

Writing Expressions for Real-World Arrays

Part 5 of 6 from the Unit: Deepening Understanding of Order of Operations

A Common Core-Aligned Lesson Plan to use in your Classroom

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The activity

Students will write numerical expressions or equations to represent real-world arrays. Students at many levels will be able to understand writing expressions without the algebraic letters they often find intimidating. Thinking about the order of operations in context so the results make sense, will help to build the foundation for understanding the order of operations.

Getting away from worksheets and textbooks that only repeat procedures, this activity brings the properties of mathematics to the high-interest context of real-world photographs.

Students will

- Interpret products of whole numbers, e.g., interpret 5×7 as the total number of objects in 5 groups of 7 objects each. CCSS 3.OA.1
- Apply properties of operations as strategies to multiply and divide. (commutative property of multiplication,...associative property of multiplication,...distributive property) CCSS 3.OA.5
- Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols. CCSS 5.OA.1
- Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. CCSS 5.OA.2
- Attend to precision. CCSS MP.6

Resources needed:

- 2 – 3 sheets blank or lined paper per participant
- 1 pencil per participant
- Photographs of real-world arrays for models (number of candies, smart phone apps, solar panel, number of hearts) which can be found at the end of this document
- 1 set of six to ten themed array photographs (laundry basket holes, window panes, cookies, cupcakes and muffins, chairs, shoe rack, cube shelf storage, or wine racks) for every three participants. You can find your own, or use the selection in the [folder in Google Drive](#).
- Group Record sheets for each group, if desired, to aid organization. You can find these in the [Google Drive folder](#).

Approximate time:

1 hour

Instructions

Academic Vocabulary: What domain or academic-specific words will you use in the lesson?

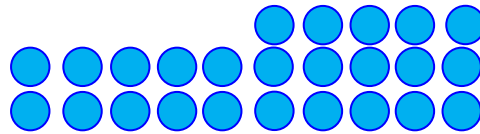
- *context* – the circumstances that form the setting for a real-world math problem; the situation which presents a mathematical problem
- *array* – a set of objects arranged in a specific pattern (usually rows and columns)
- *expression* – a math phrase made of numbers, symbols, and operation signs grouped to show the value of something
- *equation* – a written statement showing equality between two expressions

1) **Opening Discussion:**

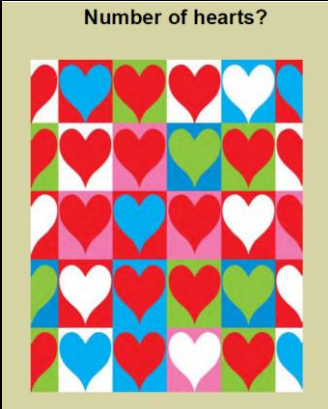
- a) Review with students how to determine how many candies are in this picture without counting. ($3 \cdot 4 = 12$ or $3^2 + 3$ for example)
- b) Review how to find out how many chips are in a bag without counting every chip. (create an array)



- Ask students for an example of an expression ($2 \cdot 10 + 5$) and of an equation ($2 \cdot 5 + 3 \cdot 5 = 25$).



- Continue the discussion using three new photographs (found at the end of this document). List possible equations for the arrays in the photographs on the board. Be sure to read with context, saying “sets of” rather than “times.” See Success Tips for other suggestions.

Smart Phone	Number of Hearts	Solar Panels
		
Possible written expressions: $3 \cdot 4 + 2 =$ $4 \cdot 2 + 2 \cdot 3 =$ $4 \cdot 4 - 2 =$ $4^2 - 2 =$	Possible written expressions: $5 \cdot \frac{1}{2} + 4 \cdot 5 + 5 \cdot \frac{1}{2} =$ $.5(1 \cdot 5) + 4 \cdot 5 =$ $4^2 + 4 + 2(5 \cdot \frac{1}{2}) =$	Possible written expressions: $4 \cdot 4 \cdot 9 \cdot 6 =$ $8(9 \cdot 6) + 8(9 \cdot 6) =$ $2(6 \cdot 9 \cdot 2 \cdot 4) =$ $4^2 \cdot 9 \cdot 6 =$

2) Small Group Activity:

- [Before class, choose [array photographs](#) (laundry, windows, cookies, muffins, chairs, shoe racks, cube storage, or wine racks) appropriate for the level of students in class.]

- 3) Pass out one set of themed [array photographs](#) to each pair or group of three students. Use the [Group Record Sheets](#) for organization, if desired. Pass out written directions as needed:

Exploring the Natural Order of Operations

As a group, write at least two numerical expressions for the arrays you see in each photograph.

- a) Circulate. Make sure students are communicating with each other and working as a group on examples rather than distributing the work. Ask clarifying questions and give feedback. Examples:
- "As I look at your equation, I notice _____. What would result if _____?"
 - "Can you predict the outcome of your equation if we changed the location [set of objects in a picture] to [new location or new number]?"
 - "Why is it better to solve [example of one of their equations] in that order?"
 - "What similarities does that equation have with this equation?"
 - "Why is multiplication performed before addition and subtraction when you find out your total?" (converting to like units → must make rows and columns of items into single items before adding)
 - "Do you need parenthesis in this equation or are they optional?" (grouping symbols are used to disrupt the natural order of operations if needed for the context of the expression)
- b) Expect students to Attend to Precision (MP.6). Look for evidence that students' written expressions contain accurate symbols and operations, and that students are using some of the vocabulary words in their descriptions of photographs as they discuss what arrays they see in their groups.
- 4) **Wrap-up (whole group):**
- a) Have small groups share a photograph and a corresponding expression or equation, read with context (not "*times*" but "*6 sets of 4 shoes minus ...*"), with the whole group.
- 5) **Extensions:**
- Take a photograph of an array that you see this week.
 - Revisit this activity at the beginning of a new week with a different set of photographs to review before moving on.

6) **Evidence of Success (Formative Assessments):** What exactly are students expected to be able to do by the end of the lesson, and how will mastery be measured? What would outsiders see that would convince them that students have developed a deep understanding?

- Students will be able to explain their ideas to fellow students. They will be able to write expressions or equations that show the use of the distributive property, commutative properties, grouping symbols, and a variety of operations.

Differentiated Instruction

Challenge more advanced students to create additional expressions for an array, use other operations, or to write their expression in English words. The themed photographs range in difficulty; choose simple or complex pictures based on what you know about your students' needs and abilities. Consider giving some of all of the individual practice sheets from Lesson 6 (Find the Missing Number, Grouping Symbols, and Creating True Equations) as homework before the lesson for students who could benefit from a head start.

Success Tips

- When demonstrating, eliminate any unnecessary parenthesis.
- Be sure to use context when reading expressions. For example, $3 \cdot 4$ can be read: "Three rows of four." "Times" does not have as much meaning.
- Be sure to *download* the PowerPoint Presentation so that you see the notes section for your own use. Use it from PowerPoint with your class rather than from Google Drive so that the animations are in place.
- Change the names within the PowerPoint Presentation to the names of people in your program.