



Lesson 21: Writing and Evaluating Expressions—Multiplication and Addition

Student Outcomes

- Students develop formulas involving multiplication and addition from real-world problems.
- Students evaluate these formulas for given values.

Lesson Notes

This lesson begins with students making a model of a real-world problem they most likely have already encountered: moving enough tables together so that a large group of people can sit together. After the problem is posed, students use square tiles to model the problem. Using this data and looking for patterns, they make generalizations about the expression that describes the problem.

It will be necessary to prepare bags of five square tiles before class and to group students thoughtfully.

Classwork

Opening (2 minutes)

Move students into groups of two or three and distribute the bags of tiles.

Mathematical Modeling Exercise (15 minutes)

- Today, we will model a problem that happens in restaurants every day: moving tables together so that everyone in a group can sit together. Use the square tiles to represent square tables. One person can sit along each edge of a table side, no crowding. Our first goal is to find how many people can sit at tables made of various numbers of square tables pushed together end-to-end.
- How many chairs can fit around one square table? What is the perimeter of the square if the edge length is one yard? Record the results in your table.
 - 4; 4 yards
- If two square tables are pushed together to form a longer rectangular table, how many chairs will fit around the new table? What is the perimeter of the rectangle? Record the results in your table.
 - 6; 6 yards

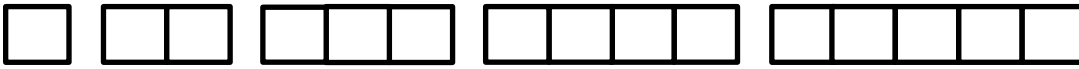
Make sure that each student can connect the square model on the desk to the picture on the classwork sheet.

- If there are twice as many square tables in the new rectangular table, why can't twice as many chairs fit around it?
 - *No chairs will fit right where the tables come together.*

- Make a record of the number of chairs that will fit around longer rectangular tables when 3, 4, and 5 square tables are pushed together to form long rectangular tables.

Mathematical Modeling Exercise

The Italian Villa Restaurant has square tables that the servers can push together to accommodate the customers. Only one chair fits along the side of the square table. Make a model of each situation to determine how many seats will fit around various rectangular tables.



Number of square tables	Number of seats at the table
1	4
2	6
3	8
4	10
5	12
50	102
200	402
T	$2T + 2$ or $2(T + 1)$

Are there any other ways to think about solutions to this problem?

Regardless of the number of tables, there is one chair on each end, and each table has two chairs opposite one another.

It is impractical to make a model of pushing 50 tables together to make a long rectangle. If we did have a rectangle that long, how many chairs would fit on the long sides of the table?

50 on each side, for a total of 100.

How many chairs fit on the ends of the long table?

2 chairs, one on each end.

How many chairs fit in all? Record it on your table.

102 chairs in all.

Work with your group to determine how many chairs would fit around a very long rectangular table if 200 square tables were pushed together.

200 chairs on each side, totaling 400, plus one on each end; grand total 402.

If we let T represent the number of square tables that make one long rectangular table, what is the expression for the number of chairs that will fit around it?

$2T + 2$

Example 1 (13 minutes)

Example 1

Look at Example 1 with your group. Determine the cost for various numbers of pizzas, and also determine the expression that describes the cost of having P pizzas delivered.

- a. Pizza Queen has a special offer on lunch pizzas: \$4.00 each. They charge \$2.00 to deliver, regardless of how many pizzas are ordered. Determine the cost for various numbers of pizzas, and also determine the expression that describes the cost of having P pizzas delivered.

Number of Pizzas Delivered	Total Cost in Dollars
1	6
2	10
3	14
4	18
10	42
50	202
P	$4P + 2$

Allow the groups to discover patterns and share them.

What mathematical operations did you need to perform to find the total cost?

Multiplication and addition. We multiplied the number of pizzas by \$4, and then added the \$2 delivery fee.

Suppose our principal wanted to buy a pizza for everyone in our class? Determine how much this would cost.

Answers will vary depending on the number of students in your class.

- b. If the booster club had \$400 to spend on pizza, what is the greatest number of pizzas they could order?

Students can use the “guess and check” method for answering this question. A scaffold question might be “Could they order 100 pizzas at this price?”

The greatest number of pizzas they could order would be 99. The pizzas themselves would cost $99 \times \$4 = \396 , and then add \$2.00 for delivery. The total bill is \$398.

- c. If the pizza price was raised to \$5.00 and the delivery price was raised to \$3.00, create a table that shows the total cost (pizza plus delivery) of 1, 2, 3, 4, and 5 pizzas. Include the expression that describes the new cost of ordering P pizzas.

Number of Pizzas Delivered	Total Cost in Dollars
1	8
2	13
3	18
4	23
5	28
P	$5P + 3$

Closing (8 minutes)

- Some mathematical expressions use both multiplication and addition. With your partner, make up a new example of a problem that uses both multiplication and addition.

Allow a short time for groups to make up a situation. Share these as a group. Ensure that there is both a coefficient and a constant in each problem. Naming these terms is not important for this lesson.

Exit Ticket (7 minutes)

Name _____

Date _____

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Exit Ticket

Krystal Klear Cell Phone Company charges \$5.00 per month for service. The company also charges \$0.10 for each text message sent.

- a. Complete the table below to calculate the monthly charges for various numbers of text messages sent.

Number of Text Messages Sent (T)	Total Monthly Bill in Dollars
0	
10	
20	
30	
T	

- b. If Suzannah's budget limit is \$10 per month, how many text messages can she send in one month?

Exit Ticket Sample Solutions

Krystal Klear Cell Phone Company charges \$5.00 per month for service. The company also charges \$0.10 for each text message sent.

- a. Complete the table below to calculate the monthly charges for various numbers of text messages sent.

Number of Text Messages Sent (T)	Total Monthly Bill in Dollars
0	5
10	6
20	7
30	8
T	$0.1T + 5$

- b. If Suzannah's budget limit is \$10 per month, how many text messages can she send in one month?

Suzannah can send 50 text messages in one month for \$10.

Problem Set Sample Solutions

1. Compact discs (CDs) cost \$12 each at the Music Emporium. The company charges \$4.50 for shipping and handling, regardless of how many compact discs are purchased.

- a. Create a table of values that shows the relationship between the number of compact discs that Mickey buys, D , and the amount of money Mickey spends, C , in dollars.

Number of CDs Mickey Buys (D)	Total Cost in Dollars (C)
1	\$16.50
2	\$28.50
3	\$40.50

- b. If you know how many CDs Mickey orders, can you determine how much money he spends? Write the corresponding expression.

$$12D + 4.5$$

- c. Use your expression to determine how much Mickey spent buying 8 CDs.

$$8(12) + 4.50 = 100.50. \text{ Mickey spent } \$100.50.$$

2. Mr. Gee's class orders paperback books from a book club. The books cost \$2.95 each. Shipping charges are set at \$4.00, regardless of the number of books purchased.

- a. Create a table of values that shows the relationship between the number of books that Mr. Gee's class buys, B , and the amount of money they spend, C , in dollars.

Number of Books Ordered(B)	Amount of Money Spent in Dollars (C)
1	6.95
2	9.90
3	12.85

- b. If you know how many books Mr. Gee's class orders, can you determine how much money they spend? Write the corresponding expression.

$$2.95B + 4$$

- c. Use your expression to determine how much Mr. Gee's class spent buying 24 books.

$$24(2.95) + 4 = 74. Mr. Gee's class spent \$74.80.$$

3. Sarah is saving money to take a trip to Oregon. She received \$450 in graduation gifts and saves \$120 per week working.

- a. Write an expression that shows how much money Sarah has after working W weeks.

$$450 + 120W$$

- b. Create a table that shows the relationship between the amount of money Sarah has (M) and the number of weeks she works (W).

Amount of Money Sarah Has (M)	Number of Weeks Worked (W)
570	1
690	2
810	3
930	4
1050	5
1170	6
1290	7
1410	8

- c. The trip will cost \$1,200. How many weeks will Sarah have to work to earn enough for the trip?

Sarah will have to work 7 weeks to earn enough for the trip.

4. Mr. Gee's Language Arts class keeps track of how many words per minute are read aloud by each of the students. They collect this Oral Reading Fluency data each month. Below is the data they collected for one student in the first four months of school.

- a. Assume this increase in Oral Reading Fluency continues throughout the rest of the school year. Complete the table to project the reading rate for this student for the rest of the year.

Month	Number of Words Read Aloud in One Minute
September	126
October	131
November	136
December	141
January	146
February	151
March	156
April	161
May	166
June	171

- b. If this increase in Oral Reading Fluency continues throughout the rest of the school year, when would this student achieve the goal of reading 165 words per minute?

The student will meet the goal in May.

- c. The expression for this student's Oral Reading Fluency is $121 + 5m$, where m represents the number of months during the school year. Use this expression to determine how many words per minute the student would read after 12 months of instruction.

The student would read 181 words per minute: $121 + 5 \times 12$.

5. When corn seeds germinate, they tend to grow 5 inches in the first week, then 3 inches per week for the remainder of the season. The relationship between height (H) and number of weeks since germination (W) is shown below.

- a. Complete the missing values in the table.

Number of Weeks Since Germination (W)	Height of Corn Plant (H)
1	5
2	8
3	11
4	14
5	17
6	20

- b. The expression for this height is $2 + 3W$. How tall will the corn plant be after 15 weeks of growth?

$2 + 3(15) = 47$. The plant will be 47 inches tall.

6. The Honeymoon Charter Fishing Boat Company only allows newlywed couples on their sunrise trips. There is a captain, a first mate, and a deck hand manning the boat on these trips.

- a. Write an expression that shows the number of people on the boat when there are C couples booked for the trip.

$$3 + 2C$$

- b. If the boat can hold a maximum of 20 people, how many couples can go on the sunrise fishing trip?

Eight couples (16 passengers) can fit along with the 3 crew members, totaling 19 people on the boat. A ninth couple would overload the boat.