SCAFFOLDING TASK: Arrays on the Farm
3-4 days

STANDARDS FOR MATHEMATICAL CONTENT

MCC.3.OA.5. Apply properties of operations as strategies to multiply and divide. Examples: If 6 × 4 = 24 is known, then 4 × 6 = 24 is also known. (Commutative property of multiplication.) 3 × 5 × 2 can be found by 3 × 5 = 15, then 15 × 2 = 30, or by 5 × 2 = 10, then 3 × 10 = 30. (Associative property of multiplication.) Knowing that 8 × 5 = 40 and 8 × 2 = 16, one can find 8 × 7 as 8 × (5 + 2) = (8 × 5) + (8 × 2) = 40 + 16 = 56. (Distributive property.) Use arrays, area models, and manipulatives to develop understanding of properties.

STANDARDS FOR MATHEMATCIAL 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

(Information quoted from Van de Walle and Lovin, Teaching Student-Centered Mathematics: Grades K-3, page 85)

"It is not intuitively obvious that 3 x 8 is the same as 8 x 3 or that, in general, the order of the numbers makes no difference (the order or commutative property). A picture of 3 sets of 8 objects cannot immediately be seen as 8 piles of 3 objects. Eight hops of 3 land at 24, but it is not clear that 3 hops of 8 will land at the same point.

The array, by contrast, is quite powerful in illustrating the order property, as shown in Figure 3.9. Children should draw or build arrays and use them to demonstrate why each array represents two different multiplications with the same product."

In this task the students use arrays to solve multiplication problems. Farmers grow their crops in arrays to make them easier to look after and to harvest.

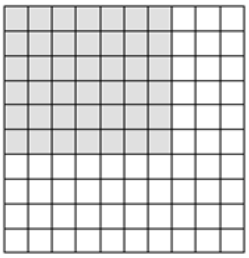
Arrays provide a quick and efficient way to count things. For example, this can be done by adding the numbers in each row together. However, it is quickest to determine the number of

objects in an array by multiplying the number in the width by the number in the height using area models.

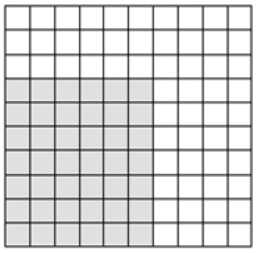
As an important side issue to this task, we ask the students to be involved in guessing and estimating. These are both useful skills that take time to develop. This task provides some practice in this area.

This task provides different contexts to explore multiplication concepts using arrays such as the one below. This array is an area model.

6 rows of 7
or
6 x 7 = 42



7 rows of 6
or
7 x 6 = 42



ESSENTIAL QUESTIONS

- What are strategies for learning multiplication facts?
- How can we practice multiplication facts in a meaningful way that will help us remember them?
- How can we connect multiplication facts with their array models?
- How is the commutative property of multiplication evident in an array model?
- How can we model multiplication?

MATERIALS

- Counter or small manipulatives
- Large pieces of paper for recording
- scissors
- Henry's Array Farm recording sheet
- Array Circles recording sheet
- Enlarged Small Station Task problems
- Station Task problems individual recording sheet

GROUPING

Partner/Small Group

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

Part I Scaffolding

1. Begin the task with the "Farmer's Problem"
   Pose the problem:
   Henry's farm produces potatoes every fall. He has 36 potato plants. How could Henry arrange his plants into equal rows and columns?

   Provide a pile of counters on an overheard, use a smart board with a shape tool (or plant image), or ask volunteers to come and show what the first row of plants might look like.
   Is there only one way to arrange Henry's potato plants?

   It's important for the students to understand what a row is so they can make sense of the problem.

   What are some predictions? How many different strategies will Henry be able to choose from? Record predictions on the board or someplace the class can see.

   2. Arrange the class into small mixed ability groups with 3 or 4 students in each. Give each group a large sheet of paper. Ask them to fold their piece of paper so it makes 4 boxes.

Strategy 2	**Strategy 4**
Strategy 1	**Strategy 3**

   Allow some time for each group to see if they can come up with 4 different ways to solve the Farmer's Problem and record their method in the 4 boxes.
   The teacher should circulate to prompt groups and challenge their thinking.

   Ask: *Are there more efficient ways to determine how many plants there are without having to count each one?*

   3. Ask the groups to cut their large sheet into the 4 boxes. Each student will take a different strategy from their group. They must be aware that they will explain the strategy

and ready to do so. Gather the class in a circle or position them so each one can see the presenting student and strategy. Ask the groups to share what they think is their most interesting strategy. Place each group's strategy in the middle of the circle or area as they are being shared. Once each group has contributed, ask the students to offer strategies that no one has shared yet.

Likely strategies	Possible teacher responses
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 ….	Can you think of a quicker way to work out how many plants there are? How many plants are there in one row?
6,12,18,24,30,36	Do you know what 6 + 6 =? Can that help you solve this problem quicker?
6 x 6 = 36	What if Henry had 9 rows of plants and there were 8 plants in each row?
6 + 6 = 12; 12 + 12 = 24; 24 + 12 = 36	You used adding to work that out. How could you have used multiplication?
2 x 6 = 12; 12 + 12 + 12 = 36	If 2 x 6 = 12, what does 3 x 6 =? How could you work out 6 x 6 from this?
3 x 6 = 18 and then doubled it	Awesome, clever you, could you work out 9 rows of 6 for me?
5 x 6 = 30; and 6 more = 36	

4. The shared strategies can be put into similar groups.
Ask: *Who used a strategy like this one?* Show Henry's Array Farm Format sheet. *How do you think we could use this to solve Henry's problem?* Send groups off to experiment with Henry's Array Farm Format sheet. Again circulate in the classroom and observe what the groups are doing.

5. As a class, share the different ways that students used the array to solve Henry's Farm problem.

6. Challenge the students to use the array in the same way as another group did and pose the following problems.

7. Review predictions made before breaking up into small groups? Which predications were most reasonable?

Henry plants 2 more rows of 6 potato plants. How many rows does he have all together now? How many plants is that all together?	*Henry's sister, Katie has a farm exactly the same size with the same amount of plants. How many plants do they have all together?*

Part II Constructing

Before the students work at small group tasks, you will need to prepare the material from Henry's Array Farm recording sheet, Array Circles sheet and Station Task sheets.

The next few days will involve working on similar problems. Allow students the opportunity to choose intervention, if they are finding the problems challenging and are unable to get started independently. This is an opportunity for the teacher to go over more examples and clarify any misunderstandings.

Begin by role playing the Airplane Rides Over the Farm problem from the Station Task sheet to get the students started. Ask 6 students to pretend to be the passengers on the plane. Ask them to bring their chair to the front and sit in a row. Leave a gap in the middle to show where the aisle is. Then choose a second group of 6 to make a second row behind the first row of 6 students.

Ask students to think about:
How many passengers would there would be if there were 4 rows of 6?
What about if there were 9 rows?
Encourage students to share and demonstrate their strategies.

Place the enlarged Station Task problem cards at each station with Henry's Array Farm, Circle Array sheets and counters or small manipulatives. (You may want to have multiple stations of each problem depending on your class size. Make sure the Station Task number is large, so when students are ready to move they can identify an open station easily)
Read the Station Tasks to the class one at a time to clarify any misunderstandings.

Explain the Station Task Recording Sheet and how it is used. (As students have finished a Station Task, they complete the tracking box and continue to the next problem. Encourage students to show their math language, working knowledge and solutions on this sheet.)

Set/remind student of classroom procedures for partner work.

Assign the partners and allow students to choose which Station Task to solve first. Spend the session circulating the stations and questioning students.

How many did you think there would be to start with?
Why did you predict that to start with?
What gave you a clue to make that prediction?
Can you think of another way to use the array to solve that problem?
Can you think of a way to solve the problem without using the array?
Which way do you think is faster, why?

Task Station 1 (have counters, Henry's Array Farm and Array Circles available)

Peanut Farm (Part 1)	Peanut Farm (Part 2)
Paul has a peanut farm with 6 plants in each row and there are 8 rows of plants. How many plants does he have in all? Prediction Solution	Paul wants to plant another field of peanut plants. He can get 24 plants at a cheap price. How many different ways can he plant these peanut plants? How many rows should he plant? How many peanut plants should be in each row? Show all the different ways Paul could plant his peanut plants in rows by making your own array on a blank piece of paper.

Task Station 2 (have counters or manipulatives available)

Onion Farm (Part 1)	Onion Farm (part 2)
Bill has an onion farm. Bill has 4 onion plants in each row and has 4 rows. Bill has a total of 3 fields the same size. How many onion plants are there on his farm? Prediction Solution	Bill's son has just bought the plants to start his own onion farm. He has purchased 36 plants and wants some help on how to arrange the plants into rows. What suggestions would you give Bill's son? Draw all the possibilities

Task Station 3

Watermelon Farm (Part 1)	Watermelon Farm (Part 2)
Wanda has a watermelon farm. In each row she has 12 watermelon plants and there are 4 rows. How many watermelon plants does she have in all? Prediction Solution	Wanda wants to double the size of her watermelon farm each year. How many plants will she have in all after… 1 year 2 years 3 years Record your strategies on an array

Task Station 4

Airplane Rides Over the Farm	Airplane Rides Over the Farm
Henry is giving airplane rides over his farm. His plane has 6 seats in each row. The seat row numbers go up to 21. How many passengers can Henry's plane hold? Prediction Solution	Henry's plane makes 2 trips over the farm each day. If the plane was full each time, how many passengers would get to see Henry's farm from the airplane? Prediction Solution

At the end of each session allow for a sharing time to discuss what students were finding interesting and challenging. Share some strategies used.

Part III
Conclusion/Reflection

On the final day of the task, ask the students to make up their own multiplication problems for their partner to solve.

Set the problem: Tell the students they are going to pretend to be tomato growers. They are to decide how many rows of tomato plants they want in each row and how many rows they will have altogether.

Now they challenge their partner to see if the partner can work out how many tomato plants they will have altogether. Ask for volunteers to share their problems and the partner share what strategy they used to solve the problem.

Challenge the students to make up 2 more problems for their partner. Suggest that they solve the problem using an array.

Conclude the lesson by talking about the types of problems we have explored and solved over the past few days. They were doing multiplication problems! Let them know there are many ways of solving these problems and that the array is just one of these ways.

FORMATIVE ASSESSMENT QUESTIONS

- What are two strategies you used to solve the problems?
- How can the same problem have two different arrays that are correct?
- How does an array model show repeated addition?
- Can you think of a quicker way to work out how many _____ there are?
- How many ____ are there in one row?
- Do you know what 6 + 6 =? Can that help you solve this problem quicker?
- What if _____ had 9 rows of _____ and there were 8 _____ in each row?
- You used adding to work that out. How could you have used mulitiplication?
- If 2 x 6 = 12, what does 3 x 6 =? How could you work out 6 x 6 from this?
- Awesome, clever you, could you work out 9 rows of 6 for me?

DIFFERENTIATION

Extension

- Replace Station Task amounts with greater numbers.
- Provide larger numbers and challenge the students to create as many possible arrays as they can for each farm

Intervention

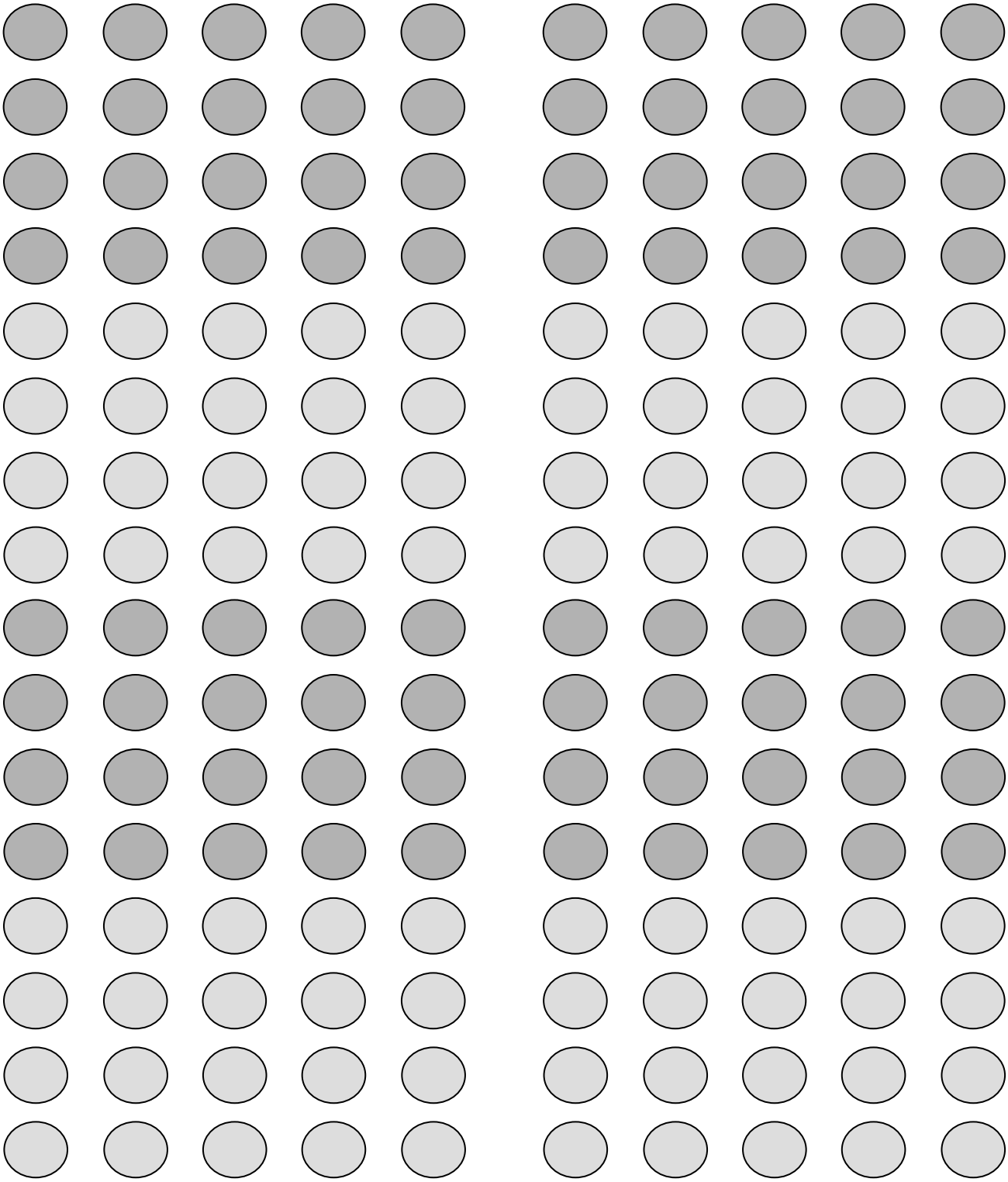
- Replace Station Tasks with lower amounts
- Provide Station Tasks with partial arrays that the student needs to complete

TECHNOLOGY CONNECTION

http://www.multiplication.com/
Practice games for multiplication facts as well as teacher resource pages with instructional ideas on how to introduce multiplication.
Note: This site contains advertising.

Make arrays and see the associated fact
http://www.haelmedia.com/OnlineActivities_txh/mc_txh3_002.html

Array of Circles



Arrays on the Farm: Task Station Cards (enlarge)

Peanut Farm (Part 1)

Paul has a peanut farm with 6 plants in each row and there are 8 rows of plants. How many plants does he have in all?

Prediction

Solution

Peanut Farm (part 2)

Paul wants to plant another field of peanut plants. He can get 24 plants at a cheap price. How many different ways can he plant these peanut plants? How many rows should he plant?

How many peanut plants should be in each row?

Show all the different ways Paul could plant his peanut plants in rows by making your own array on a blank piece of paper.

Onion Farm (Part 1)

Bill has an onion farm. Bill has 4 onion plants in each row and has 4 rows. Bill has a total of 3 fields the same size. How many onion plants are there on his farm?

Prediction

Solution

Onion Farm (part 2)

Bill's son has just bought the plants to start his own onion farm. He has purchased 36 plants and wants some help on how to arrange the plants into rows. What suggestions would you give Bill's son?

Draw all the possibilities

Watermelon Farm (Part 1) 

Wanda has a watermelon farm. In each row she has 12 watermelon plants and there are 4 rows. How many watermelon plants does she have in all?

Prediction

Solution

Watermelon Farm (Part 2)

Wanda wants to double the size of her watermelon farm each year. How many plants will she have in all after…

1 year

2 years

3 years

Record your strategies on an array

Airplane Rides Over the Farm (Part 1)

Henry is giving airplane rides over his farm. His plane has 6 seats in each row. The seat row numbers go up to 21. How many passengers can Henry's plane hold?

Prediction

Solution

Airplane Rides Over the Farm (Part 2)

Henry's plane makes 2 trips over the farm each day. If the plane was full each time, how many passengers would get to see Henry's farm from the airplane?

Prediction

Solution

Name _____

Arrays on the Farm
Student Recording Sheet

I. Station Tasks

Stations	Initial when Completed
Peanut Farm	
Onion Farm	
Watermelon Farm	
Delta's New Plane	

Peanut Farm (part 1)
Paul has a peanut farm with 6 plants in each row and there are 8 rows of plants. How many plants does he have in all?

Prediction:

Show your math language and work to find the answer here

Peanut Farm (part 2)
Paul wants to plant another field of peanut plants. He can get 24 plants at a cheap price. How many different ways can he plant these peanut plants? How many rows should he plant?

How many peanut plants should be in each row?

Show all the different ways Paul could plant his peanut plants in rows by making your own array on a blank piece of paper.

Draw all the ways you can think of here

Onion Farm (Part 1)

Bill has an onion farm. Bill has 4 onion plants in each row and has 4 rows. Bill has a total of 3 fields the same size. How many onion plants are there on his farm?

Prediction

Show your math language and work to find the answer here

Onion Farm (part 2)

Bill's son has just bought the plants to start his own onion farm. He has purchased 36 plants and wants some help on how to arrange the plants into rows. What suggestions would you give Bill's son?

Draw all the ways you can think of here

Watermelon Farm (Part 1)

Wanda has a watermelon farm. In each row she has 12 watermelon plants and there are
4 rows. How many watermelon plants does she have in all?

Prediction

Show your math language and work to find the answer here

Watermelon Farm (Part 2)

Wanda wants to double the size of her watermelon farm each year. How many plants will she have in all after…

Record your strategies on an array

1 year

2 years

3 years

Airplane Rides Over the Farm (Part 1)

Henry is giving airplane rides over his farm. His plane has 6 seats in each row. The seat row numbers go up to 21. How many passengers can Henry's plane hold?

Prediction

Show your math language and work to find the answer here

Airplane Rides Over the Farm (Part 2)

Henry's plane makes 2 trips over the farm each day. If the plane was full each time, how many passengers would get to see Henry's farm from the airplane?

Prediction

Show your math language and work to find the answer here