Elementary Education Lesson Plan Template
Student Name: Eileen Hernon
Grade Level: 3

Topic: Array Model of Multiplication
Rationale:

- So far in math, the students have been investigating multiplication in terms of equal groups. They've had a lot of exposure to repeated addition, skip counting, and illustrating groups. The array model is a logical next step to help organize the way they think about groups and multiplication. It gives them yet another method of expressing and solving multiplication problems. By allowing students to use manipulatives to create their own arrays in addition to determining multiplication problems for given arrays, I'm making the array model accessible in different ways. Throughout the lesson, students will have multiple opportunities to collaborate and discuss their strategies for using arrays to multiply.

Enduring Understandings:

- Students will understand that different models can be used to represent multiplication and division

Essential Questions:

- What is the relationship between the factors and the product?
- How can I use models to solve mathematical problems?

Primary Content Objectives:
Students will **know:** (facts/information)

- Factors are the numbers being multiplied
- Product is the answer to a multiplication equation
- The factors in the array model are the number of rows and columns
- The product in an array model is the total number of squares
- Every number can be represented with an array; most numbers can be represented by more than one array.

Students will be able to **do:** (skills and behaviors)

- Create arrays to represent a variety of multiplication equations
- Use skip counting and repeated addition to determine the number of squares in an array
- Find relationships between arrays to help them solve multiplication equations
- Connect arrays to a "naked number" multiplication problem

Related state or national standards:

- VA Math SOL 3.6:
    - The student will represent multiplication and division, using area, set, and number line models, and create and solve problems that involve multiplication of two whole numbers, one factor 99 or less and the second factor 5 or less.

Assessment:

- Formative Assessments:
    - Students will be assessed throughout the lesson based on their use of skip counting or array relationships to determine the number of squares in a given array.
        - Are they skip counting the squares in an array based on a factor?
        - Can they use a known array to solve a new one? (e.g. can they use their knowledge that 8x4 array has 32 squares to more efficiently solve 9x4 array?)
    - Exit ticket (see appendix):
        - Students will have a short worksheet to complete at the end of the lesson that measures their comfort with arrays.
            - Are they using repeated addition when solving arrays?
            - Are they accurately skip counting?
            - Can they determine each array's corresponding multiplication problem?

Materials and Resources:

Instructional Materials:

- Arrays students drew the day before (for reference)
- Snap cubes for each child
- White board and marker for teacher
- Exit ticket for each child
- Each child will need a pencil
- For possible re-teaching:
    - graph paper for each student
    - different colored pencils (teacher will distribute as needed)

Planning Resources:

- Investigations 3 (math textbook series)
- VA 3rd Grade Math SOLs
- Envisions (math textbook)

Key Vocabulary and Definitions:

- Factors: the numbers being multiplied
- Product: the answer to a multiplication problem
- Array: Items grouped in equal rows

Lesson Procedures:

1. ***Introduction and goal orientation:***
    - "Hi friends! So yesterday, we talked a little about arrays by arranging a certain number of chairs into equal rows. Well, did you know that each array represents a multiplication problem? Today, we're going to continue our work on the arrays and connect them to multiplication. You're going to get to create arrays to solve multiplication problems and then look at arrays and figure out what multiplication equation goes with it."

2. ***Connecting to prior knowledge and experiences:***
    a. Activating knowledge of groups: "Alright so we've been talking a LOT about groups in multiplication. Who can give me an example of a multiplication problem that uses groups? (wait time—possible responses include: Here are 4 tricycles. Each tricycle has 3 wheels. There are 12 wheels in all.") That's a great example! And how did you get that answer? (student should say repeated addition or skip counting; some students may say they knew that 4x3=12. In that case, I'll say something like, "and if you didn't have that fact memorized, how could you solve it? Could you add or skip counting? What would that look like?"). That's awesome!"
    b. Tying groups to array model: "So when we use arrays, we can think of each row as a group! Instead of thinking of 4x3 as 4 tricycles with 3 wheels each, we could just think of it as 4 rows, each with 3 squares (draw the array as you speak). How many squares are in all? (wait time) That's right! 12, because we can think of it as 4 groups/rows of 3 each."
    c. Reference arrays drawn on previous day: "Okay now let's take a look at the arrays you all made yesterday with the arranging chairs activity. Here are some of the arrays you created for the number of chairs you had to arrange. Turn to the person sitting next to you and talk about what you notice about some of these arrays."
        i. Possible notices include:
            1. Some arrays are squares (these numbers are perfect squares—created when you multiply one number by itself)
            2. Some numbers can only be made into a long, skinny arrays (prime numbers—contain only two factors, the number and 1)
            3. Some numbers have LOTS of possible arrays, some only have a few.
        ii. As students share, teacher should record them on the white board

3. ***Tasks and activities****:*
    a. Use what the students notice about the arrays to introduce *factors* and *products* in the array model.

i. “Those are all really wonderful observations! So in arrays, the total number of squares is called the *product.* Yesterday, you were given the total number of chairs, or product, and told to arrange the chairs into equal rows. As (child) pointed out, you could arrange some of those numbers into different amounts of equal rows. Other numbers, though, only had two possible arrangements. The number of rows in each array is one *factor,* and the number of squares/chairs in each row is another *factor.* So some numbers/products have a lot of possible *factors,* while others only have two. (Child) pointed out that some arrays are squares. What do you think the factors of those arrays are? (wait time). That’s right! The factors are equal. So if we look at the arrays you created for 16 chairs, we see that one possible set-up is 4 rows of 4 chairs. This creates a square, because the factors are 4 and 4. Do you remember talking about factors and products in multiplication equations? If I write this multiplication equation (write on white board), what are the factors and product? (wait time) That’s right! So that’s how we write multiplication equations based on the array model. We take the number of rows, and multiply it by the number of squares in each row to get the product, or the total number of squares.”

b. Draw an array for students and continue exploration of factors and product:
   i. “Okay so now I’ve drawn this array here. You see we have 4 rows. Each row has 6 squares in it. Use the snap cubes in front of you to re-create this array for yourself. (wait—make sure each student does it). Okay, what do we think the factors in this array are? (wait time). Turn and talk with the person sitting next to you. When you think you’ve got the factors, give me a silent thumbs up. (wait time). What are the factors? (students should say 4 and 6—if they don’t get it, break it down: “how many rows are there? 4 so we know 4 is one factor. And how many are in each row? 6, so we know 6 is the other factor. Does that make sense?”). And how could we figure out the product? (wait time) That’s right, we need to figure out how many squares are in the whole array. Work with your partner to figure out how many squares are in the whole array. Give me a silent thumbs up once you’ve done that. (as kids work with their partner, look to see what strategies they’re using—should see evidence of skip counting and repeated addition). Okay what’s the product? (wait time). Okay I heard 24. Do we agree or disagree? What strategy did you use to find that product? Did anyone use a different strategy? (If child counted one by one, ask if there’s a faster strategy). Okay, so we can write this array as a multiplication equation by showing 4x6=24, because our factors are 4 and 6 (4 rows of 6) and our product is 24 (there are 24 squares in the entire array).

ii. Draw a second array and repeat process of identifying factors and products—make sure students are skip-counting or using multiplication (not counting each individual square). What would be the multiplication equation for this array?
    1. If students are not picking up on skip-counting, take time to re-teach (see accommodations for individual differences).

c. Write a multiplication equation on the white board and have the students create arrays using snap cubes.
    i. "Okay now I have the equation 3x5. Use your snap cubes to create an array to represent this as an array. When you're done, compare your array with your partner's. Are they the same or different? How many snap cubes are there in all?"
        1. Students should show 3 rows of 5 cubes each. A possible mistake would be showing 5 rows of 3 cubes each. In this case, I would explain to students that we read multiplication equations as 3 rows of 5, so we have to have 3 rows, which are horizontal. However, I could then rotate their array 90 degrees, which would show 3 rows of 5. I would then explain that multiplication equations are always the same regardless of factor order, so that's why the product is the same. We just have to be careful in how we read them and make sure we're forming the correct number of rows.
        2. "And how did you determine the product? (wait time—students should say skip counting or repeated addition or knowing that 3x5 is 15. They should not be counting individual squares.) That's right—we can skip count the rows/add 5 three times."
    ii. Repeat with 4x5. Have kids add to the existing array they created with 3x5. Try to get kids to see that in addition to skip counting and repeated addition, you can use knowledge of 3x5 to solve 4x5 by just adding another row of 5, thus getting 20.
        1. If students have the hang of it, give them the extension story problems as a challenge (see accommodating for individual differences). Otherwise, continue practicing creating arrays or identifying multiplication equations with a given array.

4. ***Closure**:*
    - Students will complete an exit ticket to assess their understanding of arrays. As they finish, I will collect the tickets and determine if we need to revisit the lesson the following week.
    - "Okay boys and girls now you're going to work independently on an exit ticket. It's no big deal—just a quick way for you to show me what you know about arrays and multiplication. All you need is a pencil."

- After kids have completed exit ticket: "Okay my friends, when you go home tonight, I want you to try and notice different things that come in arrays. We talked about rows of chairs yesterday and today, but there are *tons* of other things that come in arrays. Try to notice them when you're home tonight."

Accommodations for individual differences:

- Opportunity to re-teach:
  - If students are not comfortable skip-counting the rows in an array, I will pause the lesson and have them each draw a 4x6 array on a piece of graph paper. I will then pass out 4 different colored pencils to each student and instruct them to color each row a different color. I will then prompt them to skip count by saying, "okay we can see that each row has 6 squares—there are 6 squares of each color. So the first row (state color) gives us 6, then what do we have after we include the second row (state color)? That's right, 12. And after the third row (state color)? 18. And finally, all together, we have 24. You see, a faster way of counting the number of squares in the array is by skip-counting by the number in each row. Let's practice another one." (repeat creating arrays and coloring them in as necessary)
- Opportunity to extend:
  - If students are breezing through the array model, I will give them the opportunity to solve multi-step problems with arrays (see appendix). These problems will challenge them by requiring them to work with multiple pieces of information at once.
- The students in my class are *very* social, so I will give them opportunities to work with a partner. That should meet their needs to chat while they work.
- I will read the questions on the exit ticket aloud to students who struggle with reading. This way, they aren't at an unfair disadvantage.

Behavioral and organizational strategies:

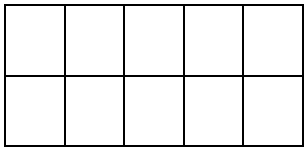
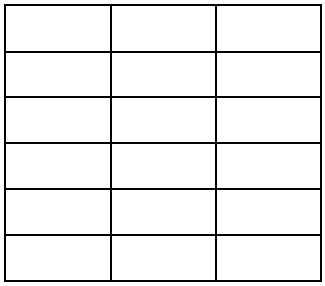
- We will review our classroom rule of respect: the students have to treat all materials with respect. Ask them how they can treat the snap cubes with respect.
- Some students have a tendency to get frustrated if they can't do things perfectly right the first time. For these students, I will remind them that math takes time to learn, and math mistakes happen all the time. Mistakes are perfectly fine and actually help us learn.
- I will keep colored pencils, graph paper, and challenge problems off to the side and only bring them out case I need to re-teach or extend. This should help minimize distractions.

Appendix:

Exit Ticket:

Name _____ Date _____

Fill in the blanks to show repeated addition, skip counting, and multiplication for each array.

1.  5+__ = 10 5, __ __ x 5 = ___	2.  3+__+__+__+__+__= __ 3, __, __, __, __, __ 6 x __ = __	3.  __+__+__+__ = __ __, __, __, __ __ x __ = __

4. Nicholas and Laveah are setting up chairs. They each set up a row of 9 chairs. How many rows are there in all? Draw an array to solve. How would you write this as a multiplication equation?

Extension Activity: (read these questions aloud to students and have them work collaboratively to solve)

1. Derek is having a piano recital. He has sold 154 tickets to his recital. The auditorium has 17 rows, each with 9 chairs. Are there enough chairs for everyone?

How many people will have to stand?

Mr. Dan, the custodian, has agreed to put 2 more chairs in each row. How many more tickets can Derek sell to his recital?

2. Maren and her dad are baking brownies. They have to serve 24 brownies. How many different ways can they cut the brownie pan to get 24? (Draw a rectangle on white board to represent brownie pan. This one may require offering background information about brownie pans—some students may have never baked brownies before.)