OBJECTIVE

To review the concept of area and find the area of plane figures using formulas and by decomposing composite figures into smaller figures

FOCUS LESSON

The Focus Lesson question leads students to find the area of a composite figure. First, students should recognize that the given figure is a composite shape and can be decomposed into different combinations of figures. Discuss the different ways the figure can be decomposed, such as into two rectangles and a trapezoid, two rectangles and a triangle, three trapezoids. In each case, the formulas for finding the area will change, but the total area is the same. Any of the combinations can be used. Students should be able to recall the formulas for the area of a rectangle, a triangle, a parallelogram, and a trapezoid. Guide students in discussing how to find missing dimensions in the shape. Students should then be able to use the formulas to find the areas of each shape and then recognize that the total area of the figure is the sum of the areas of the smaller figures.

GUIDED PRACTICE

Students must recognize that a regular hexagon is a figure made up of 6 congruent triangles. They should then be able to find the height of one triangle using the given height of the hexagon and calculate the area of one triangle, allowing them to estimate the area of the entire figure.

Vocabulary

Area: the space inside a figure, measured in square units

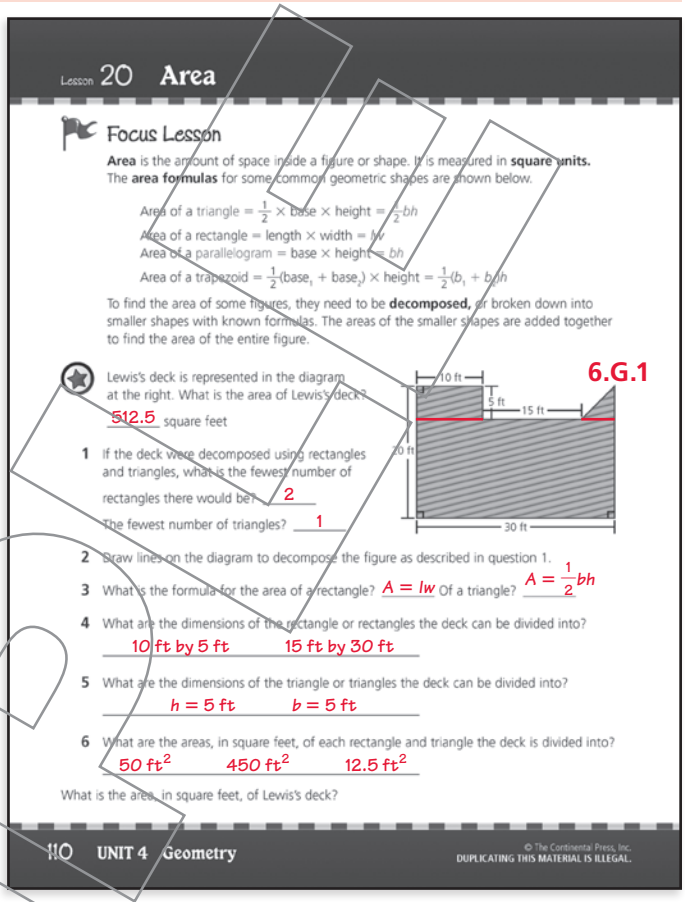
Area Formulas: equations used to find the areas of plane figures

Decompose: to break apart

Square Units: units that are squared, or raised to the 2nd power

Common Core Learning Standard

6.G.1: Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.



Lesson 20 Area

Focus Lesson

Area is the amount of space inside a figure or shape. It is measured in **square units.** The **area formulas** for some common geometric shapes are shown below.

Area of a triangle = $\frac{1}{2} \times$ base $\times$ height = $\frac{1}{2}bh$
Area of a rectangle = length $\times$ width = lw
Area of a parallelogram = base $\times$ height = bh
Area of a trapezoid = $\frac{1}{2}(\text{base}_1 + \text{base}_2) \times \text{height} = \frac{1}{2}(b_1 + b_2)h$

To find the area of some figures, they need to be **decomposed,** or broken down into smaller shapes with known formulas. The areas of the smaller shapes are added together to find the area of the entire figure.

6.G.1

Lewis's deck is represented in the diagram at the right. What is the area of Lewis's deck?
512.5 square feet

1 If the deck were decomposed using rectangles and triangles, what is the fewest number of rectangles there would be? 2
The fewest number of triangles? 1

2 Draw lines on the diagram to decompose the figure as described in question 1.

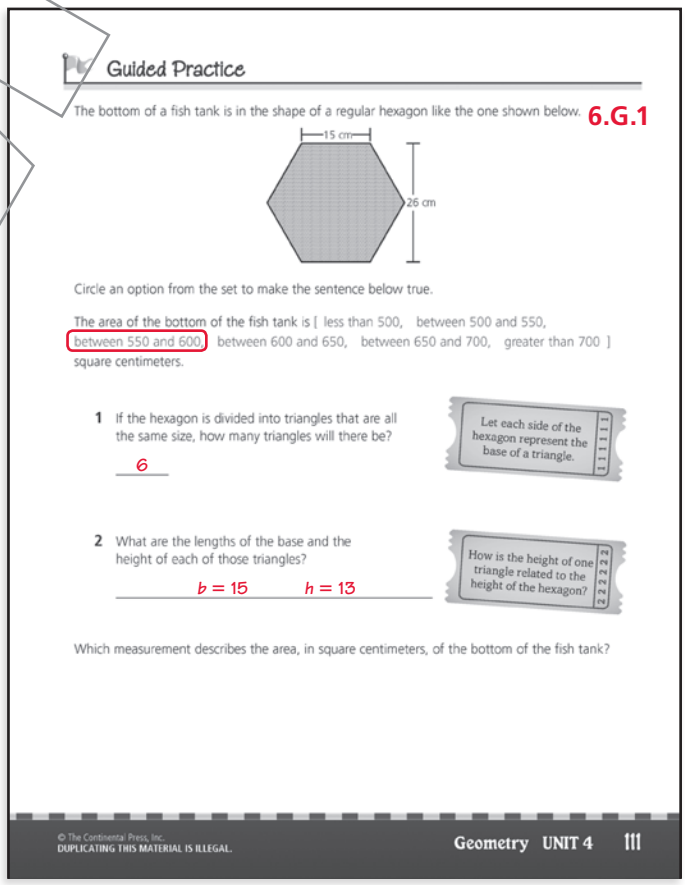
3 What is the formula for the area of a rectangle? $A = lw$ Of a triangle? $A = \frac{1}{2}bh$

4 What are the dimensions of the rectangle or rectangles the deck can be divided into?
10 ft by 5 ft 15 ft by 30 ft

5 What are the dimensions of the triangle or triangles the deck can be divided into?
$h = 5$ ft $b = 5$ ft

6 What are the areas, in square feet, of each rectangle and triangle the deck is divided into?
50 ft^2 450 ft^2 12.5 ft^2

What is the area, in square feet, of Lewis's deck?



Guided Practice

The bottom of a fish tank is in the shape of a regular hexagon like the one shown below. 6.G.1

Circle an option from the set to make the sentence below true.

The area of the bottom of the fish tank is [less than 500, between 500 and 550, between 550 and 600, between 600 and 650, between 650 and 700, greater than 700] square centimeters.

1 If the hexagon is divided into triangles that are all the same size, how many triangles will there be?
6

Let each side of the hexagon represent the base of a triangle.

2 What are the lengths of the base and the height of each of those triangles?
$b = 15$ $h = 13$

How is the height of one triangle related to the height of the hexagon?

Which measurement describes the area, in square centimeters, of the bottom of the fish tank?

Independent Practice

Solve the following problems.

1 A triangular sign is shown below.

6.G.1
DOK: 2

What is the area, in square centimeters, of this sign?

558 square centimeters

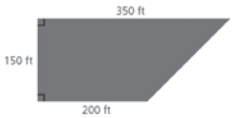
2 One leg of a right triangle is half the length of the other leg. One leg has a length of 10 meters. What could be the area, in square meters, of this triangle? Select all that apply.

6.G.1
DOK: 2

(A) 25 m²
B 50 m²
(C) 100 m²
D 150 m²
E 200 m²

3 The diagram below shows the dimensions of a parking lot.

6.G.1
DOK: 2



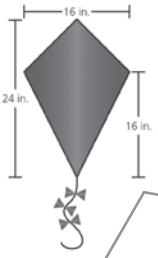
What is the area, in square feet, of the parking lot?

41,250 square feet

Independent Practice

4 The dimensions of a kite are shown in the figure below.

6.G.1
DOK: 2



Which expressions can be used to find the area, in square inches, of the kite? Select all that apply.

A 24×16
B $\frac{1}{2} \times (8 \times 24)$
(C) $2 \times \left(\frac{1}{2} \times 8 \times 24\right)$
D $8 \times 16 + 16 \times 16$
E $2 \times (8 \times 16) + 2 \times (16 \times 16)$
(F) $\frac{1}{2} \times (8 \times 16) + \frac{1}{2} \times (16 \times 16)$

ANSWER RATIONALE

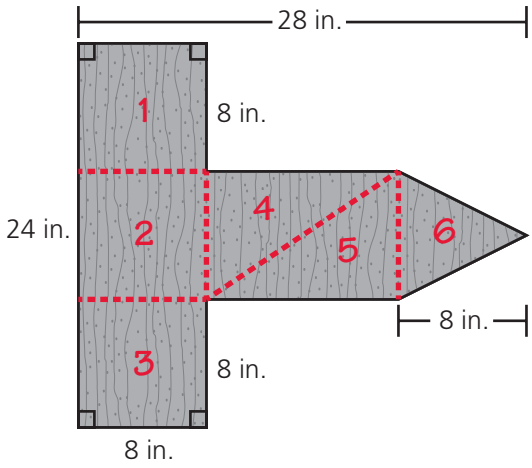
1 The area of a triangle is $\frac{1}{2} \times base \times height$. The base is 36 centimeters, and the height is 31 centimeters. So, the area is $\frac{1}{2} \times 36 \times 31 = 558$ square centimeters.

2 If the longer leg is 10 meters, then the shorter leg is 5 meters and the area of the triangle is $\frac{1}{2} \times 10 \times 5 = 25$ m², so option A is correct. If the shorter leg is 10 meters, then the longer leg is 20 meters and the area of the triangle is $\frac{1}{2} \times 10 \times 20 = 100$ m², so option C is correct.

3 Draw a vertical line in the diagram to form a rectangle and a triangle. The total area is the sum of the area of the rectangle, 150 ft × 200 ft = 30,000 ft², and the area of the triangle, $\frac{1}{2} \times 150$ ft $\times (350 - 200)$ ft = 11,250 ft². So, the area is 41,250 ft² since 30,000 + 11,250 = 41,250.

4 The correct answers are C and F. In option C, if a vertical line is drawn to divide the kite into two triangles, one on the left and the other on the right, the area of the kite is $2 \times \left(\frac{1}{2} \times 8 \times 24\right)$, so this option is correct. In option F, if a horizontal line is drawn to divide the kite into two triangles, one on the top and the other on the bottom, the area of the kite is $\frac{1}{2} \times (8 \times 16) + \frac{1}{2} \times (16 \times 16)$, so this option is correct. The incorrect answers are A, B, D, and E. In option A, 24×16 gives the area of the rectangle that surrounds the kite, so that is not correct. In option B, $\frac{1}{2} \times (8 \times 24)$ gives the area of either the left side or the area of the right side of the kite when a vertical line is drawn down the middle. In option D, if a horizontal line is drawn to divide the kite into two triangles, a top and a bottom triangle, the expression $8 \times 16 + 16 \times 16$ would equal the areas of the rectangles surrounding these triangles. If $\frac{1}{2}$ multiplies these two areas, that would equal the area of the kite. In option E, instead of multiplying the expression in option D by $\frac{1}{2}$, the expression $2 \times (8 \times 16) + 2 \times (16 \times 16)$ multiplies by 2. So this option is incorrect.

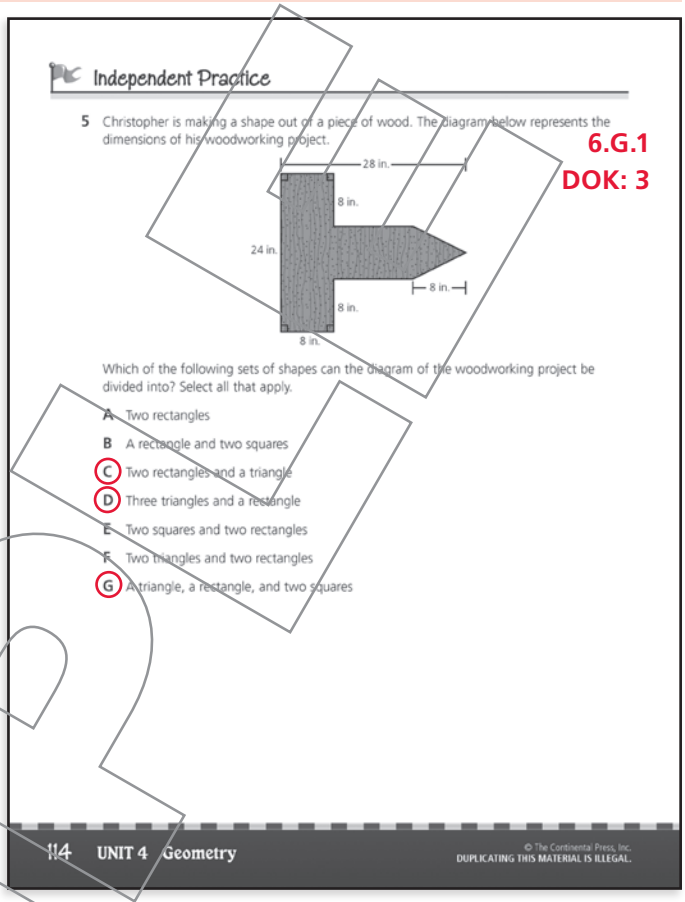
5 The dashed lines shows ways this shape can be divided.



At least one triangle, 6, is needed, to make this shape, so options A, B, and E are not correct. The shape can be made with either one (6) or three triangles (4, 5, 6) and some rectangles, but not two triangles, so option F is not correct. Option C is correct because two rectangles (1-2-3 and 4-5) and a triangle (6) form the shape. Option D is correct because three triangles (4, 5, and 6) and a rectangle (1-2-3) form the shape. Option G is correct because a triangle (6), a rectangle (2-4-5) and two squares (1, 3) form the shape.

6 The length is equal to 12 yards since $27 - 15 = 12$. The width is equal to 9 yards since $15 - 6 = 9$. Accept answers that give the length as 9 and the width as 12.

7 The area of shapes A and C are the same since they both have the same base lengths and heights. Their areas are each 45 cm^2 since $\frac{1}{2} \times 15 \times 6 = 45$. The area of shape B is 300 cm^2 since $20 \times 15 = 300$. So, options B, C, and D are correct. Options A and E are not correct.



Independent Practice

5 Christopher is making a shape out of a piece of wood. The diagram below represents the dimensions of his woodworking project.

6.G.1
DOK: 3

Which of the following sets of shapes can the diagram of the woodworking project be divided into? Select all that apply.

A Two rectangles
B A rectangle and two squares
C Two rectangles and a triangle
D Three triangles and a rectangle
E Two squares and two rectangles
F Two triangles and two rectangles
G A triangle, a rectangle, and two squares

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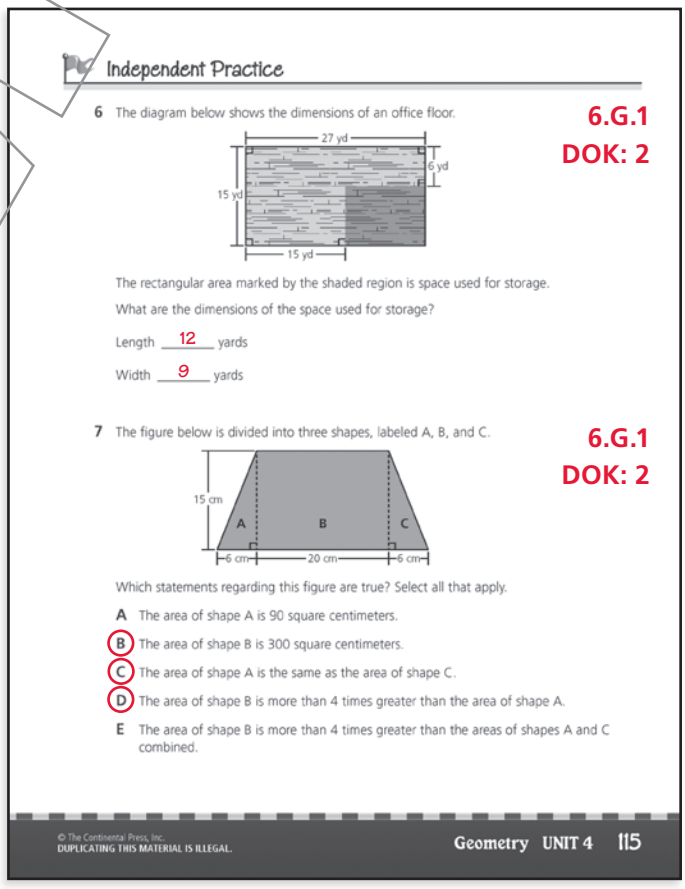

Independent Practice

6 The diagram below shows the dimensions of an office floor.

6.G.1
DOK: 2

The rectangular area marked by the shaded region is space used for storage.

What are the dimensions of the space used for storage?

Length 12 yards

Width 9 yards

7 The figure below is divided into three shapes, labeled A, B, and C.

6.G.1
DOK: 2

Which statements regarding this figure are true? Select all that apply.

A The area of shape A is 90 square centimeters.
B The area of shape B is 300 square centimeters.
C The area of shape A is the same as the area of shape C.
D The area of shape B is more than 4 times greater than the area of shape A.
E The area of shape B is more than 4 times greater than the areas of shapes A and C combined.

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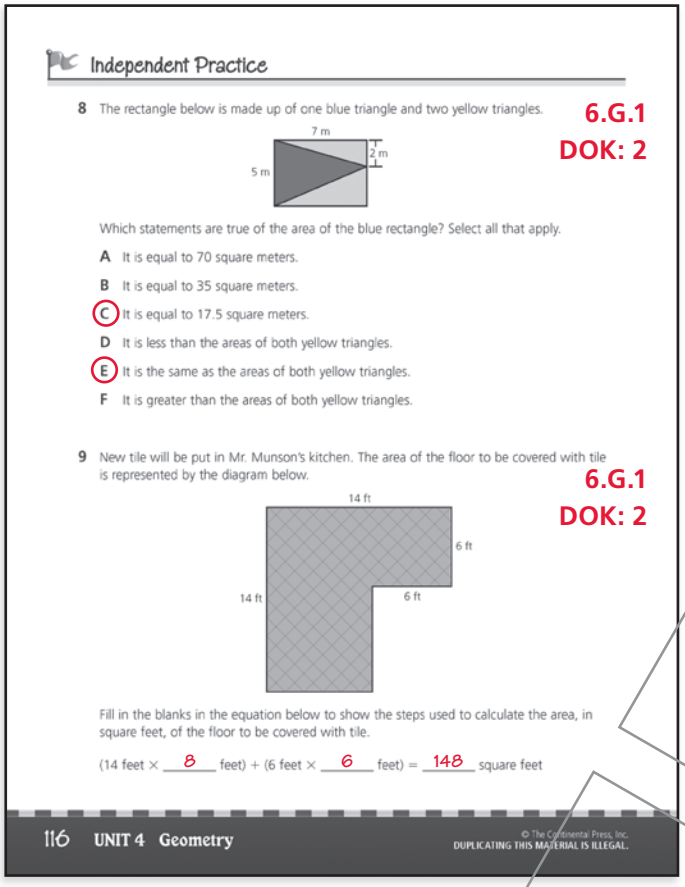

Independent Practice

8 The rectangle below is made up of one blue triangle and two yellow triangles. 6.G.1 DOK: 2

Which statements are true of the area of the blue rectangle? Select all that apply.

A It is equal to 70 square meters.
B It is equal to 35 square meters.
(C) It is equal to 17.5 square meters.
D It is less than the areas of both yellow triangles.
(E) It is the same as the areas of both yellow triangles.
F It is greater than the areas of both yellow triangles.

9 New tile will be put in Mr. Munson's kitchen. The area of the floor to be covered with tile is represented by the diagram below. 6.G.1 DOK: 2

Fill in the blanks in the equation below to show the steps used to calculate the area, in square feet, of the floor to be covered with tile.

(14 feet × 8 feet) + (6 feet × 6 feet) = 148 square feet

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8 The area of the blue triangle, which has a base of 5 m and a height of 7 m, is $\frac{1}{2} \times 5 \times 7 = 17.5$ m^2. The area of the full rectangle is 35 m^2 since $5 \times 7 = 35$. The area of the two yellow triangles is 17.5 m^2 since $35 - 17.5 = 17.5$. So, options C and E are correct. The other options are not.

9 The first part of the expression refers to the area created by dividing the diagram into a rectangle and square with a vertical segment. The rectangle has a width of 14 feet and a length of 8 feet since $14 - 6 = 8$. The square has side lengths of 6 feet each. So, the expression is (14 feet × 8 feet) + (6 feet × 6 feet) = 148 square feet.

Hands-On Extension Activity

Create a set of tag board shapes less than 4 inches in length; include triangles, rectangles, parallelograms, and trapezoids. Ask students to trace around various combinations of these figures to create a composite figure of their own design and then to find the area of the composite figure.