Lesson M2.2
Arrays Around Us

In this lesson, students will explore ways to use arrays to find patterns to support adding quickly and how to represent the total number of objects in an array using a repeated addition equation. Students are engaged in the Fluency, Originality, Flexibility, and Elaboration Thinking Strategy during this lesson when they are asked to develop multiple and/or unique (from other students in the class) equations that could represent the arrays provided. This introduction to arrays and repeated addition can serve as a foundation for the concept of multiplication.

For information about the interpretation of arrays as multiplication, see the *Math Matters* book (p. 76-80).

CCSS.MATH.CONTENT.2.OA.C.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 addends.

Standards for Mathematical Practice
MP7: Look for and make use of structure.

Time Frame: ~60 minutes
To allow students to investigate the tasks and concepts in this lesson fully, it will likely take more than one class period. If the lesson will extend across two class periods, a good place to pause the lesson is after the Explain section. When restarting the lesson, be sure to start with a brief review of what students discovered the day before during the Explain section of the lesson.

Materials
2 Twelve dot pictures (see below)
Picture of hearts in an array (see below)
Square sticky notes
Square inch tiles
Graph paper
Word wall cards (row, column, array)
Video (link included)
Copies of the Wall Tile Arrays
Copies of the Exit Ticket
Stickers (optional, for the exit ticket)

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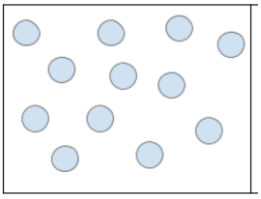
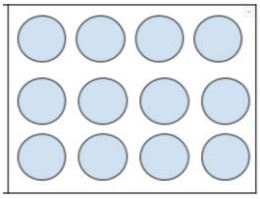
Engage

The teacher will begin the lesson by showing the students two different pictures of 12 dots (see example) one at a time. Start with showing the picture of the 12 dots scattered and asking students, “How many dots do you see in the picture?” and “How do you know?” Have several students answer.



Then show students the picture of the 12 dots arranged in an array and asking, “How many dots do you see in the picture?” and “How do you know?” Have several students answer.



Facilitate a discussion about with which arrangement/picture it was easier to figure out the number of dots. Questions the teacher might ask include, *Which of these pictures is easier to count? How are the pictures different? Why is it easier for you to find the total number of dots in one picture versus the other? etc.* During the discussion teacher first may have students share with a partner and then share out with the whole class. Be sure to have multiple students share ideas throughout the discussion. Students should ultimately conclude that the dots in the array arrangement are easier to count and they may provide multiple reasons for why. Some students might mention the idea that they can add the number in the row/columns.

When students are thinking about multiple possible equations for representing the array, they are engaging in thinking fluently.

Explore

Show the students a new set of images (see below) arranged in an array and ask students to think about how they might show the total number of hearts using an equation (or number sentence). Ask students if they think there might be more than one equation they could write to show the total number of hearts.

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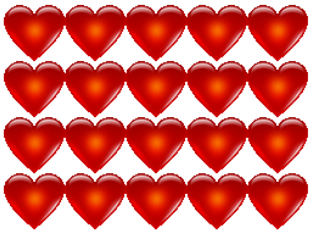

Provide each student with a picture of the heart array and have students work with a partner to develop as many equations that show the total number of hearts as they can. At this point students may develop number sentences that have equal addends (and that represent the row and columns, ex. 4+4+4+4+4=20) or they may use unequal addends (may circle groups of hearts with different numbers and represent the equation to match, ex. 8+8+4). Have students record their equations on sticky notes; they should only record one equation on each sticky note.

Throughout the student work time, encourage students to develop multiple equations that can be used to represent the total number of hearts in the array. The teacher might say, *"How many different ways can you use addition to figure out how many hearts there are? Can you find a way that no one else will?"*

Questions such as these encourage students to engage in fluency, flexibility, and originality of thinking.

Look For

- Students who are using addition strategies. (Strategic)
- Students who are able to explain repeated patterns and connect them with arrays. (Communicative)

Explain

In reference to the equations students developed to represent the array of 20 hearts, have pairs of students share the sticky notes with their equations. As each pair shares, have students sort or organize the sticky notes on a chart or white board by grouping equations that have equal addends together and equations that have unequal addends together. Although not expected at this time, if students used multiplication equations to represent the arrays they also can be grouped together.

Once all pairs have shared, call students' attention to the equations that have equal addends. Tell students that in mathematics we say that equations like this are showing repeated addition because the addends in a given equation are the same so the addends are "repeating" (ex. 4+4+4+4+4=20 or 5+5+5+5=20).

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Consider creating word wall cards for the words row, column, and array. These can be introduced as they are discussed in this part of the lesson.

This may be a brief discussion at this point depending on students' prior knowledge/ experience with arrays. If they struggle to come up with some, show the video and then discuss arrays that they might see at school or at home.

This part of the lesson may help students with flexibility in thinking as they consider that arrays can be many different things.

At this point in the lesson, introduce the word "array." The teacher can say, "An array is an arrangement of pictures, objects, or numbers in columns and rows." The word "array" and the definition can be added to a word wall that students use. Students could eventually add examples of arrays to the word wall. Continue the description of an array by describing the rows and columns. The teacher can say, "A row goes across *(teacher directs students to move their arm horizontally in the air).* A column goes up and down *(teacher directs students to move their arm vertically in the air)*."

Ask students to talk with a partner about where they might see arrays around school or home. Allow partners to discuss ideas and then have pairs share out ideas to the class. Be sure to solicit many ideas from different pairs in the class. Record students' ideas on a chart or whiteboard.

Follow this discussion by asking students how a repeated addition equation can be used to represent the total number of objects in an array. Encourage students to use to hearts array from earlier in the lesson to justify their ideas. Show students other examples from this video - http://viewpure.com/ks-q6gKoQKs . Pause after each array so students can see and discuss the repeated addition equations. The teacher can say, "Look at each row, the number for the items in each row is used in the number sentence." (Ex: "In the first picture we see a carton of eggs. The first row has 6 eggs and the second row has 6 eggs. If I add them together, 6 + 6 = 12.")

Continue the discussion of the arrays and equations. When the picture of the soda cans appears (40 second mark), pause the video and have students discuss the possible equations for total number of cans in the array. The video contains many more examples of arrays with small and large numbers of objects.

Look For

- Students who recognize different ways to represent the arrays. (Perceptive)
- Students who connect background knowledge to everyday arrays. (Resourceful)

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Elaborate/Extend

Target Task

In the previous part of the lesson, students may have said that some school walls or bathroom walls have arrays. Tell students that you have pictures of three tile walls (see below). Use one of the arrays to demonstrate how students might record what the array looks like on graph paper and to write the repeated addition sentence to represent it. Have partners select one of the wall tile arrays (1-3) to investigate other arrays that could be used to represent *the same number of tiles*. Students can use square inch tiles to represent the tiles in the array so they can manipulate the tiles to make arrays. For example, Wall Tile Array 2 represents 36 tiles as 4 rows of 9 tiles. Students would work to come up with other arrays that represent 36, such as 6 rows of 6 tiles, 3 rows of 12 tiles, 12 rows of 3 tiles, etc. Students can record the arrays they make on graph paper and should include the repeated addition sentences that would represent the array they made. Note that when the students write the equations, the addends that are repeated can be either the number of tiles in the rows or the number of tiles in the columns.

Extend the Task

For students who were observed engaging in one of the high-potential behaviors or demonstrated advanced understanding of the concept in the Explain section of the lesson, this target task can be extended by providing students with the Wall Tile Array for Extend the Task modification which represents 72 tiles. Have partners investigate other arrays that could be used to represent the same number of tiles. For the number 72 there are more arrays that students could create. Students can use square inch tiles to represent the tiles in the array so they can manipulate the tiles to make arrays. Students can record the arrays they make on graph paper and should include the repeated addition or multiplication (if they come up with them) equations that would represent the array they made.

Scaffolding and Support

If pairs seem to need more support, consider assigning an array that has fewer tiles than the others, like Wall Tile Array 1, which represents 30 tiles. Also, since each of these wall tile arrays is beyond what the CCSS standard specifies (5x5 arrays), the pictures can be cut to be 5x5 arrays or smaller if some students are still developing the meaning of the array. Students can record the arrays they make on graph paper and should include the repeated addition sentences that would represent the array they made.

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Look For

- Students who recognize different ways to represent the arrays. (Perceptive)
- Students who connect background knowledge to everyday arrays. (Resourceful)

Evaluate

Using the fishbowl sharing out strategy, have all the pairs of students who used the same wall tile array sit on the inside of a circle. Have the rest of the students stand around the outside of the circle. The students in the center of the circle will share their repeated addition equations. Ask the students around the outside of the circle what they notice or what questions they want to ask. Conduct this fishbowl discussion with the students who investigated each wall tile picture having a turn in the center of the circle.

As an exit ticket, students will think of an array that they may see in school or at home and draw it. They should also then write at least one repeated addition equation that matches the array. If students struggle with keeping rows/columns evenly spaced by drawing the arrays, consider providing stickers for students to use instead of drawing the arrays.

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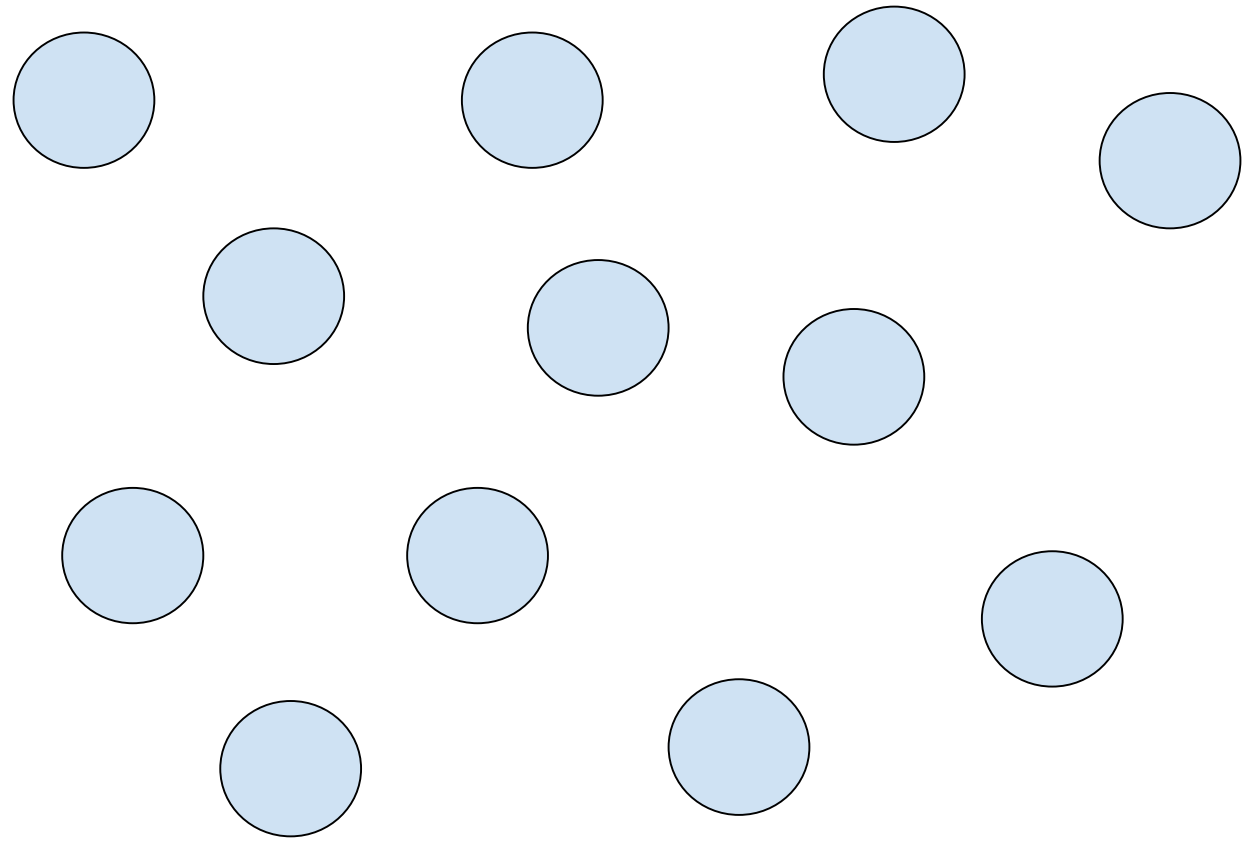
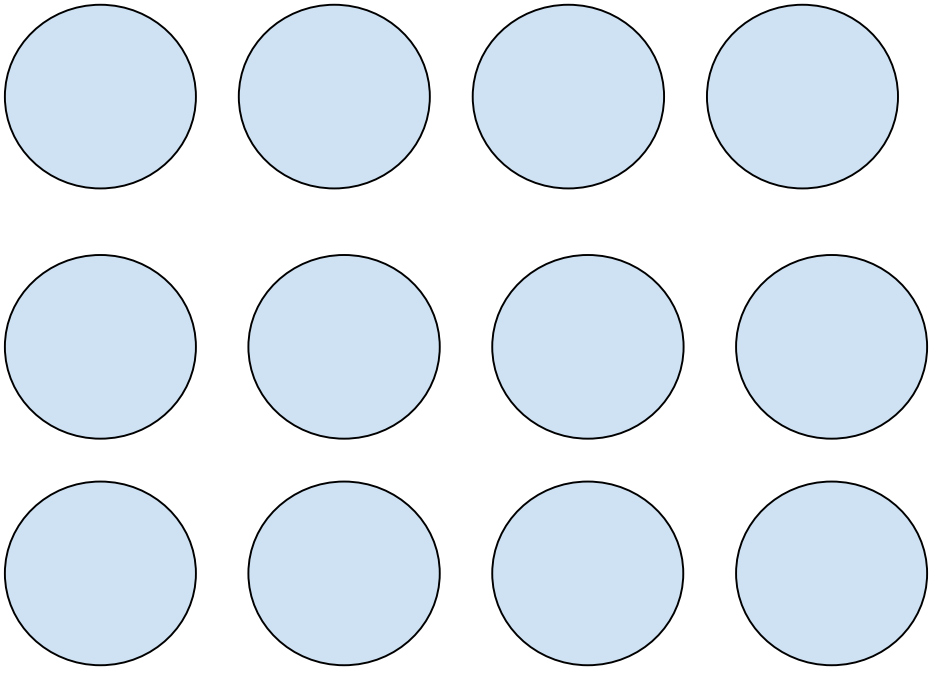
Engage - Arrangement of 12 dots





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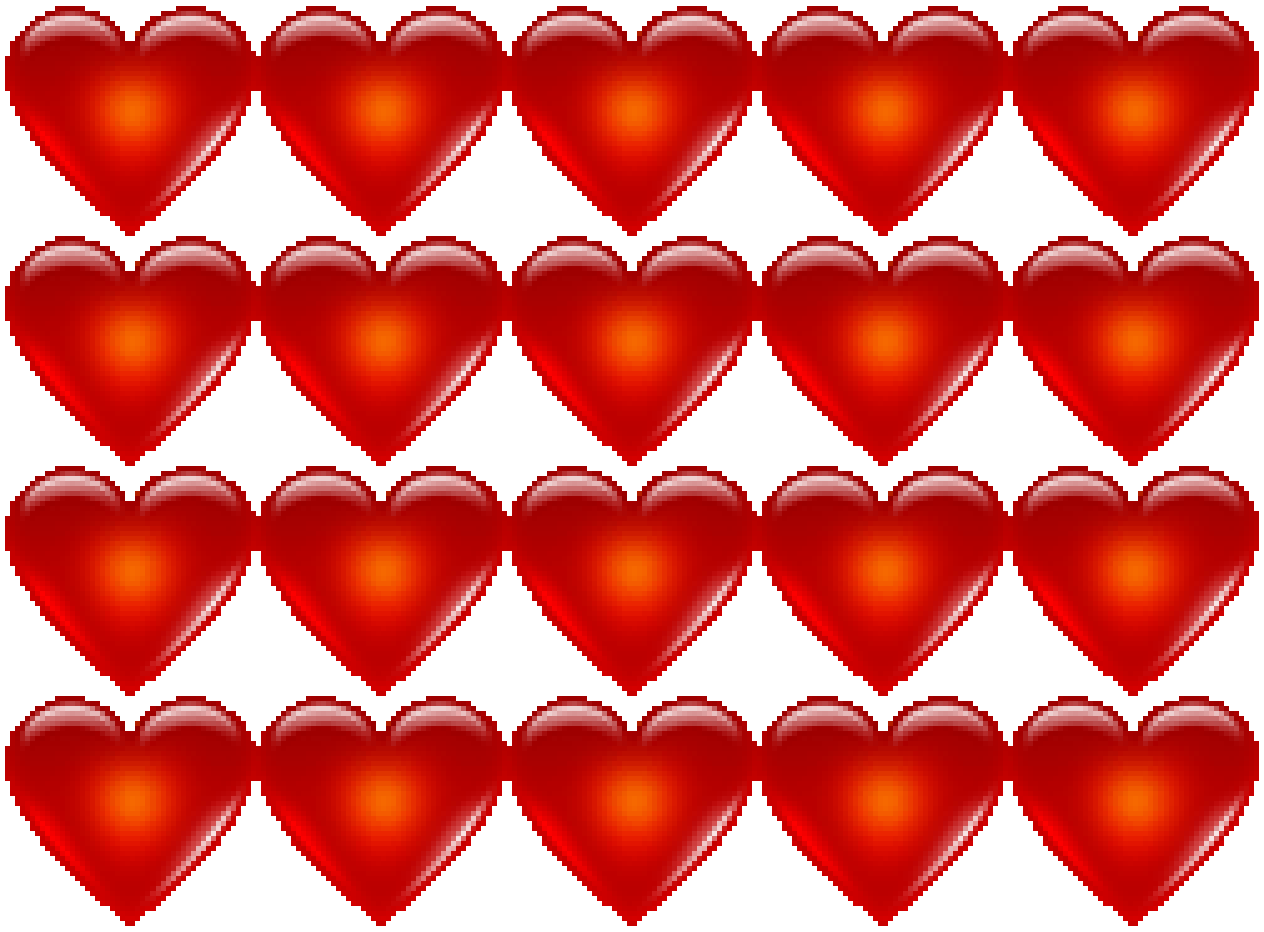
Explore



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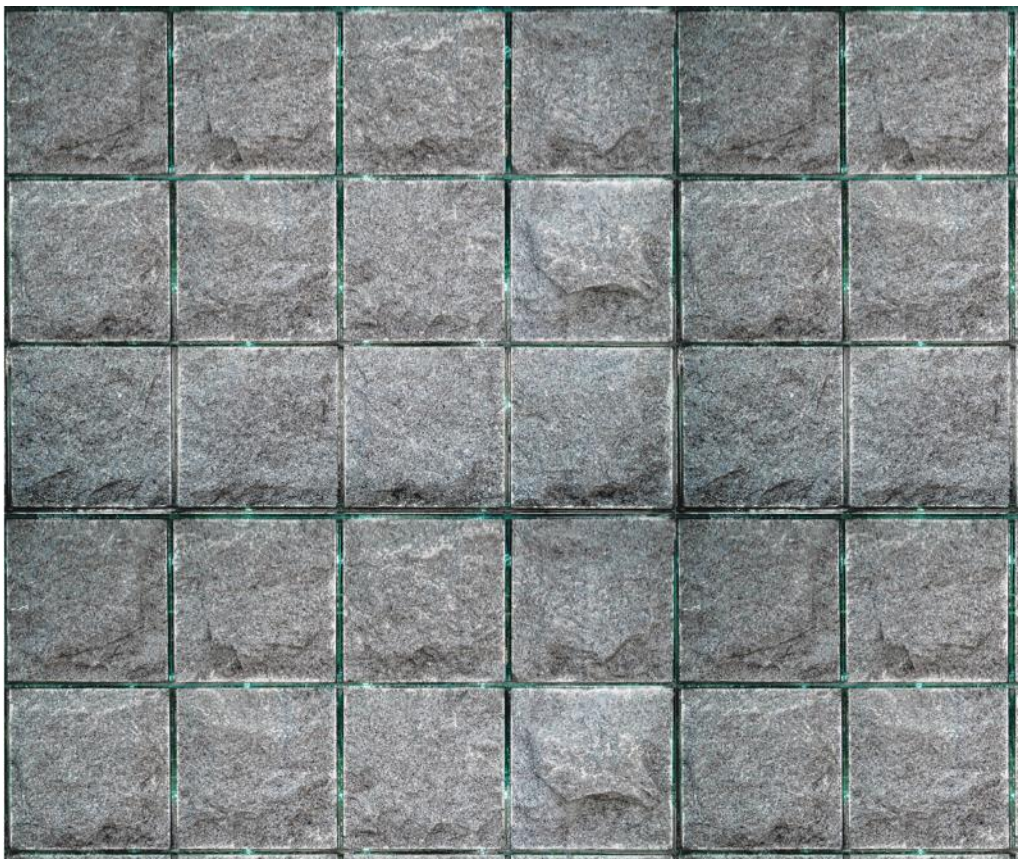
Wall Tile Array 1 (30 tiles)



Wall Tile Array 2 (36 tiles)

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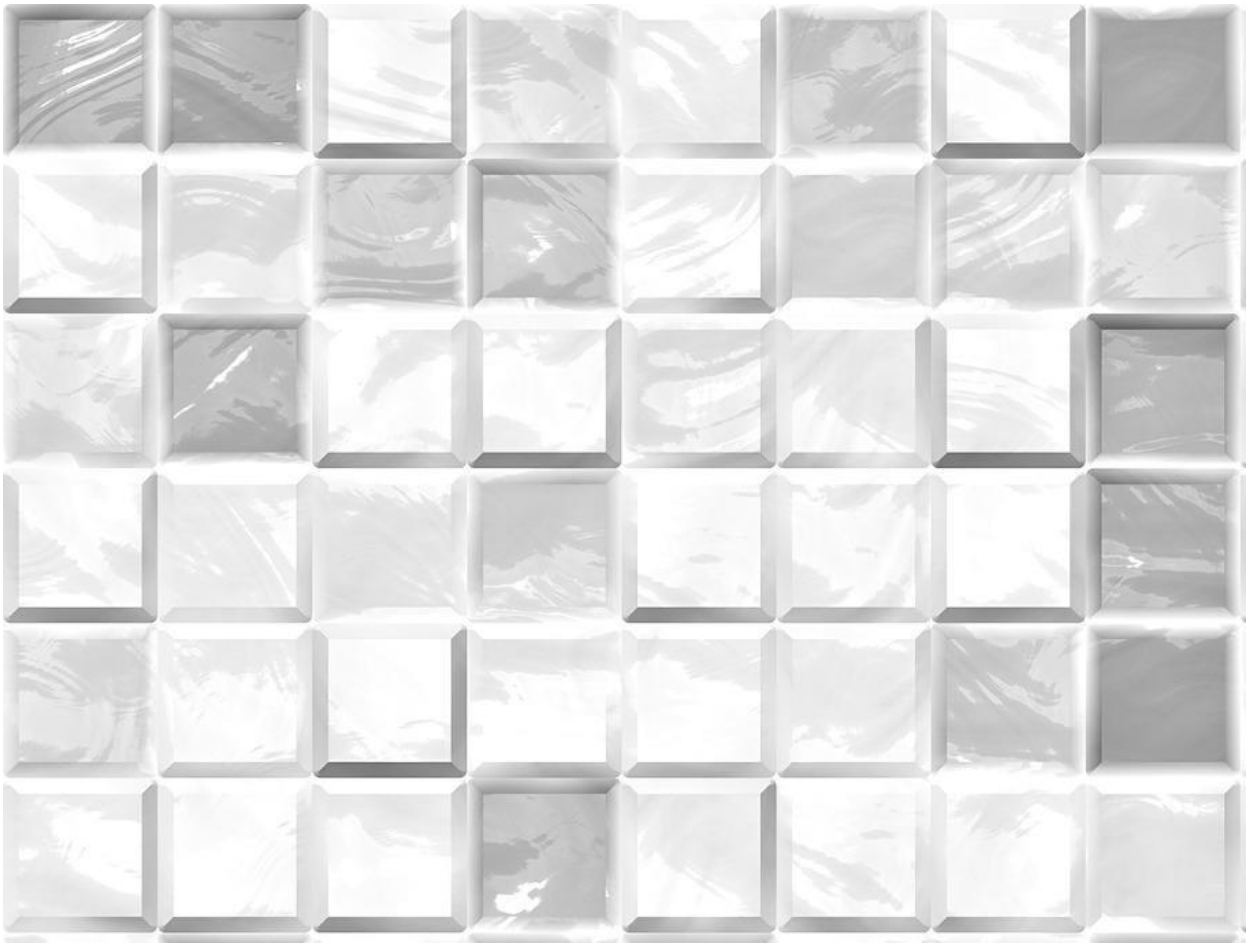
Wall Tile Array 3 (48 tiles)



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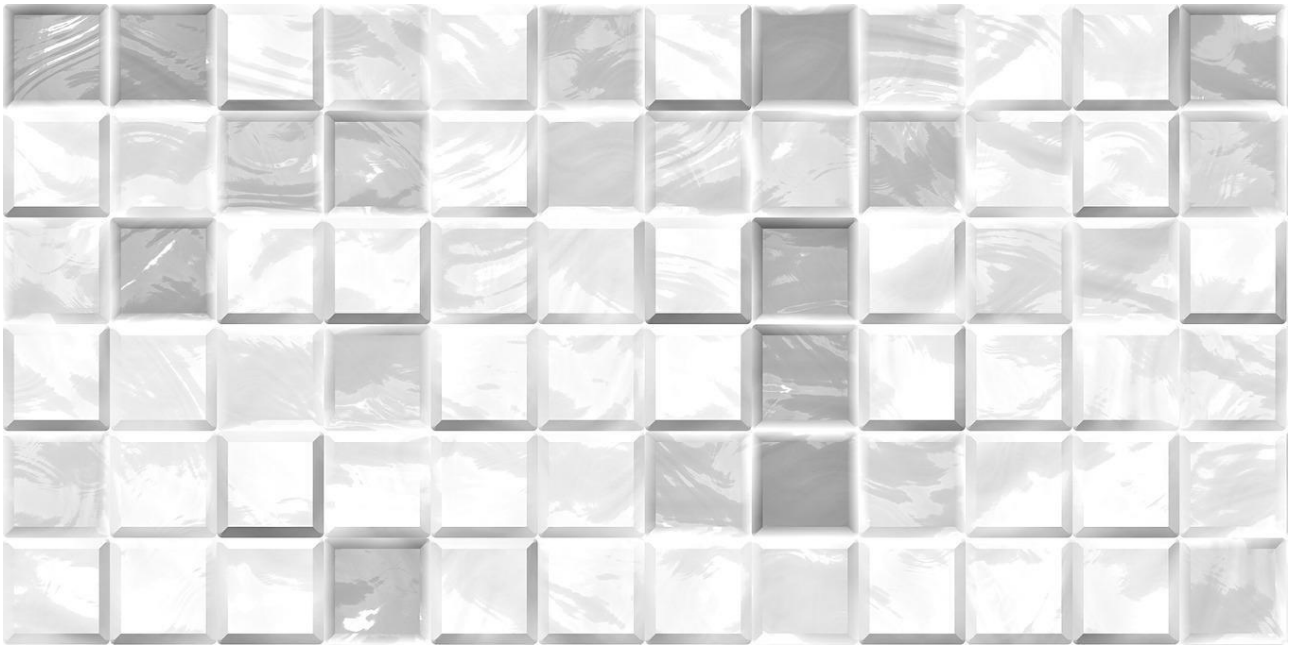
Wall Tile Array for Extending the Task modification (72 tiles)



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Name: _____

Exit Ticket

Think about the video we watched. We noticed that arrays are everywhere in our world. Think of an array that you have seen and draw an example. Write at least one repeated addition equation that matches the array.

Equations that match the array:

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column

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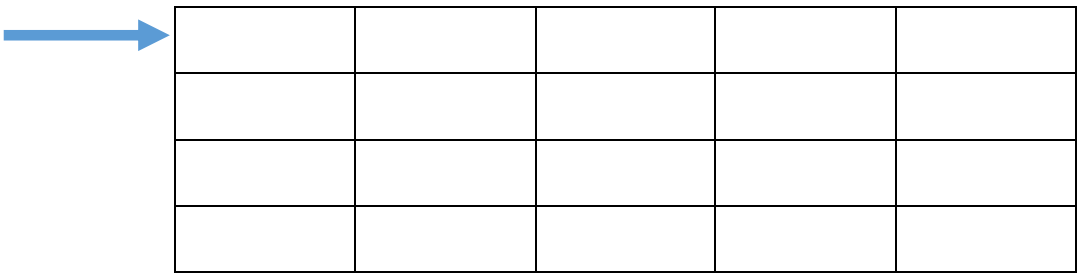
row



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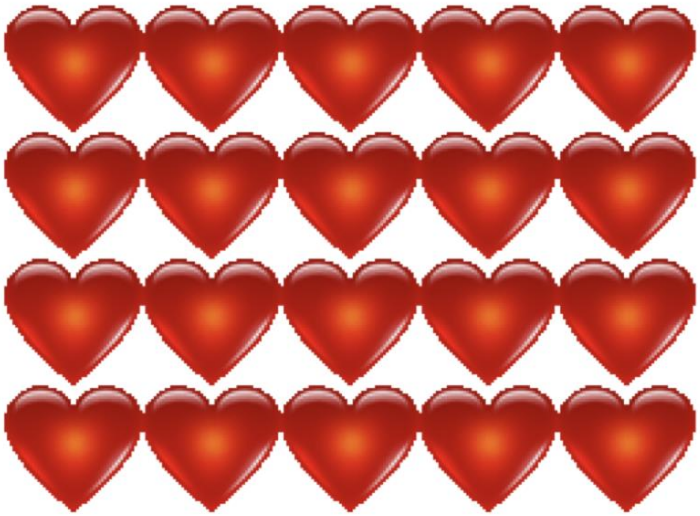
array



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