Math Objectives

- Students will be able to describe how the area of a parallelogram relates to the area of a rectangle with the same base and height.
- Students will be able to describe how the area of a triangle relates to the area of a parallelogram with the same base and height.
- Students will be able to describe how the area of a trapezoid relates to the area of a parallelogram with the same height and with a base equal to the sum of the bases of the trapezoid.
- Students will be able to use relationships to compute the areas of parallelograms, triangles, and trapezoids given their dimensions.

Vocabulary

- rectangle
- parallelogram
- triangle
- trapezoid

About the Lesson

Students will:

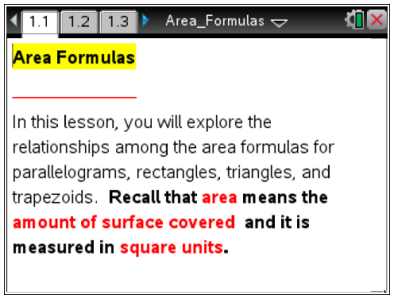
- Observe the relationships between figures and compare the areas of the figures.
- Formulate expressions to compute the area of parallelograms, triangles, and trapezoids.

TI-Nspire™ Navigator™ System

- Send out the *Area_Formulas.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies: TI-Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software



Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Materials:

Student Activity

- Area_Formulas_Student.pdf
- Area_Formulas_Student.doc

TI-Nspire document

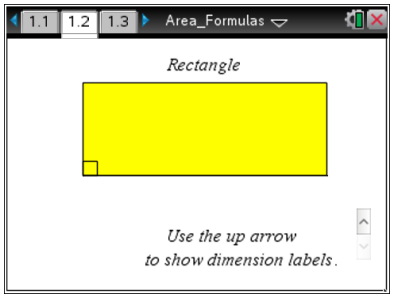
- Area_Formulas.tns

Discussion Points and Possible Answers

Tech Tip: If students experience difficulty dragging a point, make sure they have not selected more than one point. Press esc to release points. Check to make sure that they have moved the cursor (arrow) until it becomes a hand () getting ready to grab the point. Then select ctrl to grab the point and close the hand (). When finished moving the point, select esc to release the point.

Tech Tip: Tap the up arrow to show dimension labels. **Longer taps may be necessary.**

Move to page 1.2.



1. Use the "up" arrow to show the dimension labels of the rectangle.
   a. What are the labels for the dimensions of the given rectangle?

      Answer: base and height

   b. What is the formula for the area of the rectangle in terms of base and height?

      Answer: Area = base × height

      Teacher Tip: You may want to discuss the different vocabulary (labels) used for the dimensions of the rectangle (width and height, length and width, and base and height). For this activity, the dimensions will be referred to as base and height.

2. Drag the top left or bottom right vertex to change the dimensions of the rectangle. If you change the dimensions of the rectangle, would this change the formula for the area of the rectangle?

   Answer: No, it would still be Area = base × height.

   Tech Tip: To change the dimensions of the rectangle, students should select a vertex of the figure and drag it. Note that the point at a vertex of the rectangle will not be visible until the student begins dragging it. Dragging the point at the top left corner of the figure will change the height. Dragging the point at the bottom right corner will change the base.

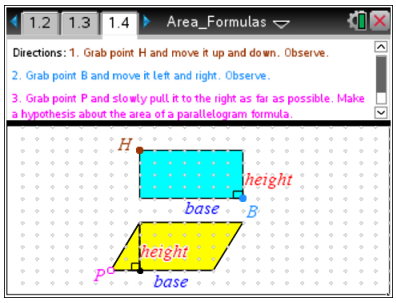
TI-Nspire Navigator Opportunities

Send students the following Always/Sometimes/Never Quick Poll, and then have students justify their responses.

Rectangles with the same perimeter have the same area.

Answer: Sometimes. 3 rectangles with a perimeter of 12 units could have dimensions 2×4, 4×2, and 1×5.

Move to page 1.3. After reading the instructions, move to page 1.4.



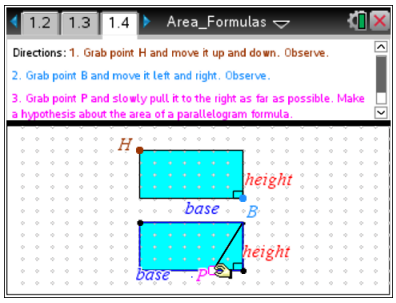
3. a. How do the base and height of the parallelogram compare to the base and height of the rectangle at the top of the screen?

Answer: The base of the parallelogram = the base of the rectangle.
The height of the parallelogram = the height of the rectangle.

b. Move point *H* or point *B*. Describe the changes that occur in the rectangle and the changes in the parallelogram.

Answer: As the base of the rectangle changes, the base of the parallelogram changes accordingly. As the height of the rectangle changes, the height of the parallelogram changes accordingly.

4. Drag point *P* to the right as far as you can.
   a. Explain why the new figure on the bottom of the screen is a rectangle.



Answer: The new figure is a quadrilateral with right angles.

b. What does this tell you about the area of the original parallelogram?

Answer: The original parallelogram has the same area as the rectangle.

c. Why do the parallelogram and the rectangle have the same area?

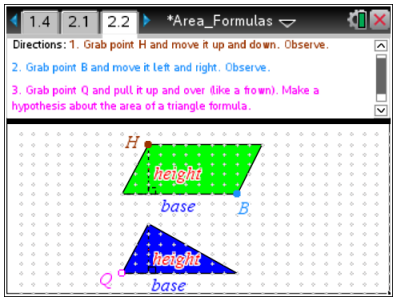
Answer: They have the same base and height.

d. What could be a formula for the area of the parallelogram?

Answer: Area = base × height

> **Teacher Tip:** Make sure students understand they cannot always simply measure the sides to find area. Ask probing questions such as: Is a side length ever a height? If you know the area, can you find the base and height?

Move to page 2.1. After reading the instructions, move to page 2.2.



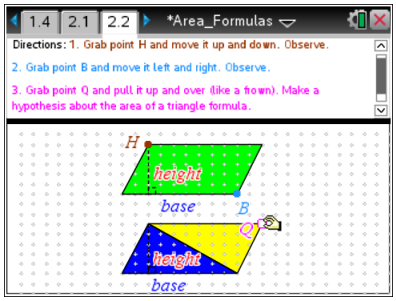
5. a. How do the base and height of the triangle compare to the base and height of the parallelogram at the top of the screen?

Answer: The base of the triangle = the base of the parallelogram.
The height of the triangle = the height of the parallelogram.

b. Move point *H* or point *B* on the parallelogram. Describe the changes that occur in the parallelogram and the changes in the triangle.

Answer: As the base of the parallelogram changes, the base of the triangle changes accordingly. As the height of the parallelogram changes, the height of the triangle changes accordingly.

6. Rotate point *Q* until it is as far right as possible.



a. What type of figure is formed?

Answer: a parallelogram

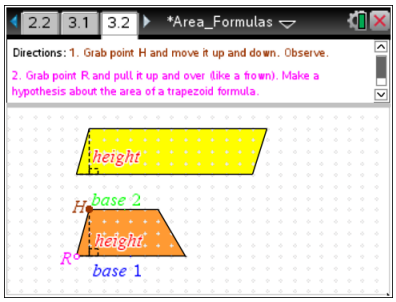
b. How does the area of the original shaded triangle compare to the area of the parallelogram?

Answer: The area of the triangle is half the area of the parallelogram. (It takes two triangles to equal the parallelogram.)

7. If the area of a parallelogram is base times height, then what could be a formula for the area of the triangle?

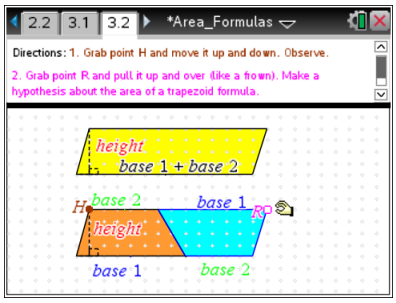
   Answer: Area = $\frac{1}{2} \times$ base $\times$ height

Move to page 3.1. After reading the instructions, move to page 3.2.



8. Rotate point *R* until it is as far right as possible.
   a. What type of figure is formed?

      Answer: a parallelogram



   b. How is the base of the parallelogram related to the trapezoid?

      Answer: The base of the parallelogram is the sum of the bases of the trapezoid, base1 + base2.

   c. Write an expression to represent the area of the parallelogram—either the parallelogram on the top of the screen or the newly formed parallelogram at the bottom of the screen.

      Answer: Area of the parallelogram = (base1 + base2) $\times$ height

TI-Nspire Navigator Opportunities

Have students change the base and/or height of the trapezoid. Show a Class Capture to the class so that students can see the relationship between the trapezoid and parallelogram above it for trapezoids with various dimensions.

9. How does the area of the original shaded trapezoid compare to the area of the parallelogram?

   Answer: The area of the trapezoid is half the area of the parallelogram.

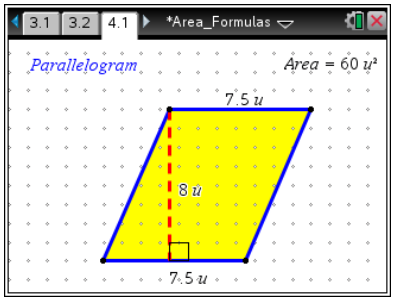
10. If the area of a parallelogram is base times height, then what could be a formula for the area of the trapezoid?

Answer: Area of the trapezoid = $\frac{1}{2}$ (base1 + base2) × height

Teacher Tip: The following problems are designed to help students correctly associate specific shapes with the appropriate formula for area. In addition, the problems provide an opportunity for you to assess their understanding of how the variables and formulas are used. Students are expected to substitute values in the correct formula to find the area.

11. For each problem below:
    - Draw the figure.
    - Write a formula that could be used to find the area of each figure.
    - Use your formula to find the area of each figure.

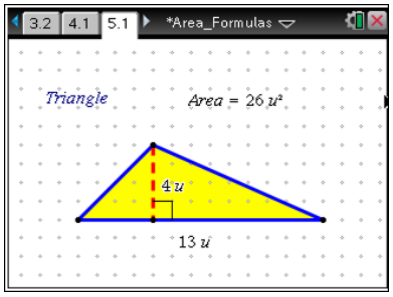
a. A parallelogram with base of 7.5 units and height of 8 units



Answer: Area = base × height

Area = 7.5 units × 8 units = 60 square units (60 u^2)

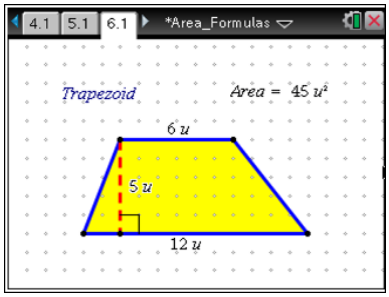
b. A triangle with base of 13 units and height of 4 units



Answer: Area = $\frac{1}{2}$ × base × height

Area = $\frac{1}{2}$ × 13 units × 4 units = 26 square units (26 u^2)

c. A trapezoid with height of 5 units, and bases of 12 units and 6 units



Answer: Area = $\frac{1}{2}$ (base1 + base2) × height

Area = $\frac{1}{2}$ (12 + 6) units × 5 units = 45 square units (45 u^2)

TI-Nspire Navigator Opportunities

Have students send in their responses to the area problems using an Open Response Quick Poll.

Wrap Up

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

- Understand how the area of a parallelogram relates to the area of a rectangle with the same base and height.
- Understand how the area of a triangle relates to the area of a parallelogram with the same base and height.
- Understand how the area of a trapezoid relates to the area of a parallelogram with the same height and with base equal to the sum of the bases of the trapezoid.