



## **Constructing Task: The Queen's Dilemma**

Approximately 3 days

### **STANDARDS FOR MATHEMATICAL CONTENT**

**MCC2.OA.4.** Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns; write an equation to express the total as a sum of equal addend

### **STANDARDS FOR MATHEMATICAL PRACTICE**

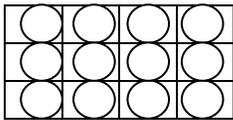
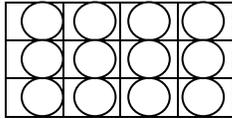
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

**\*\*\*Mathematical Practices 1 and 6 should be evident in EVERY lesson\*\*\***

### **BACKGROUND KNOWLEDGE**

This standard calls for students to use rectangular arrays to work with repeated addition. This is a building block for multiplication in 3rd Grade. Students should explore this concept with concrete objects (e.g., counters, bears, square tiles, etc.) as well as pictorial representations on grid paper or other drawings. Based on the commutative property of addition, students can add either the rows or the columns and still arrive at the same solution.

Example below:

<p><b>Student 1</b></p> <p>I see 3 counters in each column and there are 4 columns. So I added: <math>3 + 3 + 3 + 3</math>. That equals 12.</p> 	<p><b>Student 2</b></p> <p>I see 4 counters in each row and there are 3 rows. So I added <math>4 + 4 + 4</math>. That equals 12.</p> 
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### **ESSENTIAL QUESTIONS**

- What is an array?
- What is repeated addition?

- How can rectangular arrays help us with repeated addition?
- How are arrays and repeated addition related?
- How does skip counting help us solve repeated addition problems?
- How can we use model repeated addition equation with an array?

## **MATERIALS**

- *A Remainder of One* by Elinor J. Pinczes (Houghton Mifflin Co., 1995) or similar book
- Array recording sheet (per group)
- Half sheet of chart paper (per group)
- Various manipulatives (pop cubes, counters, tiles, etc.)

## **GROUPING**

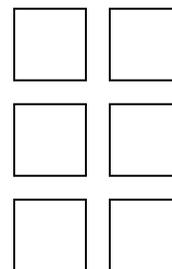
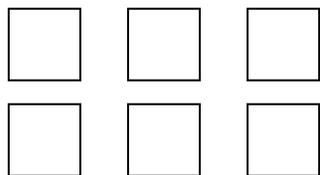
Partners

## **TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION**

### **Part I**

Begin the lesson with a review of arrays. Share pictures of arrays that can be seen in the real world and discuss the difference between a row and a column. Read aloud the book, *A Remainder of One*. Throughout the book, discuss the arrays with the students, focusing on the number of rows and columns and the product of each array. After reading the book, explain and demonstrate how the ants were not able to make equal rows with 2, 3 or 4 in a row but they could make equal rows with 5. Model the language 5 by 5. Indicate that the repeated addition sentence for this is  $5+5+5+5+5$ . Remind the children this is called an array because you can make a rectangle with the number. Tell the students that now they will get to act as the Queen and will be given a certain number of ants to divide into an equal number of rows and an equal number of columns with nothing left over. For example, if she had only 6 soldiers in the group they could march in 2 rows with 3 in each row, a 2 by 3 array (2x3) Orthey could march in 3 rows with 2 in each row, a 3 by 2 array (3x2). Keep in mind writing a multiplication equation is not something second grade students are required to master at this point. The focus is on the concept of multiplication and how we can model it with both repeated addition sentences and arrays.

(They can also march in 1 row of 6 or 6 rows of 1, in other words, single file as when going to lunch.)



So a group of six makes a rectangle (or an array).

Share the task with the students:

The queen of the \_\_\_\_ (insert school name) \_\_\_\_ Ant Colony has 16 ants in her army. The queen is attempting to organize her ants into arrays. She wants to know how many arrays she can create using her 16 ants. How many arrays can she make with 16 ants? Using manipulatives, drawings and words, explain your work.

**Note:** This task could be interpreted that the queen must use all 16 ants. This task can also be used to allow students to leave some ants out. This would give students multiple different arrays. Consider this for your differentiation.

Allow the students to work with a partner to experiment with different arrays that the queen could create when arranging the ants. Have the students use manipulatives to create their arrays. Then, encourage the students to draw their arrays on the chart paper and record the repeated addition equation on the recording sheet. While students are working, circulate the room and ask questions from the formative assessment list.

### **Part II**

After students have completed Part I of the task, choose several students to share their discoveries and observations with the class.

If students used numbers up to 16, use this to lead discussion: The teacher or students can record the arrays the students have found on a larger version of the “The Queen’s Dilemma” sheet. Ask questions which require them to look for patterns. Some things that they may notice are:

- 5, 7, 11 and 13 can only march in single file
- 4, 9 and 16 can be made into squares with equal sides
- 2,4,6,8,10,12,14 and 16 can all be divided into 2 equal rows

As the students “discover” this information, use this data to create a graph that shows how many of the numbers could only create single file lines, made squares, 2 equal rows or others. Graphing this data will reveal patterns about numbers, allowing for discussion of odd and even, among other things.

### **FORMATIVE ASSESSMENT QUESTIONS**

- What manipulatives are you using to help solve this problem?
- Why are you arranging the tiles in that way?
- What are some ways the queen could arrange 6 ants? 10? 16? etc.
- What are some ways that she cannot arrange them?
- How many rows does this array have?
- How many columns does this array have?
- How can you tell the difference between rows and columns?
- What strategies are you using to help figure out ways the queen could arrange the ants?
- Are you noticing anything about the numbers that she is or is not able to use?

- How could you use repeated addition to help you solve this problem?
- Could this number be arranged in a different way?
- How would the equation be different if this array were rotated a  $\frac{1}{4}$  turn?
- How are you communicating the results you have found?
- What patterns are you noticing from your chart?
- Why are we able to make different arrays for some numbers but not others?
- Do any of the arrays you have made have the same product?

## **DIFFERENTIATION**

### **Extension**

- If students complete the assigned task, ask students what additional arrays the ants could march in if the queen allowed 14 more ants to join the army.
- Have students create all the arrays up to 16 ants. Use the included recording sheet.

### **Intervention**

- Students who are having difficulty may need additional questioning with the use of manipulatives.



Group Members: \_\_\_\_\_ Date: \_\_\_\_\_

### The Queen's Dilemma Recording Sheet

Number	Arrays	Equation
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		