

Lesson 19: Substituting to Evaluate Addition and Subtraction Expressions

Classwork

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

- a. Looking at the table, what patterns do you see? Tell a partner.

My sister's age is always two years more than my age.

- b. On the day I turned 8 years old, how old was my sister?

10 years old

- c. How do you know?

Since my sister's age is two years more — add 2 to my age $8 + 2 = 10$

- d. On the day I turned 16 years old, how old was my sister?

18 years old

- e. How do you know?

Since my sister's age is always two years more, we add 2 to my age

$$16 + 2 = 18$$

- f. 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

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

- a. 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.

- b. Please add that to the last row of the table.

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

- a. How old was I when my sister was 6 years old?

4 years old

- b. How old was I when my sister was 15 years old?

13 years old

- c. How do you know?

My age is always 2 years less than my sister's age.

- d. Look at the table in Example 2. If you know my sister's age, can you determine my age?

We can subtract two from my sister's age, and that will equal her age.

- e. If we use the variable G for my sister's age in years, what expression would describe my age in years?

$$G - 2$$

- f. Fill in the last row of the table with the expressions.

My age is $G - 2$ years. My sister is G years old.

- g. 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.

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?

$$10 + 10 = 20 ; \text{ On day 10, Noah would have brought in 20 box tops.}$$

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

$$10 + 15 = 25 ; \text{ On day 10, Carter would have brought in 25 box tops.}$$

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.

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

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

Shelly is 21 years old.

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

Shelly is $K+5$ years old.

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

Kristen is $S-5$ years old.