

Answer: $a = b\left(\frac{P}{2} - b\right)$

Wrap Up

Upon completion of the discussion, the teacher should ensure that students understand:

- The relationship between side length and area in a rectangle with a fixed perimeter.
- An algebraic approach to generalizing their findings to other rectangles.