

The Logic Behind the Formula

Purpose

Students will understand the formulas for the area of a triangle, parallelogram, and trapezoid by comparing them to the area of a related rectangle and will apply those formulas.

Materials

For the teacher: 2 enlarged cardstock copies of Black Line Master (BLM) *Shapes for Area Formulas*, tape, chalk, chalkboard

For each student: 2 cardstock copies of BLM *Shapes for Area Formulas*, scissors, ruler, copy of BLM *Using Area Formulas*

Activity

A. Pre-Activity Preparation

Make two enlarged copies of the BLM *Shapes for Area Formulas*. Enlarge the copies so that the sides measure to exact inches or centimeters. Cut out the shapes on both copies.

B. Student Activity

1. Distribute two cardstock copies of the BLM *Shapes for Area Formulas* to each student. Instruct students to cut out the shapes.
2. Ask students to tell you the shapes for which they know formulas for area. Keep a record of those on the chalkboard (it will likely be only a square and rectangle).
3. Place the parallelogram on the chalkboard and tell students that, while they do not know the formula for finding the area of a parallelogram, they may be able to manipulate the shape so that it is converted into a square or rectangle.
4. Allow students to manipulate the parallelogram shapes that they have cut out to form a rectangle. Tell them that they may need to cut off a portion of the parallelogram and move it to form the rectangle. (Have students consult with you before they actually cut their shapes).
5. When several students have discovered the correct manipulation, have one of them share it with the class using the enlarged shapes. Allow students to complete the manipulation with their copy of the shapes. (Refer to the back of the BLM for the manipulation directions and area formulas of each shape).
6. Have students measure the sides of the newly-formed rectangle and calculate the area of the rectangle. Write the formula for

(continued)

connecting
across the
curriculum



English/ Language Arts

Have students write in their math journals. Instruct them to explain why the formula for the area of one of the shapes in the activity is justified through manipulation of the shape and the given formula for a simpler shape.

MEETING
INDIVIDUAL
NEEDS



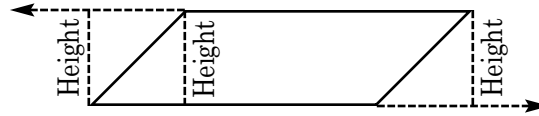
Give students who finish quickly a few regular polygons and have them manipulate the shapes to discover a formula for finding the area of each. Tell them to divide each polygon into congruent triangles with their corners meeting at the center of each polygon.

Standards Links
5.2.4, 5.3.2, 5.4.1, 5.7.3

Activity (continued)

finding area of a rectangle on the chalkboard and substitute the measurements in place of length and width.

- Lead students to find the same two measurements on the original parallelogram. Define height by drawing the perpendicular lines shown below, explaining that any of the lines shown measure the height. Point out the right angle formed by drawing the perpendicular line. Explain that the width will be called the height of the shape and that the length will be called the base. Write the formula for area of the parallelogram on the board, using these terms.








- Add “parallelogram” to the record of shapes for which students know the formula for finding area.
- Place the triangle on the chalkboard and repeat the process for leading students to find the formula for area of a triangle (comparing the measurements of the parallelogram formed to measurements of the triangle). If necessary, tell students that they will not need to cut off a portion to form a new shape; instead they will use both triangles to form a new shape.
- Place the trapezoid on the chalkboard and repeat the process for leading students to find the formula for area of a trapezoid (comparing measurements of the newly formed triangles to measurements of the trapezoid). If necessary, tell students that they will need to divide the trapezoid in such a way as to form two new shapes for which they know the formula for the area.
- Hand each student the BLM *Using Area Formulas* and have them complete it in class.

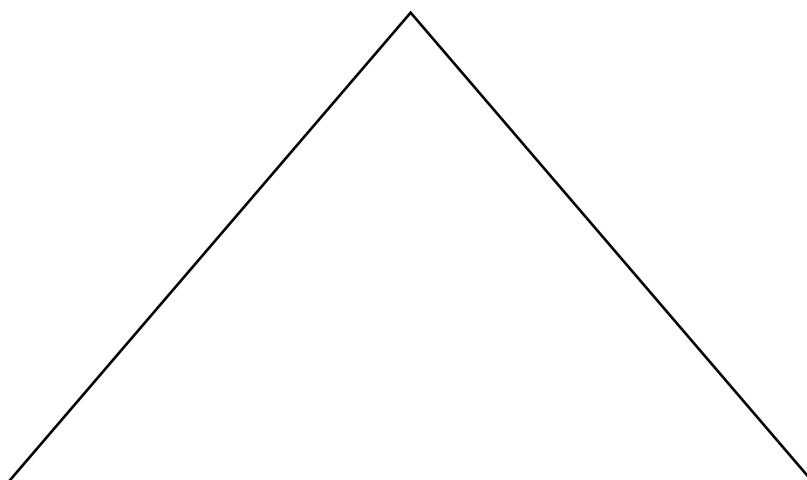
Questions for Review

Basic Concepts and Processes

During the activity, ask students the following questions:

-  What is the formula for finding the area of a parallelogram?
 -  Using your shapes, show me how to move a portion of the parallelogram to create a rectangle.
 -  How does this movement justify the formula for finding the area of a parallelogram?
-  What is the area of a triangle with a base of six inches and a height of three inches?
-  What line shows the height of this triangle [*indicate a triangle that is not a right triangle*]?

Shapes for Area Formulas



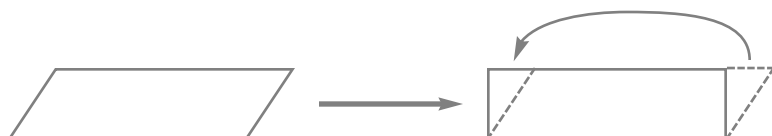
Shapes for Area Formulas

Teacher Directions

Make two cardstock copies of the BLM *Shapes for Area Formulas* for each student. Have students cut out the shapes. Allow students to manipulate the parts of each shape during the activity to lead them to create a simpler shape for which they know the formula for the area.

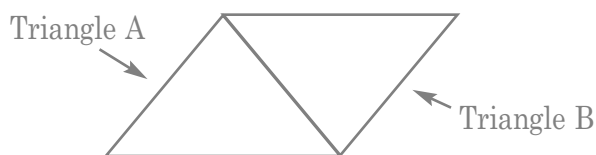
Answer Key

Parallelogram



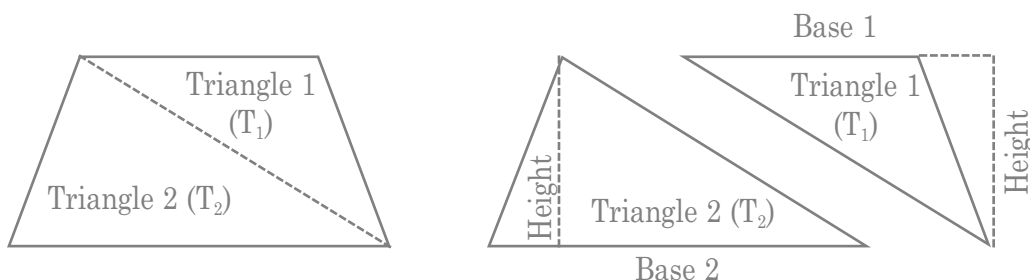
Area of parallelogram = base \times height (where the height is determined by a perpendicular line segment from the base to the line parallel to the base)

Triangle



Area of Triangle = $\frac{1}{2}$ (base \times height)

Trapezoid



Area of trapezoid = $\frac{1}{2} h(b_1 + b_2)$

(Because the development of the formula for a trapezoid may require unlearned algebraic skills, you may wish to provide the actual formula to the class. You may then explain the development of the formula or allow advanced students to discover the formula as an extra credit activity.)

Name: _____

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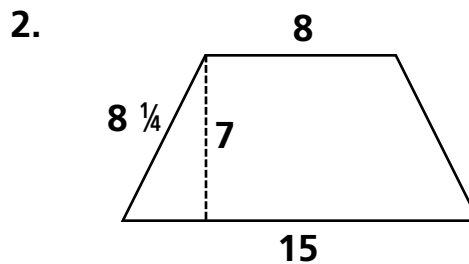
Find the area of each shape below, using the formulas that you have learned for areas of rectangles, squares, parallelograms, triangles, and trapezoids. Measurements are shown in inches. Show your work.



Formula _____

Length = _____ Width = _____

Area = _____

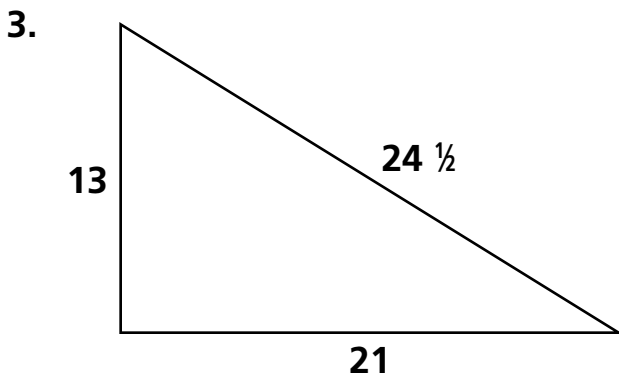


Formula _____

Base₁ = _____ Base₂ = _____

Height = _____

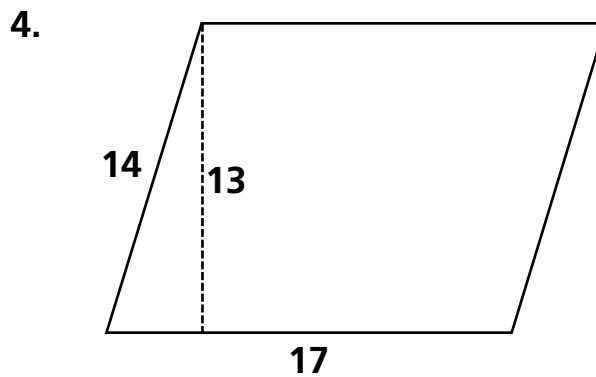
Area = _____



Formula _____

Base = _____ Height = _____

Area = _____



Formula _____

Base = _____ Width = _____

Area = _____

Using Area Formulas

Teacher Directions

Distribute one copy of the BLM *Using Area Formulas* to each student. Have students use the formulas for finding area of rectangles, parallelograms, triangles, and trapezoids to find the area of the shapes.

Answer Key

1. Formula: Area = length \times width
Length = 16 inches Width = 8 inches
Area = 128 square inches
2. Formula: Area = $\frac{1}{2} h$ (base₁ + base₂)
Base₁ = 8 or 15 inches Base₂ = 15 or 8 inches
Height = 7 inches Area = $80\frac{1}{2}$ square inches
3. Formula: Area = $\frac{1}{2}$ (base \times height)
Base = 21 inches Height = 13 inches
Area = $136\frac{1}{2}$ square inches
4. Formula: Area = base \times height
Base = 17 inches Height = 13 inches
Area = 221 square inches