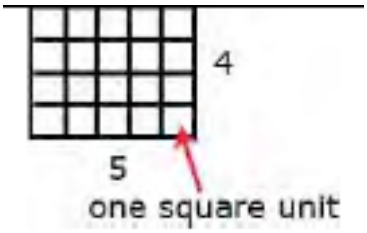
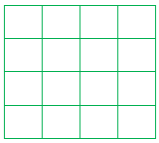
GRADE 3 - MODULE 10 - MEASUREMENT - AREA

Big Idea
The geometric concept of area can be modeled and used to solve mathematical and real-world problems.
Vocabulary
area, formula, square unit, length, width, side length, dimensions, complex figure, non-overlapping, attributes, properties, polygon, quadrilateral, rectangle, square, plane figure, gap, overlap, square units, tiling, side length, decomposing
Prior Learning
In Grade 2, students identified and classified geometric shaped according to specific attributes. A foundation was built for area by using addition to determine the total number of congruent squares in a figure.
Essential Questions
• What is area? • How do we find the areas of rectangles? • How do we find the areas of figures made up of rectangles? • How does finding the area of a rectangle relate to multiplication? • What is the relationship between the size of measurement units and the number of units needed to measure perimeter or area? • How is a square unit similar to and different from a linear unit? • What strategies can help us solve measurement problems (e.g., composition/decomposition of shape and distributive property)?
Competencies
• Students will estimate and determine the area of a rectangle using concrete materials. • Students will use grids and arrays to determine the area of rectangles. • Students will express the measurement of area as a number of square units. • Students will find the area of rectangles by multiplying side lengths • Students will find the area of figures that can be decomposed into non-overlapping rectangles • Students will apply multiplication facts to find the area of rectangles. • Students will solve real world problems using properties of area of polygons.
Misconceptions
• Students may confuse perimeter and area when they measure the sides of a rectangle. • Students may have difficulty transitioning from the foundational understanding of area as an additive measure to applying the algorithm.
Resources from The Key Elements to Mathematics Success - KEMS Grade 3 for Building the Conceptual Understanding of this Module
LESSON 26 - AREA OF SQUARES AND RECTANGLES Additional Activities: Quiz – T759–T760; Area of Squares and Rectangles– Scavenger Hunt T1001 LESSON 28 - AREA OF COMPLEX FIGURES Additional Activities: Quiz – T821-T824; Area of Complex Figures – Scavenger Hunt T1004-T1005

Mathematics Content Standard	Examples
3.MD.5 Recognize area as an attribute of plane figures and understand concepts of area measurement. a. A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area. b. A plane figure which can be covered without gaps or overlaps by n unit squares is said to have an area of "n" square units.	These standards call for students to explore the concept of covering a region with "unit squares," which could include square tiles or shading on grid or graph paper. 

Questions for 3.MD.5

1. Determine the area by counting how many square units make up the figure.



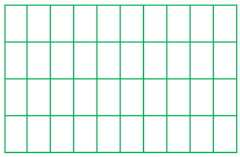
Area = _____

2. The top of a jewelry box has a length that measures 10 units and a width of 4 units. Draw the design for the jewelry box using unit tiles and find the area.

Answer Key for Questions for 3.MD.5

1. Area = 16 square units

2.



Area = 10 × 4 = 40 square units

Tasks for 3.MD.5

*Teacher Note: Please read the Commentary section for the Illustrative Math Tasks. Some tasks will be instructional requiring more teacher modeling and direction. Others will provide the opportunity for students to demonstrate their knowledge of a concept.

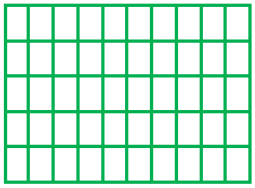
Extra Questions for Warm-ups and Homework for 3.MD.5

1. Explain the meaning of a unit square and how it can be used to measure the area of a rectangle.

Mathematics Content Standard	**Examples**
3.MD.6 Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).	Students should be counting the square units to find the area could be done in metric, customary, or non-standard square units. Using different sized graph paper, students can explore the areas measured in square centimeters and square inches.

Questions for 3.MD.6

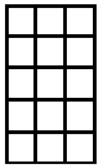
1. Shade a figure with an area of 24 units.

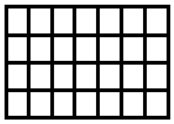


2.

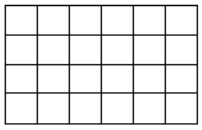
Area = _____ square units

Area = _____ square units





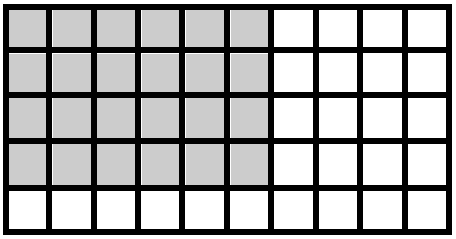
3. The playground area at a school is in the shape of a rectangle. If each square represents a square yard, what is the total area of the playground?



4. Use centimeter cubes to create a rectangle that is 6 cubes long and 3 cubes wide. Draw the figure below and determine the area.

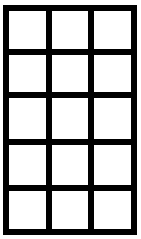
Answer Key for Questions for 3.MD.6

1. Shading will vary

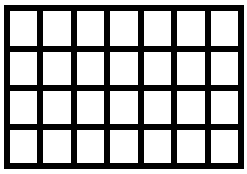


2.

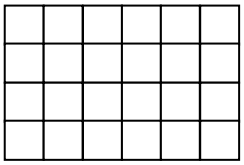
Area = 15 square units



Area = 28 square units

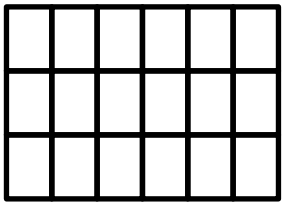


3. Length is 6 yards, and width is 4 yards. There are 24 square yards in the playground.



4.

6 units



3 units

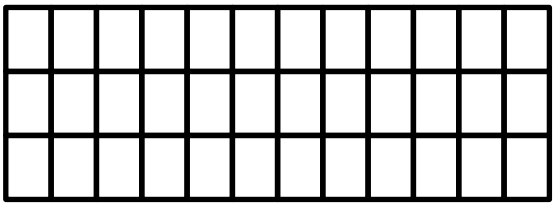
Tasks for 3.MD.6

*Teacher Note: Please read the Commentary section for the Illustrative Math Tasks. Some tasks will be instructional requiring more teacher modeling and direction. Others will provide the opportunity for students to demonstrate their knowledge of a concept.

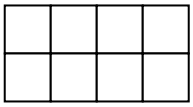
Illustrative Math Task: Finding the Area of Polygons
https://tasks.illustrativemathematics.org/content-standards/3/MD/C/6/tasks/1515
Illustrative Math Task: The Square Counting Shortcut
https://tasks.illustrativemathematics.org/content-standards/3/MD/C/tasks/516

Extra Questions for Warm-ups and Homework for 3.MD.6

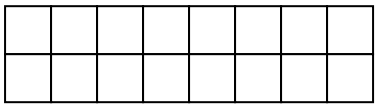
1. Explain a strategy that you can use to determine the area of the figure below without multiplying the length and width.



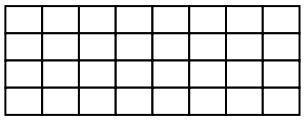
2. What is the area of the figure? _____



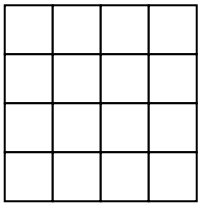
3. Count the units in the rectangle to determine the area in square units. _____



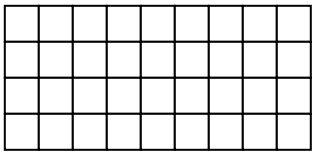
4. Count the number of square units in the rectangle to find the area of the rectangle in square units._____



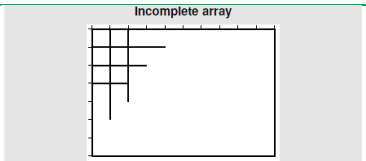
5. What is the area of the rectangle? _____

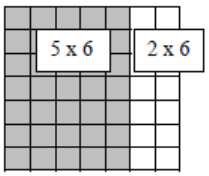


6. What is the area (in square units) of the rectangle shown below? _____

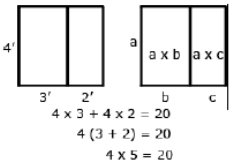


Mathematics Content Standard	**Examples**
3.MD.7 Relate area to the operations of multiplication and addition. a. Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths.	Students can learn how to multiply length measurements to find the area of a rectangular region. Students might draw rectangular arrays of squares and learn to determine the number of squares in each row with increasingly sophisticated strategies, such as skip-counting the number in each row and eventually multiplying the number in each row by the number of rows. They learn to partition a rectangle into identical squares by anticipating the final structure and forming the array by drawing line segments to form rows and columns. They use skip counting and multiplication to determine the number of squares in the array.

	 To determine the area of this rectangular region, students might be encouraged to construct a row, corresponding to the indicated positions, then repeating that row to fill the region. Cutouts of strips of rows can help the needed spatial structuring and reduce the time needed to show a rectangle as rows or columns of squares. Drawing all of the squares can also be helpful, but it is slow for larger rectangles. Drawing the unit lengths on the opposite sides can help students see that joining opposite unit end-points will create the needed unit square grid. Students should understand and explain why multiplying the side lengths of a rectangle yields the same measurement of area as counting the number of tiles (with the same unit length) that fill the rectangle's interior. For example, students might explain that one length tells how many unit squares in a row and the other length tells how many rows there are. Students should tile rectangle then multiply the side lengths to show it is the same. To find the area one could count the squares or multiply 3 × 4 = 12. 1 2 3 4 5 6 7 8 9 10 11 12
b. Multiply side lengths to find areas of rectangles with whole-number side lengths in the context of solving real world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning.	Students should solve real world and mathematical problems Example: Drew wants to tile the bathroom floor using 1-foot tiles. How many square foot tiles will he need? 8 square feet 6 square feet Students might solve problems such as finding all the rectangular regions with whole-number side lengths that have an area of 12 area-units, doing this for larger rectangles (e.g., enclosing 24, 48, 72 area-units), making sketches rather than drawing each square. Students learn to justify their belief they have found all possible solutions. (Progressions for the CCSSM, Geometric Measurement, CCSS Writing Team, June 2012, page 18)
c. Use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths a and b + c is the sum of a × b and a × c. Use area models to represent the distributive property in mathematical reasoning.	Students should tile rectangle then multiply the side lengths to show it is the same. To find the area one could count the squares or multiply 3 x 4 = 12. 1 2 3 4 5 6 7 8 9 10 11 12 Example: This standard extends students' work with the distributive property. For example, in the picture below the area of a 7 x 6 figure can be determined by finding the area of a 5 x 6 and 2 x 6 and adding the two sums.

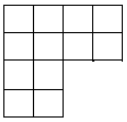


Example:

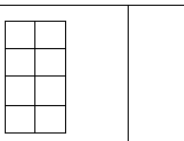


4 x 3 + 4 x 2 = 20
4 (3 + 2) = 20
4 x 5 = 20

d. Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems.



How could this figure be decomposed to help find the area?



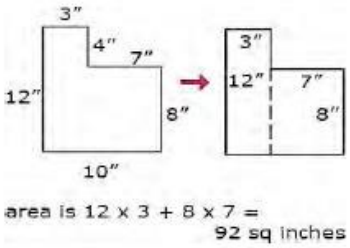
This portion of the decomposed figure is a 4 x 2.

This portion of the decomposed figure is 2 x 2.

4 x 2 = 8 and 2 x 2 = 4
So 8 + 4 = 12
Therefore the total area of this figure is 12 square units

Example: There is a drawing of a storage shed. What is the total area? How could the figure be decomposed to help find the area?

Students can decompose a rectilinear figure into different rectangles. They find the area of the figure by adding the areas of each of the rectangles together.



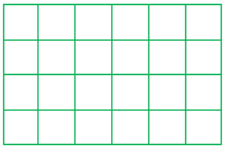
area is 12 x 3 + 8 x 7 =
92 sq inches

Questions for 3.MD.7

1. Maya wants new carpeting for her bedroom. Her bedroom is a 10 ft by 8 ft rectangle. How much carpeting does she need to buy to cover her entire bedroom floor? _____

Draw a rectangle and divided it into square feet to model your answer.

2. Each square in the figure is 1 square unit. Which equation shows the area of this figure in square units?



A. 4 + 6 + 4 + 6 = 20 square units B. 6 + 6 + 6 + 6 + 6 + 6 = 36 square units

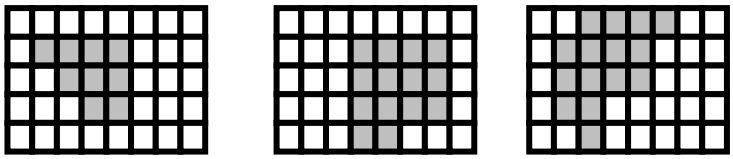
C. 4 + 4 + 4 + 4 + 4 + 4 = 24 square units D. 4 + 6 + 4 + 6 + 4 + 6 = 30 square units

3. Use centimeter cubes to create two rectangles.

Rectangle 1: width of 3 and length of 4 Rectangle 2: width of 5 and length of 2

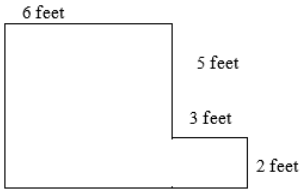
What is the total area of the two rectangles when they are joined together?

4. Write the area of the shaded figure on each grid.



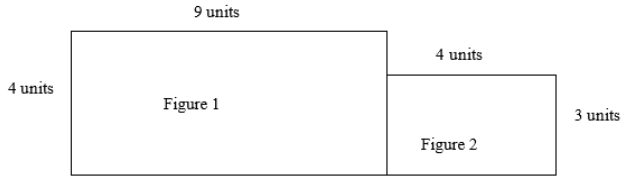
5. Show how to break Antonio's garden into two smaller rectangles. Show two different ways.

What is the area of each rectangle?



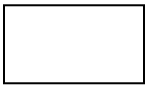
6. Create a composite figure with 3 rectangles. Shade each rectangle in a different color and determine the total area.

7. Use the following figure to determine the areas of Figure 1 and Figure 2.



8. The length of a rectangle is 4 units, and the width of a rectangle is 2 units. What is the area of the rectangle in square units? _____

If three of the rectangles are placed side by side, what is the total area of the three rectangles?



9. Margie's bedroom has a length of 9 feet and a width of 8 feet. What is the area of the bedroom? Use a model of a rectangle to show your answer.

10. A poster for the front hall has a height of 4 feet and a width of 3 feet. What is the area of the poster?

Answer Key for Questions for 3.MD.7

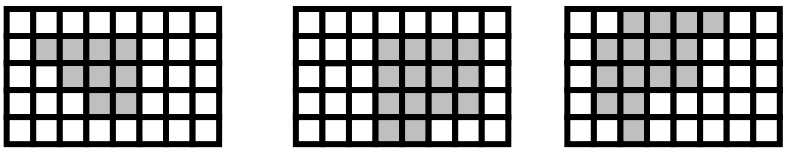
1. 8 × 10 = 80
Maya will need 80 square feet of carpeting.

2. C. 4 + 4 + 4 + 4 + 4 + 4 = 24 square units

3. Area = 3 × 4 = 12 units^2 **Area = 5 × 2 = 10 units^2**

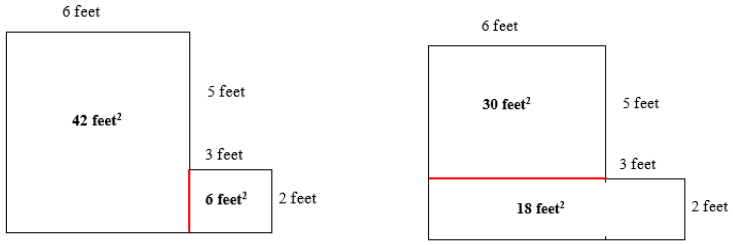
Total area = 12 + 10 = 22 units^2

4.

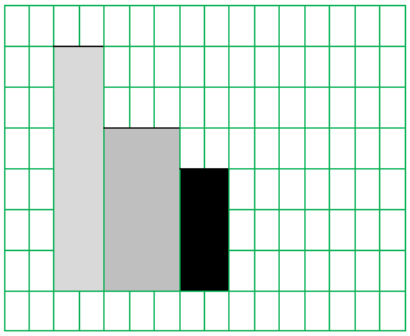


9 square units **14** square units **15** square units

5.



6.



Total area = 12 + 12 + 6 = 30 square units

7. Area of figure 1 = 9 × 4 = 36 units^2
Area of figure 2 = 4 × 3 = 12 units ^{2}

8. Area = 3 × 8 = 24 square units

9. Area = 9 × 8 = 72 square feet

10. 4 × 3 = 12 square feet
The area of the poster is 12 square feet.

Tasks for 3.MD.7

*Teacher Note: Please read the Commentary section for the Illustrative Math Tasks. Some tasks will be instructional requiring more teacher modeling and direction. Others will provide the opportunity for students to demonstrate their knowledge of a concept.

Illustrative Math Task: India's Bathroom Tiles
https://www.illustrativemathematics.org/content-standards/3/MD/C/7/tasks/1990
Illustrative Math Task: Finding the Area of Polygons
https://tasks.illustrativemathematics.org/content-standards/3/MD/C/6/tasks/1515
Illustrative Math Task – Three Hidden Rectangles
https://tasks.illustrativemathematics.org/content-standards/3/MD/C/7/tasks/1836

Extra Questions for Warm-ups and Homework for 3.MD.7

1. Draw 3 rectangles that each have an area of 36 square centimeters.

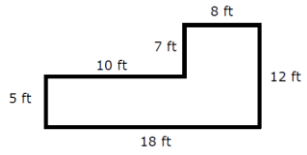
2. How many different rectangles can you build with an area of 24 square inches?

3. The math classroom is divided into two rooms by a room divider. One side of the classroom has a length of 4 yards and a width of 3 yards. The other side of the room has the same dimensions. What is the total area of the classroom?

4. Explain the meaning of a complex figures and draw an example of a complex figure.

5. A rectangular room is 20 meters by 25 meters. It would cost $20.00 per square meter to paint a room. How much would it cost to paint the room?

6. Abe is building a new deck. The cost to build the deck is $10 per square foot. What is the total cost of the deck?

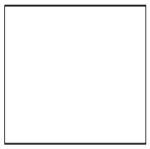


7. Alex used two rectangles to create a new figure. The first figure has a length of 10 feet and a width of 5 feet. The second rectangle has a length of 12 feet and a width of 6 feet. Draw a picture of the possible figure he created and determine the total area.

8. Create a complex figure that can be divided into 3 rectangles. Mark each of the dimensions of the sides. Exchange papers with your partner and determine the area of the complex figure from your partner.

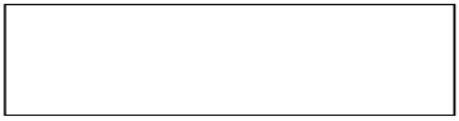
9. Divide the following rectangle into equal sized squares. The width of the rectangle is 2 units and the length of the rectangle is 4 units. What is the area of the rectangle in square units?

10. The sides on a square each measure 3 units. Divide the square into equal units. What is the area?



11. The width of the rectangle is 2 units. The length of the rectangle is 6 units.

Divide the rectangle into square units. What is the area of the rectangle in square units?



12. The length of the rectangle is 8 units and the width is 3 units. Divide the rectangle into square units and find the area.

13. The width of a rectangle is 5 units. The length of a rectangle is 10 units.

Draw the rectangle and divide it into unit squares to determine the area.

14. The length of a rectangle is 9 meters. The width of the rectangle is 8 meters. What is the area of the rectangle? Divide the following rectangle into square units to model your answer.

Works Referenced in the Development of the Module	
Common Core State Standards Initiative www.corestandards.org	Ohio Department of Education http://education.ohio.gov/Topics/Learning-in-Ohio/Mathematics
Illustrative Mathematics Project https://illustrativemathematics.org/	North Carolina Math Tools for Teachers https://tools4ncteachers.com/
Mathematics Assessment Project https://www.map.mathshell.org/index.php	Smarter Balanced Assessment Consortium https://smarterbalanced.org/
PARCC http://parcconline.org/	Utah Education Network https://www.uen.org/core/math/
NOYCE Foundation: https://www.insidemathematics.org/	