

Approximate Time Frame: 2-3 weeks

Connections to Previous Learning:

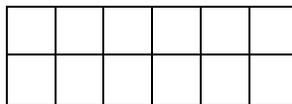
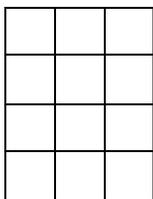
Prior to the study of area, third grade students developed an understanding of the concept of perimeter through various experiences, such as walking around the perimeter of a room, using a geoboard, or using technology. Initially, students counted unit lengths with sides marked. Later, the lengths of the sides were labeled with numerals. They found the perimeter of objects; used addition to find perimeters; and recognized the patterns that exist when finding the sum of the lengths and widths of rectangles. Students also used tools, such as geoboards, tiles, graph paper or technology to find all the possible rectangles that have a given perimeter. They recorded all the possibilities using dot or graph paper, compiled the possibilities into an organized list or a table, and determined whether they had all the possible rectangles. This experience allowed students to reason about connections between their representations, side lengths, and the perimeter of the rectangles. In addition, given a perimeter and a length or width, students used objects or pictures to find missing length or width.

During students' introduction to multiplication readiness in Grade 2, they explored areas of rectangular shapes, leading to the understanding that rectangular arrays can be decomposed into identical rows or into identical columns. By decomposing rectangles into rectangular arrays of squares, students will connect area to repeated addition, and justify using addition to determine the area of a rectangle. This skill can be applied to the study of area in third grade.

Focus of the Unit:

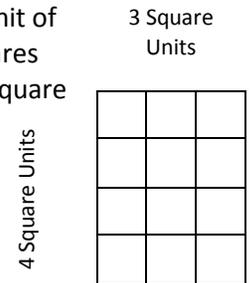
Building upon addition concepts relative to perimeter, third grade students will recognize area as an attribute of two-dimensional regions. They will measure the area of a shape by finding the total number of same size units of area required to cover the shape without gaps or overlaps, a square with sides of unit length being the standard unit for measuring area, i.e. square cm, square in. Covering a region with "unit squares," could include square tiles or shading on grid or graph paper. Based on students' development, they should have ample experiences filling a region with square tiles before transitioning to pictorial representations on graph paper. 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 will explore the areas measured in square centimeters and square inches. Students can use geoboards, tiles, graph paper, or technology to find all the possible rectangles with a given area, e.g., find the rectangles that have an area of 12 square units. They will record all the possibilities using dot or graph paper, compile the possibilities into an organized list or a table, and determine whether they have all the possible rectangles. Students can then investigate the perimeter of the rectangles with a given area, such as 12. Further investigation will involve rectangles and squares with the same perimeter.

Examples of Rectangles with an Area of 12:



Connections to Subsequent Learning:

Based on work in third grade, fourth grade students learn to consider applications using rectangle area. Fourth graders use multiplication; spatially structuring arrays, and area, they determine the formula for the area of a rectangle $A = l \times w$. Students will generalize that, given a unit of length, a rectangle whose sides have the length of $4w$ (*width*) units and $3l$ (*length*) units, can be partitioned into $4w$ (*width*) rows of unit squares with $3l$ (*length*) squares in each row. The product $l \times w$ gives the number of unit squares in the partition, thus the area measurement is $l \times w$ square units. These square units are derived from the length unit. Repeated reasoning about how to calculate rectangle area, will help students see area formulas as summaries of addition calculations. In Grade 4 and later grades, rectangle area problems become more complex. Students learn to apply these understandings and formulas to the solution of real-world and mathematical problems.



$$L \times w = \text{area: } 3 \times 4 = 12 \text{ square units}$$

Adapted from North Carolina Department of Public Instruction, *Instructional Support Tools for Achieving New Standards*, Updated August 2012

From the K-5 Geometric Measurement progression document, pg. 16 and 18.

Third graders focus on learning area. Students learn formulas to compute area, with those formulas based on, and summarizing, a firm conceptual foundation about what area is. Students need to learn to conceptualize area as the amount of two-dimensional space in a bounded region and to measure it by choosing a unit of area, often a square. A two-dimensional geometric figure that is covered by a certain number of squares without gaps or overlaps can be said to have an area of that number of square units.^{3.MD.5} Activities such as those in the Geometry Progression teach students to compose and decompose geometric regions. To begin an explicit focus on area, teachers might then ask students which of three rectangles covers the most area. Students may first solve the problem with decomposition (cutting and/or folding) and re-composition, and eventually analyses with area-units, by covering each with unit squares (tiles).^{3.MD.5, 3.MD.6} Discussions should clearly distinguish the attribute of area from other attributes, notably length.

Third grade students will recognize perimeter as an attribute of plane figures and distinguish between linear and area measures with strong and distinct concepts of both perimeter and area established, students can work on problems to differentiate their measures. For example, they can find and sketch rectangles with the same perimeter and different areas or with the same area and different perimeters and justify their claims (MP3).^{3.MD.8} Differentiating perimeter from area is facilitated by having students draw congruent rectangles and measure, mark off, and label the unit lengths all around the perimeter on one rectangle, then do the same on the other rectangle but also draw the square units. This enables students to see the units involved in length and area and find patterns in finding the lengths and areas of non-square and square rectangles (MP7). Students can continue to describe and show the units involved in perimeter and area after they no longer need these.

Desired Outcomes

Standard(s):

Geometric measurement: understand concepts of area and relate area to multiplication and to addition.

3.MD.5 Recognize areas as an attribute of plane figures and understand concepts of area measurement.

3.MD.6 Measure areas by counting unit squares (square cm, square m, square in., square ft., and improvised units).

Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures

3.MD.8 Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Transfer: *Students will apply...*

Area measurement to real-world problem solving situations.

Add To, Result Unknown Example: If the area of a garden is measured in square feet, one side of the garden is 8 feet and another side is 2 feet. What is the area of the garden?

Solution: $8 + 8 = ?$ or $2 + 2 + 2 + 2 = 16$

Understandings: *Students will understand that ...*

- Everyday objects have a variety of attributes, each of which can be measured in many ways.
- Area and addition are related.
- Perimeter and area are related.

Essential Questions:

- How can understanding the relationship between addition and area aid in problem solving?

Highlighted Mathematical Practices:

- 1. Make sense of problems and persevere in solving them.** Students can tell if word problems involve perimeter and/or area and choose a modality to represent the problem. Problems should encompass real-world situations.
- 2. Reason abstractly and quantitatively.** Students will demonstrate their abstract and quantitative reasoning counting square tiles and recognize the quantitative relationship to repeated addition.
- 3. Construct viable arguments and critique the reasoning of others.** Students will create visual models of word problems (manipulative or picture) and explain their models. Students will use objects or pictures to show rectangles with the same perimeter, but different area. Students justify and communicate their solutions using words, diagrams, pictures, numbers, and an interactive whiteboard. They will also listen to each other, explain what their peers have said, and give reasons why they agree or disagree.
- * **4. Model with mathematics.** In this unit, students demonstrate modeling by transferring rectangle area representations to real-world situations. Students can transfer between modalities to solve real-world problems.
- 5. Use appropriate tools strategically.** Strategic use of tools is demonstrated when students use square units to measure area and linear units to measure perimeter.
- 6. Attend to precision.** Students will use the measurement process precisely. For example when using square units, students will understand units must be of equal size and the inside of a figure must be covered completely.
- 7. Look for and make use of structure.** Students demonstrate understanding of structure by drawing rectangular arrays, determining perimeter and area, and describing and analyzing these attributes of the arrays.
- * **8. Look for express regularity in repeated reasoning.** When students can decompose rectangles into rectangular arrays of squares and relate quantities to repeated addition they use repeated reasoning.

Prerequisite Skills/Concepts:

- Use a ruler to measure side length.
- Solve real world and mathematical problems involving perimeters of polygons.
- Find the perimeter given the side lengths.
- Find an unknown side length.
- Exhibiting rectangles with the same perimeter.

Advanced Skills/Concepts:

- Solve multi-step problems for area involving more complex polygons and rectangles.

Knowledge: *Students will know...*

- Addition problem solving strategies.
- A square unit is used to measure area.

Skills: *Students will be able to do...*

- Recognize areas as an attribute of plane figures and understand concepts of area measurement. (3.MD.5)
- Measure areas by counting unit squares (square cm, square m, square in., square ft., and improvised units). (3.MD.6)
- Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters. (3.MD.8)

WIDA Standard:

English language learners communicate information, ideas and concepts necessary for academic success in the content area of Mathematics.

English language learners will benefit from:

- An awareness of area measurement vocabulary.
- Labels for square measurement units.
- The use of visual tools such as tiles, geoboards, etc.

Academic Vocabulary:

Critical Terms:

attribute
 perimeter
 area
 square unit
 square cm,
 square m
 square in.
 square ft
 nonstandard units
 array

Supplemental Terms:

plane figure
 gap
 overlap
 tiling
 side length
 decomposing
 linear
 polygon

Assessment

Pre-Assessments	Formative Assessments	Summative Assessments	Self-Assessments

Sample Lesson Sequence

--