Math Objectives

- Students will factor trinomials of the form $x^2 + bx + c$, where b and c are positive integers.
- Students will relate factoring a quadratic trinomial to an area model.
- Students will generalize the process for factoring trinomials of the form $x^2 + bx + c$, where b and c are positive integers.

Vocabulary

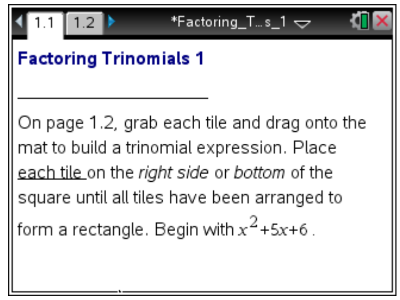
- trinomials
- factor

About the Lesson

- This lesson involves factoring trinomials using a dynamic area model. As such, it is implicit that x represents a positive quantity.
- As a result, students will factor trinomials of the form $x^2 + bx + c$, where b and c are positive integers, recognizing that in general the factors of c that sum to b are those needed to correctly factor the trinomial.

TI-Nspire™ Navigator™ System

- Use Quick Poll to check student understanding.
- Use Screen Capture to examine patterns that emerge.
- Use Live Presenter to engage and focus students.



TI-Nspire™ Technology Skills:

- Open a document
- Move from one page to another
- Grab and drag by an identified vertex

Tech Tip:

- Download a TI-Nspire document.
- Make sure the font size on your TI-Nspire handheld is set to Medium.

Lesson Materials:

Student Activity

- Factoring_Trinomials_1_Student.pdf
- Factoring_Trinomials_1_Student.doc

TI-Nspire document

- Factoring_Trinomials_1.tns

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

Discussion Points and Possible Answers

Tech Tip: To drag a tile to a new location on page 1.2, grab the point at the top left vertex and move the tile. The pieces will "snap" into place, their orientation changing depending on where you try to place them.

If students experience difficulty dragging a tile, check to make sure that they have moved the cursor arrow close to the point (vertex). The arrow should become a hand ( ) getting ready to grab the point. They are then to press ctrl to grab the tile; the hand will close. After the tile has been moved, students press esc to release the point.

Teacher Tip: Discuss page 1.2. Review that *factor* means "rewrite the entire expression as a product rather than a sum." Explain that students will use tiles to represent the factors in a trinomial. Note that tiles should not be placed on top of other tiles, adding that the pieces must be used to create a rectangle.

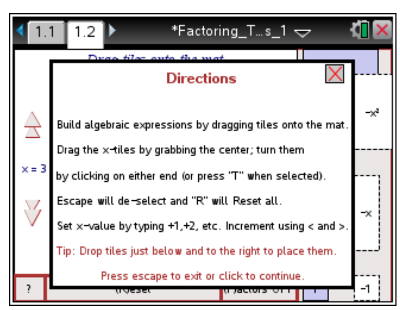
Discuss why the dimensions of the rectangle are the factors of the trinomial. Students can create two rectangles that look different but are actually congruent because $(x + 1)(x + 2)$ is the same factorization as $(x + 2)(x + 1)$ by virtue of the commutative property of multiplication.

TI-Nspire Navigator Opportunities

Make yourself the *Live Presenter* to demonstrate how to factor the trinomial $x^2 + 3x + 2$ using the tiles. In that way, students can see exactly what they need to do, and what pitfalls to avoid.

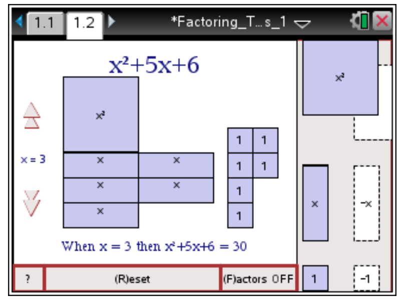
Move to page 1.2.

Follow the onscreen instructions to construct trinomial $x^2 + 5 \cdot x + 6$.



1. Arrange all the tiles to form a rectangle with the area $x^2 + 5x + 6$. What are the dimensions of the rectangle?

   Answer: The dimensions are $(x + 3)$ by $(x + 2)$.



> **Teacher Tip:** Students should be reminded that they are working with an area model and that by placing additional *x* tiles, they are adding area to the x^2 tile. You may wish to circulate throughout the classroom to help struggling students with the placement of the tiles.

TI-Nspire Navigator Opportunities

Select a student to be the *Live Presenter* to illustrate how to form the rectangle.

2. a. Multiply the dimensions you found for the rectangle to prove that $x^2 + 5x + 6$ is the area of the rectangle.

   Answer: $$\begin{aligned}(x+3)(x+2) &= x^2+3x+2x+6\\ &= x^2+5x+6\end{aligned}$$

   b. How do the dimensions of the rectangle relate to the numbers 5 and 6?

   Answer: $2 + 3 = 5$ and $2 \cdot 3 = 6$.

Click the Reset box in the lower left portion of the screen.

Construct the trinomial $x^2 + 7 \cdot x + 6$.

TI-Nspire Navigator Opportunities

Use *Screen Capture* to monitor students' progress. Assist students as necessary. If too many students are having difficulty, make one student the *Live Presenter* to show how to finish a particular problem.

3. a. Arrange all the tiles to form a rectangle with area $x^2 + 7x + 6$. What are the dimensions of the rectangle?

Answer: The dimensions of the rectangle are $(x + 1)$ and $(x + 6)$.

b. How do the dimensions of the rectangle relate to the numbers 7 and 6?

Answer: $1 + 6 = 7$ and $1 \cdot 6 = 6$

4. For each of the following, move the correct tiles to the mat. Factor each trinomial by arranging all the tiles to make a rectangle. Verify that your answer for each one is correct by finding the product.

a. $x^2 + 5x + 4$

Answer: $$\begin{aligned}(x+1)(x+4) &= x^2 + x + 4x + 4 \\ &= x^2 + 5x + 4\end{aligned}$$

b. $x^2 + 4x + 4$

Answer: $$\begin{aligned}(x+2)(x+2) &= x^2 + 2x + 2x + 4 \\ &= x^2 + 4x + 4\end{aligned}$$

5. The trinomial $x^2 + 6x + 4$ cannot be factored.

a. How does the TI-Nspire document illustrate that it cannot be factored?

Answer: It is impossible to build a rectangle with the tiles shown.

b. How can the constant term be changed so that the trinomial can be factored?

Answer: Answers will vary depending on how students approached the building of the rectangle. Possible answers are 0, 5, 8, and 9.

c. State your new trinomial, and show its factors.

Answer: Answers will vary. Possibilities that use the constants specified in question 7b are as follows:

$x^2 + 6x + 8 = (x + 4)(x + 2)$
$x^2 + 6x = x(x + 6)$
$x^2 + 6x + 5 = (x + 1)(x + 5)$
$x^2 + 6x + 9 = (x + 3)(x + 3)$

6. a. Find the factors of each of the following trinomials.

Trinomial	Factored Form
$x^2 + 4x + 3$	**$(x + 3)(x + 1)$**
$x^2 + 8x + 15$	**$(x + 5)(x + 3)$**
$x^2 + 9x + 20$	**$(x + 4)(x + 5)$**
$x^2 + 12\,x + 20$	**$(x + 10)(x + 2)$**

b. Explain how you know you have factored each trinomial correctly.

Answer: Explanations will vary. Students may build rectangles on page 1.3 with the given dimensions, multiply the factors, or show that the constants add up to the coefficient of the second term of the trinomial and multiply out to the third term of the trinomial.

Teacher Tip: All of the factorizations can be modeled using the handheld. You should circulate throughout the room to help those students who are struggling either with the mathematics or the technology. You might also want to assign these factorizations as homework. Be sure that students can articulate the fact that the factors of the constant term must add up to the coefficient of the linear term.

7. Suppose $x^2 + bx + c = (x + m)(x + n)$. How are m and n related to b? How are m and n related to c?

Answer: $m + n = b$ and $m \cdot n = c$

TI-Nspire Navigator Opportunities

Use a *Quick Poll* to have students submit their answer to question 7. Then, compare and discuss those answers.

Wrap Up

Upon completion of the discussion, ensure that students are able to understand:

- How to factor trinomials of the form $x^2 + bx + c$ with positive integer coefficients.
- The relationship between an area model and factoring trinomials.
- The relationship between b and c and the constant terms in the factors of a trinomial of this form.