



Lesson 19: Substituting to Evaluate Addition and Subtraction Expressions

Student Outcomes

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

Lesson Notes

In this lesson, students begin by filling in data tables to help them organize data and see patterns; then, they move to drawing their own tables. Encourage students to label the columns completely.

Classwork

Fluency Exercise (5 minutes): Subtraction of Decimals

Sprint: Refer to the Sprints and Sprint Delivery Script sections in the Module Overview for directions on how to administer a Sprint.

Opening Exercise (3 minutes)

Opening Exercise

My older sister is exactly two years older than I am. Sharing a birthday is both fun and annoying. Every year on our birthday we have a party, which is fun, but she always brags that she is two years older than I am, which is annoying. Shown below is a table of our ages, starting when I was born:

My Age (in years)	My Sister's Age (in years)
0	2
1	3
2	4
3	5
4	6

Scaffolding:

Some students will benefit from having blank tables prepared ahead of time.

Make sure students understand the context of the story problem. It should be clear that the day I was born was my sister's second birthday. My first birthday was her third birthday; my second birthday was her fourth birthday; etc.

Discussion (5 minutes)

- Today in class we will use data tables. They help us organize data and see patterns. We can use variables to make generalizations about the patterns we see.

- Looking at the table, what patterns do you see? Tell a partner.
My sister's age is always two years more than my age.
- On the day I turned 8 years old, how old was my sister?
10 years old
- How do you know?
Since my sister's age is always two years more than my age, we just add 2 to my age. $8 + 2 = 10$.
- On the day I turned 16 years old, how old was my sister?
18 years old
- How do you know?
Since my sister's age is always two years more than my age, we just add 2 to my age. $16 + 2 = 18$.
- Do we need to extend the table to calculate these answers?
No; the pattern is to add 2 to your age to calculate your sister's age.

Example 1 (5 minutes)

Example 1

My Age (in years)	My Sister's Age (in years)
0	2
1	3
2	4
3	5
4	6
Y	$Y + 2$

Scaffolding:

A number line in the classroom can provide an additional reference for students. A cardboard sheet with two windows cut to reveal Y and $Y + 2$ works with Examples 1 and 2.

- What if you don't know how old I am? Let's use a variable for my age. Let Y = my age in years. Can you develop an expression to describe how old my sister is?
Your sister is $Y + 2$ years old.
- Please add that to the last row of the table.

- My age is Y years. My sister is $Y + 2$ years old. So, no matter what my age is (or was), my sister's age in years will always be two years greater than mine.

MP.6

Example 2 (5 minutes)

Example 2

My Age (in years)	My Sister's Age (in years)
0	2
1	3
2	4
3	5
4	6
$G - 2$	G

- How old was I when my sister was 6 years old?
4 years old
- How old was I when my sister was 15 years old?
13 years old
- How do you know?
My age is always 2 years less than my sister's age.
- Look at the table in Example 2. If you know my sister's age, can you determine my age?
We can subtract two from your sister's age, and that will equal your age.
- If we use the variable G for my sister's age in years, what expression would describe my age in years?
 $G - 2$
- Fill in the last row of the table with the expressions.
My age is $G - 2$ years. My sister is G years old.
- With a partner, calculate how old I was when my sister was 22, 23, and 24 years old.
You were 20, 21, and 22 years old, respectively.

Exercises (15 minutes)

Exercises

1. Noah and Carter are collecting box tops for their school. They each bring in 1 box top per day starting on the first day of school. However, Carter had a head start because his aunt sent him 15 box tops before school began. Noah's grandma saved 10 box tops, and Noah added those on his first day.

- a. Fill in the missing values that indicate the total number of box tops each boy brought to school.

School Day	Number of Box Tops Noah Has	Number of Box Tops Carter Has
1	11	16
2	12	17
3	13	18
4	14	19
5	15	20

- b. If we let D be the number of days since the new school year began, on day D of school, how many box tops will Noah have brought to school?

$$D + 10 \text{ box tops}$$

- c. On day D of school, how many box tops will Carter have brought to school?

$$D + 15 \text{ box tops}$$

- d. On day 10 of school, how many box tops will Noah have brought to school?

$$10 + 10 = 20 \text{ box tops}$$

- e. On day 10 of school, how many box tops will Carter have brought to school?

$$10 + 15 = 25 \text{ box tops}$$

2. Each week the Primary School recycles 200 pounds of paper. The Intermediate School also recycles the same amount but had another 300 pounds left over from summer school. The Intermediate School custodian added this extra 300 pounds to the first recycle week.

- a. Number the weeks and record the amount of paper recycled by both schools.

Week	Total Amount of Paper Recycled by the Primary School This School Year in Pounds	Total Amount of Paper Recycled by the Intermediate School This School Year in Pounds
1	200	500
2	400	700
3	600	900
4	800	1,100
5	1,000	1,300

- b. If this trend continues, what will be the total amount collected for each school on Week 10?

The Primary School will have collected 2,000 pounds. The Intermediate School will have collected 2,300 pounds.

3. Shelly and Kristen share a birthday, but Shelly is 5 years older.

- a. Make a table showing their ages every year, beginning when Kristen was born.

<i>Kristen's Age (in years)</i>	<i>Shelly's Age (in years)</i>
0	5
1	6
2	7
3	8

- b. If Kristen is 16 years old, how old is Shelly?

If Kristen is 16 years old, Shelly is 21 years old.

- c. If Kristen is K years old, how old is Shelly?

If Kristen is K years old, Shelly is $K + 5$ years old.

- d. If Shelly is S years old, how old is Kristen?

If Shelly is S years old, Kristen is $S - 5$ years old.

Closing (2 minutes)

- Why were we able to write these expressions?
 - *There was a relationship between the two quantities that we could identify.*
- What is important to remember about labeling columns in a table?
 - *The label should be complete, with units, so the reader understands precisely what is meant.*
- How are addition and subtraction expressions related to one another?
 - *They are inverse operations. One undoes the other.*

Exit Ticket (5 minutes)

Name _____

Date _____

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Exit Ticket

Jenna and Allie work together at a piano factory. They both were hired on January 3, but Jenna was hired in 2005, and Allie was hired in 2009.

- a. Fill in the table below to summarize the two workers' experience totals.

Year	Allie's Years of Experience	Jenna's Years of Experience
2010		
2011		
2012		
2013		
2014		

- b. If both workers continue working at the piano factory, when Allie has A years of experience on the job, how many years of experience will Jenna have on the job?
- c. If both workers continue working at the piano factory, when Allie has 20 years of experience on the job, how many years of experience will Jenna have on the job?

Exit Ticket Sample Solutions

Jenna and Allie work together at a piano factory. They both were hired on January 3, but Jenna was hired in 2005, and Allie was hired in 2009.

- a. Fill in the table below to summarize the two workers' experience totals.

Year	Allie's Years of Experience	Jenna's Years of Experience
2010	1	5
2011	2	6
2012	3	7
2013	4	8
2014	5	9

- b. If both workers continue working at the piano factory, when Allie has A years of experience on the job, how many years of experience will Jenna have on the job?

Jenna will have been on the job for $A + 4$ years.

- c. If both workers continue working at the piano factory, when Allie has 20 years of experience on the job, how many years of experience will Jenna have on the job?

$$20 + 4 = 24$$

Jenna will have been on the job for 24 years.

Problem Set Sample Solutions

1. Suellen and Tara are in sixth grade, and both take dance lessons at Twinkle Toes Dance Studio. This is Suellen's first year, while this is Tara's fifth year of dance lessons. Both girls plan to continue taking lessons throughout high school.

- a. Complete the table showing the number of years the girls will have danced at the studio.

Grade	Suellen's Years of Experience Dancing	Tara's Years of Experience Dancing
Sixth	1	5
Seventh	2	6
Eighth	3	7
Ninth	4	8
Tenth	5	9
Eleventh	6	10
Twelfth	7	11

- b. If Suellen has been taking dance lessons for Y years, how many years has Tara been taking lessons?

Tara has been taking dance lessons for $Y + 4$ years.

2. Daejoy and Damian collect fossils. Before they went on a fossil-hunting trip, Daejoy had 25 fossils in her collection, and Damian had 16 fossils in his collection. On a 10-day fossil hunting trip, they each collected 2 new fossils each day.

- a. Make a table showing how many fossils each person had in their collection at the end of each day.

Day	Number of Fossils in Daejoy's Collection	Number of Fossils in Damian's Collection
1	27	18
2	29	20
3	31	22
4	33	24
5	35	26
6	37	28
7	39	30
8	41	32
9	43	34
10	45	36

- b. If this pattern of fossil-finding continues, how many fossils does Damian have when Daejoy has F fossils?

When Daejoy has F fossils, Damian has $F - 9$ fossils.

- c. If this pattern of fossil-finding continues, how many fossils does Damian have when Daejoy has 55 fossils?

$$55 - 9 = 46$$

When Daejoy has 55 fossils, Damian has 46 fossils.

3. A train consists of three types of cars: box cars, an engine, and a caboose. The relationship between the types of cars is demonstrated in the table below.

Number of Box Cars	Number of Cars in the Train
0	2
1	3
2	4
10	12
100	102

- a. Tom wrote an expression for the relationship depicted in the table as $B + 2$. Theresa wrote an expression for the same relationship as $C - 2$. Is it possible to have two different expressions to represent one relationship? Explain.

Both expressions can represent the same relationship, depending on the point of view. The expression $B + 2$ represents the number of box cars plus an engine and a caboose. The expression $C - 2$ represents the whole car length of the train, less the engine and caboose.

- b. What do you think the variable in each student's expression represents? How would you define them?

The variable C would represent the total cars in the train. The variable B would represent the number of box cars.

4. David was 3 when Marieka was born. Complete the table.

Marieka's Age in Years	David's Age in Years
5	8
6	9
7	10
8	11
10	13
17	20
32	35
M	$M + 3$
$D - 3$	D

5. Caitlin and Michael are playing a card game. In the first round, Caitlin scored 200 points, and Michael scored 175 points. In each of the next few rounds, they each scored 50 points. Their score sheet is below.

Caitlin's points	Michael's points
200	175
250	225
300	275
350	325

- a. If this trend continues, how many points will Michael have when Caitlin has 600 points?
 $600 - 25 = 575$
Michael will have 575 points.
- b. If this trend continues, how many points will Michael have when Caitlin has C points?
Michael will have $C - 25$ points.
- c. If this trend continues, how many points will Caitlin have when Michael has 975 points?
 $975 + 25 = 1,000$
Caitlin will have 1,000 points.
- d. If this trend continues, how many points will Caitlin have when Michael has M points?
Caitlin will have $M + 25$ points.
6. The high school marching band has 15 drummers this year. The band director insists that there are to be 5 more trumpet players than drummers at all times.
- a. How many trumpet players are in the marching band this year?
 $15 + 5 = 20$. *There are 20 trumpet players this year.*
- b. Write an expression that describes the relationship of the number of trumpet players (T) and the number of drummers (D).
 $T = D + 5$ or $D = T - 5$

- c. If there are only 14 trumpet players interested in joining the marching band next year, how many drummers will the band director want in the band?

$$14 - 5 = 9$$

The band director will want 9 drummers.



Subtraction of Decimals–Round 1

Number Correct: _____

Directions: Subtract the decimals to determine the difference.

1.	$9.4 - 4.1$	
2.	$7.4 - 3.2$	
3.	$49.5 - 32.1$	
4.	$20.9 - 17.2$	
5.	$9.2 - 6.8$	
6.	$7.48 - 2.26$	
7.	$58.8 - 43.72$	
8.	$38.99 - 24.74$	
9.	$116.32 - 42.07$	
10.	$46.83 - 35.6$	
11.	$54.8 - 43.66$	
12.	$128.43 - 87.3$	
13.	$144.54 - 42.09$	
14.	$105.4 - 68.22$	
15.	$239.5 - 102.37$	

16.	$41.72 - 33.9$	
17.	$354.65 - 67.5$	
18.	$448.9 - 329.18$	
19.	$8 - 5.38$	
20.	$94.21 - 8$	
21.	$134.25 - 103.17$	
22.	$25.8 - 0.42$	
23.	$115 - 1.65$	
24.	$187.49 - 21$	
25.	$345.77 - 248.69$	
26.	$108 - 54.7$	
27.	$336.91 - 243.38$	
28.	$264 - 0.742$	
29.	$174.38 - 5.9$	
30.	$323.2 - 38.74$	

Subtraction of Decimals–Round 1 [KEY]

Directions: Subtract the decimals to determine the difference.

1.	$9.4 - 4.1$	5.3
2.	$7.4 - 3.2$	4.2
3.	$49.5 - 32.1$	17.4
4.	$20.9 - 17.2$	3.7
5.	$9.2 - 6.8$	2.4
6.	$7.48 - 2.26$	5.22
7.	$58.8 - 43.72$	15.08
8.	$38.99 - 24.74$	14.25
9.	$116.32 - 42.07$	74.25
10.	$46.83 - 35.6$	11.23
11.	$54.8 - 43.66$	11.14
12.	$128.43 - 87.3$	41.13
13.	$144.54 - 42.09$	102.45
14.	$105.4 - 68.22$	37.18
15.	$239.5 - 102.37$	137.13

16.	$41.72 - 33.9$	7.82
17.	$354.65 - 67.5$	287.15
18.	$448.9 - 329.18$	119.72
19.	$8 - 5.38$	2.62
20.	$94.21 - 8$	86.21
21.	$134.25 - 103.17$	31.08
22.	$25.8 - 0.42$	25.38
23.	$115 - 1.65$	113.35
24.	$187.49 - 21$	166.49
25.	$345.77 - 248.69$	97.08
26.	$108 - 54.7$	53.3
27.	$336.91 - 243.38$	93.53
28.	$264 - 0.742$	263.258
29.	$174.38 - 5.9$	168.48
30.	$323.2 - 38.74$	284.46

Subtraction of Decimals—Round 2

Number Correct: _____

Improvement: _____

Directions: Subtract the decimals to determine the difference.

1.	$8.4 - 5.4$	
2.	$5.6 - 3.1$	
3.	$9.7 - 7.2$	
4.	$14.3 - 12.1$	
5.	$34.5 - 13.2$	
6.	$14.86 - 13.85$	
7.	$43.27 - 32.14$	
8.	$48.48 - 27.27$	
9.	$64.74 - 31.03$	
10.	$98.36 - 24.09$	
11.	$33.54 - 24.4$	
12.	$114.7 - 73.42$	
13.	$45.2 - 32.7$	
14.	$74.8 - 53.9$	
15.	$238.4 - 114.36$	

16.	$14 - 10.32$	
17.	$43.37 - 28$	
18.	$24.56 - 18.88$	
19.	$33.55 - 11.66$	
20.	$329.56 - 284.49$	
21.	$574.3 - 342.18$	
22.	$154 - 128.63$	
23.	$247.1 - 138.57$	
24.	$12 - 3.547$	
25.	$1.415 - 0.877$	
26.	$185.774 - 154.86$	
27.	$65.251 - 36.9$	
28.	$144.2 - 95.471$	
29.	$2.11 - 1.949$	
30.	$100 - 34.746$	

Subtraction of Decimals—Round 2 [KEY]

Directions: Subtract the decimals to determine the difference.

1.	$8.4 - 5.4$	3.0
2.	$5.6 - 3.1$	2.5
3.	$9.7 - 7.2$	2.5
4.	$14.3 - 12.1$	2.2
5.	$34.5 - 13.2$	21.3
6.	$14.86 - 13.85$	1.01
7.	$43.27 - 32.14$	11.13
8.	$48.48 - 27.27$	21.21
9.	$64.74 - 31.03$	33.71
10.	$98.36 - 24.09$	74.27
11.	$33.54 - 24.4$	9.14
12.	$114.7 - 73.42$	41.28
13.	$45.2 - 32.7$	12.5
14.	$74.8 - 53.9$	20.9
15.	$238.4 - 114.36$	124.04

16.	$14 - 10.32$	3.68
17.	$43.37 - 28$	15.37
18.	$24.56 - 18.88$	5.68
19.	$33.55 - 11.66$	21.89
20.	$329.56 - 284.49$	45.07
21.	$574.3 - 342.18$	232.12
22.	$154 - 128.63$	25.37
23.	$247.1 - 138.57$	108.53
24.	$12 - 3.547$	8.453
25.	$1.415 - 0.877$	0.538
26.	$185.774 - 154.86$	30.914
27.	$65.251 - 36.9$	28.351
28.	$144.2 - 95.471$	48.729
29.	$2.11 - 1.949$	0.161
30.	$100 - 34.746$	65.254