Math Planting a Square Foot Garden

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Overview:

Students will explore how much space plants need to grow by participating in a yoga sequence that represents the plant life cycle - once lined up close to other students, and once with enough room to "grow". Then, students will work in small groups to divide a 12x12 inch sheet of newspaper into nine equal squares, using their knowledge of multiplication (arrays) and division. Students will paste a variety kale seeds - one in the middle of each of the nine squares. They will then describe what they planted using their knowledge of fractions. After the square foot gardens dry, the small groups will place them together to determine the area and the perimeter of their different possible garden configurations. The square foot gardens can then be planted in the garden in a place where they will get plenty of air and light.

Time Needed: 40 minutes

Common Core Math Standards:

- Multiplication and Division
  - 3rd Grade
    - CCSS.MATH.CONTENT.3.OA.A.3. Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.

Common Core Math Standards:

- Fractions
  - 3rd Grade
    - CCSS.MATH.CONTENT.3.G.A.2. Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole.
    - CCSS.MATH.CONTENT.3.NF.A.3.B. Recognize and generate simple equivalent fractions, e.g., 1/2 = 2/4, 4/6 = 2/3. Explain why the fractions are equivalent, e.g., by using a visual fraction model.

- 4th Grade
  - CCSS.MATH.CONTENT.4.NF.A.2. Compare two fractions with different numerators and different denominators. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.
- 5th Grade
  - CCSS.MATH.CONTENT.5.NF.A.2. Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem.

- Geometric Measurement
  - 3rd Grade
    - CCSS.MATH.CONTENT.3.MD.C.5. Recognize area as an attribute of plane figures and understand concepts of area measurement.
      - CCSS.MATH.CONTENT.3MD.C.5.A. A square with a unit length of 1 unit, called “a unit square” is said to have “one square unit” of area, and can be used to measure area.
      - CCSS.MATH.CONTENT.3.MD.C.5.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.
    - CCSS.MATH.CONTENT.3.MD.C.6. Measure areas by counting unit squares.
    - CCSS.MATH.CONTENT.3.MD.C.7. Relate area to operations of multiplication and addition.
      - CCSS.MATH.CONTENT.3.MD.C.7.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.
      - CCSS.MATH.CONTENT.3.MD.C.7.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.
    - CCSS.MATH.CONTENT.3.MD.D.8. Solve real world mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths.

- 4th Grade
  - CCSS.MATH.CONTENT.4MDA.3. Apply the area and perimeter formulas for rectangles in real world and mathematical problems.

Objectives:

- Students will determine how to partition their square foot of newspaper into nine equal parts using their knowledge of multiplication and division. Students will express the area of each part as a unit fraction of the whole.
- Students will generate simple equivalent fractions and explain why the fractions are equivalent by using a visual fraction model.
- Students will compare two fractions with different numerators and different denominators, recording the results of the comparison with symbols >, =, or <, and justifying conclusions by using a visual fraction model.
- Students will solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, by using visual fraction models.
- Students will measure area by counting unit squares and show that the area is the same as would be found by multiplying the side lengths.
- Students will solve real world mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths.

Materials:

- kale seeds (nine seeds per small group)
- 12x12 inch Newspaper (one page per small group)
- Rulers (one per small group)
- Pencils
- Flour, water, bowl to make paste (one per small group)
- Popsicle sticks for paste (one per small group)

Reproducibles:

- Yoga Pose Posters - From Seed to Plant

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Outline:

- Engage: Complete yoga sequence representing plant growth
- Explore: Create square foot gardens using knowledge of multiplication (arrays) and division
- Explain: Describe what is planted within them using knowledge of fractions
- Extend: Create class garden and calculate the area and perimeter of different configurations

Lesson Plan:

- Engage (whole group / on the carpet) - 5 minutes
  - Model the Seed to Plant Yoga Poses to represent a seed growing into a plant while students follow along. First, space students so every student has enough personal space to complete the poses fully and then repeat the poses with students spaced side by side, moving carefully through the poses without full extension.
  - After completing the sequence, ask students to imagine if they were a seed – Did they have enough room to grow? Could any other "seeds" fit in their "garden"?
- Explore (small groups / in seats) - 10 minutes
  - Explain that the class will be creating square foot gardens - this is the practice of dividing a growing area into small square sections to ensure efficient use of space.
  - Provide small groups of students with a 12 x 12 in. piece of newspaper and a ruler.
  - Challenge groups to explore how to partition their square foot of newspaper into nine equal parts.
    - Remind students to consider what they know about a square foot. *The length of each side is 12 inches.*
    - Encourage students to consider what they know about arrays to determine how to divide each side of the square foot to result in nine equal parts total. *X * Y = 9, 3*3 = 9*
    - Students can use their knowledge of division to determine how to divide the side of 12 inches into 3 equal parts. *12 in / 3 = 4 in*
    - Students can divide each side into 4 inch sections, creating 3 squares on each side, and 9 squares total.

- Provide students with kale seeds and a bowl of paste made of flour combined with enough water for a paste consistency (or allow students to make the combination themselves). Students can use popsicle sticks to put a dot of the paste in the middle of each of their nine squares. Then, students can place a seed of their choice on top of each of the nine paste dots.

- Explain (small groups / in seats) - 10 minutes
  - Ask students to use their knowledge of fractions to describe the amount of seeds of each plant their group planted in their square foot garden.
    - Describe how much of the garden is planted with each type of seed.
      Example: 5/9 is kale #1, 1/9 is kale #2, 3/9 is kale #3
    - Simplify any fractions and use the visual model to check that the fractions are equivalent.
      Example: 5/9 is kale #1, 1/9 is kale #2, 3/9 = 1/3 is kale #3
    - Compare the fraction of your square foot garden that is planted with each type of seed. Check your answers by using the visual model of the garden.
      Example: 5/9 kale #1 > 1/3 kale #3 > 1/9 kale #2
    - Write an equation that shows that the combination of the fractions of the square foot garden equal the whole.
      Example: 5/9 kale #1 + 1/3 kale #3 + 1/9 kale #2 = 1 square foot garden

- Extend (whole group / in the classroom or garden) - 15 minutes
  - Challenge students to consider what the combined area of all of their square foot gardens planted next to each other would be.
    - First, count the unit squares - adding 1 square foot for each garden.
    - Then, check your answer by laying out the squares into a polygon and multiplying the sides of each of the rectangular figures that make up the complete garden.

- Challenge students to calculate what the perimeter of the combined garden would be. Remembering that each side of their square foot gardens is one foot long. Pose the situation as if they were going to create a border around their garden of bricks, rope, etc.
  - Ask students to consider if they changed the configuration of their garden if the area would change and if the perimeter would change.
  - Reconfigure the class garden multiple times calculating the area and perimeter each time to determine how they are affected.
- When complete, the class can plant their square foot gardens outdoors. They should be placed in an area that receives plenty of sunlight and the newspaper sheet should be covered up with about ½ inch of soil. The gardens should be watered regularly when rain is not consistent. Kale should be harvested regularly at the "baby" stage since they will be planted closer together than they prefer when they are full grown.

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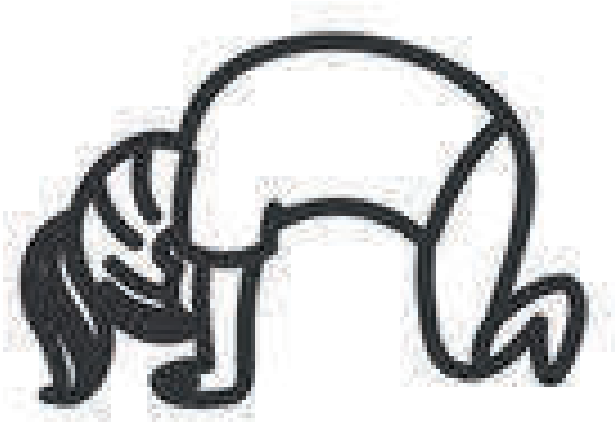
- Evaluate:
  Example Evaluation

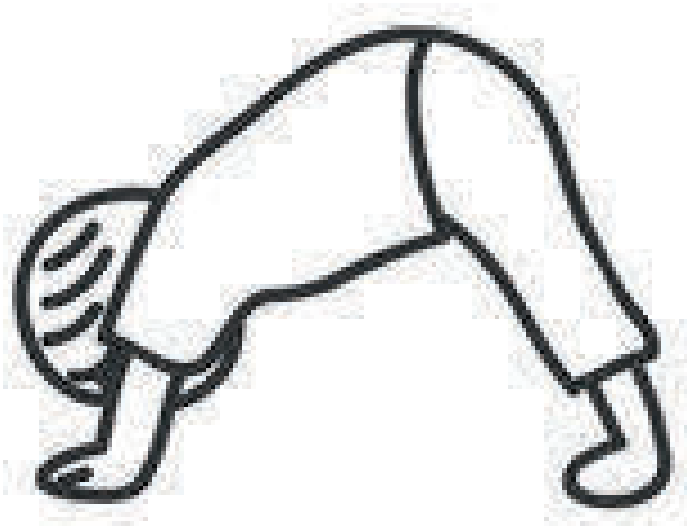
CCSS.MATH.CONTENT.3.OA.A.3.	Explain with words and drawings how your group used their knowledge of multiplication (arrays) and division to divide the newspaper into nine equal parts.	
CCSS.MATH.CONTENT.3.G.A.2.	What fraction represents one of the squares that you created on your square foot garden?	
CCSS.MATH.CONTENT.3.NF.A.3.B.	Describe the fraction of the whole square foot garden that you planted with each type of seed. Simplify fractions to equivalent fractions, if possible.	
CCSS.MATH.CONTENT.4.NF.A.2.	Compare the fractions of each type of seed you planted using the symbols >, =, and <.	
CCSS.MATH.CONTENT.5.NF.A.2.	Create an addition sentence that shows that the fraction of the whole that represents each type of seed planted equals the whole.	
CCSS.MATH.CONTENT.3MD.C.5.A.	What is the area of your square foot garden?	
CCSS.MATH.CONTENT.3.MD.C.7.A.	What is the area of your class's combined garden? Explain with words and pictures how you multiplied the side lengths of each rectangle that made up the garden.	
CCSS.MATH.CONTENT.3.MD.D.8.	What is the perimeter of your class's combined garden? Explain with words and pictures how you figured it out.	

You are a little seed, just planted in the ground.

With warmth and water,
you grow...



... and grow.



Then your stem comes up out of the ground.

Your roots dig down into the earth as your leaves stretch up towards the sun.

With the soil holding you tight and providing you with nutrients, you stand strong.