7.5 Algebra: Introducing balance to solve addition equations

In this lesson, students solve simple algebraic equations using algebra tiles and a pan balance model to reinforce the equivalence.

Step 1 Preparing the lesson

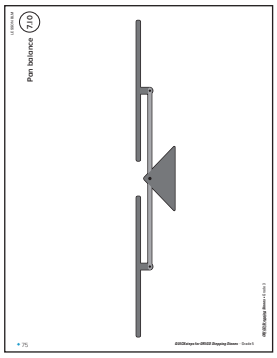
Each pair of students will need:

- 1 pan balance card from *The Number Case*
  (*Note*: If not available, use Blackline Master 7.10.)

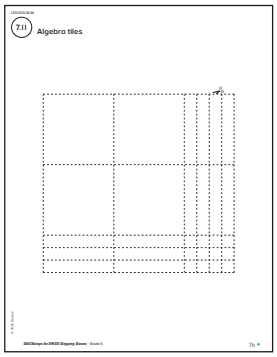
Each student will need:

- 1 set of algebra tiles (*Note*: If not available, use cut-outs from Blackline Master 7.11.)
- Student Journal 7.5

Blackline Master 7.10



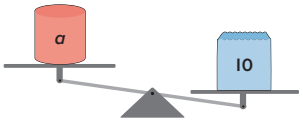
Blackline Master 7.11

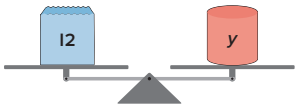


Step 2 Starting the lesson

Draw a picture of the pan balance, as shown below left, and ask, *What do you know about the picture?* (One object weighs more than the other.) *What value could we write for a to make the picture true? What mathematical sentences could we write to match?* (The value of *a* does not equal 10. The value of *a* is less than 10. Ten is greater than the value of *a*.)

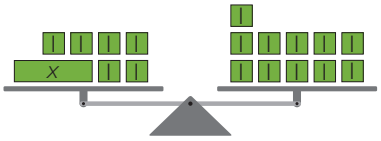
Now, draw a picture to show two objects that balance one another, as shown below right. Ask, *What can you tell me about this picture?* (The value of *y* is equal to 12.) *What equation could we write to match?* (*y* = 12.) *What does the equal symbol mean?* (**SMP6**) Some students may still see the equal symbol as an operator meaning *the answer is*. Students with this misconception need support to recognize that the symbol shows a relationship of equivalence (for example, *y* is equivalent to 12).





Step 3 Teaching the lesson

Organize the students into pairs and draw the picture, as shown, on the board. Ask the students to model the picture using their algebra tiles and pan balance. Then discuss the points below:



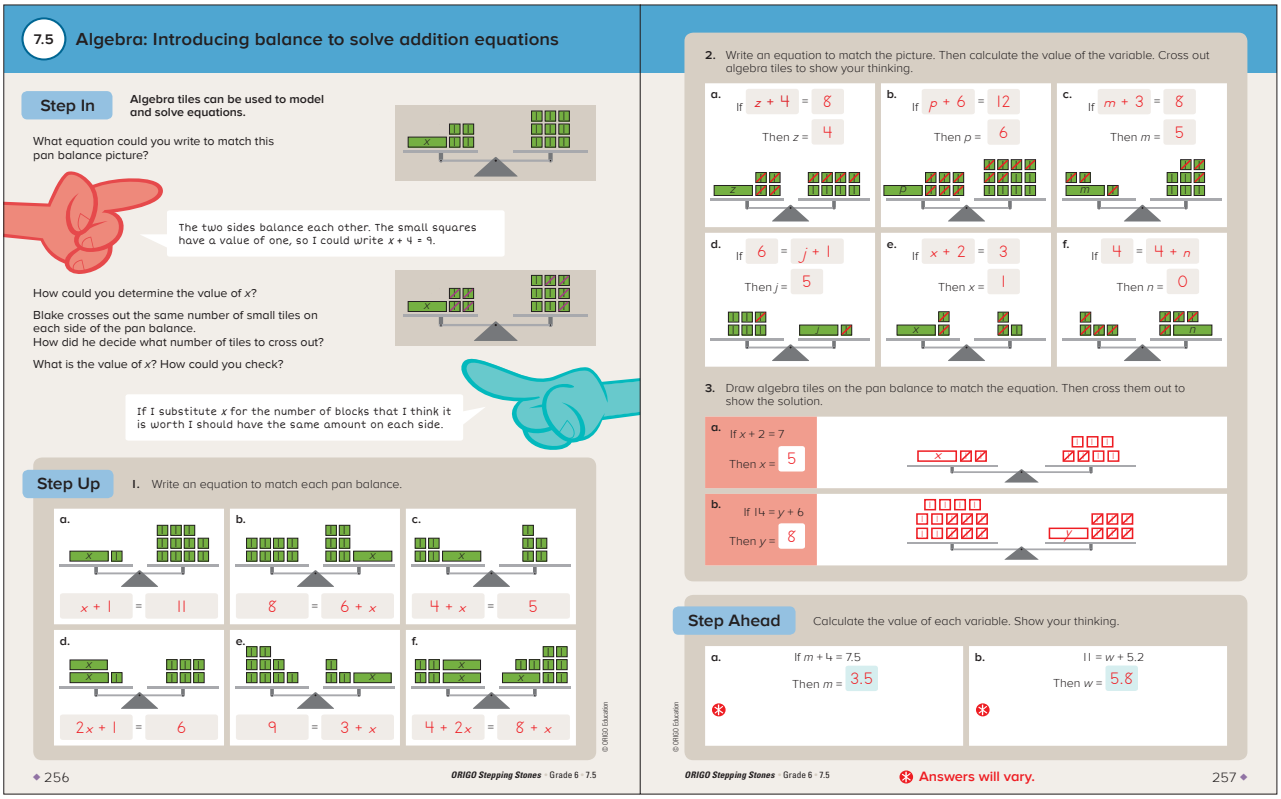
What does the pan balance tell you about the two groups of tiles?

What equation could you write to match the pan balance picture? (*x* + 6 = 11)

How can we find out the value of x in this problem?

Ask the students to demonstrate their thinking by removing the single tiles on each side of their pan balance until *x* remains alone on the left and its value remains on the right. Remind them that whatever they do to the tiles on one pan they must do to the tiles on the other pan, to maintain the equivalence. Some students may use the relationship between addition and subtraction to write the related subtraction equation 11 – 6 = *x*, then calculate the value for *x* (**SMP7**). Ask, *How can we check that our answer is correct?* (Substitute that value for *x* into the equation to see if it is true.) (**SMP1**).

Student Journal 7.5, pp. 256–257



7.5 Algebra: Introducing balance to solve addition equations

Step In Algebra tiles can be used to model and solve equations.

What equation could you write to match this pan balance picture?

The two sides balance each other. The small squares have a value of one, so I could write $x + 4 = 9$.

How could you determine the value of x?

Blake crosses out the same number of small tiles on each side of the pan balance.
How did he decide what number of tiles to cross out?

What is the value of x? How could you check?

If I substitute x for the number of blocks that I think it is worth I should have the same amount on each side.

Step Up 1. Write an equation to match each pan balance.

a. $x + 1 = 11$
b. $8 = 6 + x$
c. $4 + x = 5$
d. $2x + 1 = 6$
e. $9 = 3 + x$
f. $4 + 2x = 8 + x$

256 ORIGO Stepping Stones · Grade 6 · 7.5

2. Write an equation to match the picture. Then calculate the value of the variable. Cross out algebra tiles to show your thinking.

a. If $z + 4 = 8$, Then $z = 4$
b. If $p + 6 = 12$, Then $p = 6$
c. If $m + 3 = 8$, Then $m = 5$
d. If $6 = j + 1$, Then $j = 5$
e. If $x + 2 = 3$, Then $x = 1$
f. If $4 = 4 + n$, Then $n = 0$

3. Draw algebra tiles on the pan balance to match the equation. Then cross them out to show the solution.

a. If $x + 2 = 7$, Then $x = 5$
b. If $14 = y + 6$, Then $y = 8$

Step Ahead Calculate the value of each variable. Show your thinking.

a. If $m + 4 = 7.5$, Then $m = 3.5$
b. $11 = w + 5.2$, Then $w = 5.8$

Answers will vary.

ORIGO Stepping Stones · Grade 6 · 7.5 257

Repeat the discussion by drawing other pictures for the students to model. (*Note*: If students struggle with the idea that the same variable (x) can represent different values in different equations, remind them that each equation represents a new problem or situation and therefore the value of the variable will vary.)

Work through the Step In discussion (Student Journal 7.5) with the whole class. Read the Step Up and Step Ahead instructions with the students. If necessary, remind them that the rectangular tiles can represent any variable such as x, y, or z. Make sure they know what to do, then have them work independently to complete the tasks.

ELL

Ensure students understand the difference between the words *mass* as in weight, and *mass* as in a religious event. Encourage the students to use hand gestures (such as a thumbs up or down) to show they understand.

Step 4 Reflecting on the work

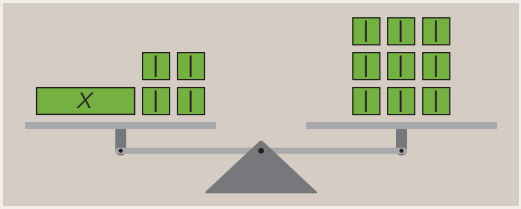
Discuss the students' answers to Student Journal 7.5. For each of the examples in Questions 2 and 3, invite students to explain how they determined the value of the variable. For example, for Question 2b a student may say, "I crossed out 6 single tiles on each side of the pan balance. That left p on one side and 6 on the other side, so p equals 6." Discuss Question 2f with the students and ask, *How did you know that n equals zero?* For Step Ahead, invite students to show their thinking on the board. Compare and contrast the different methods used.

7.5 Algebra: Introducing balance to solve addition equations

Step In

Algebra tiles can be used to model and solve equations.

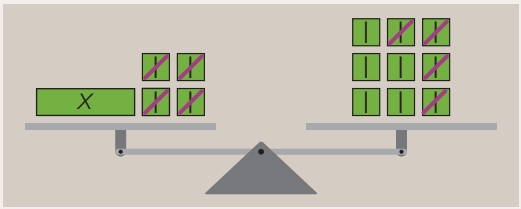
What equation could you write to match this pan balance picture?



The two sides balance each other. The small squares have a value of one, so I could write $x + 4 = 9$.

How could you determine the value of x?

Blake crosses out the same number of small tiles on each side of the pan balance.
How did he decide what number of tiles to cross out?



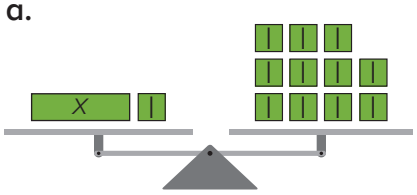
What is the value of x? How could you check?

If I substitute x for the number of blocks that I think it is worth I should have the same amount on each side.

Step Up

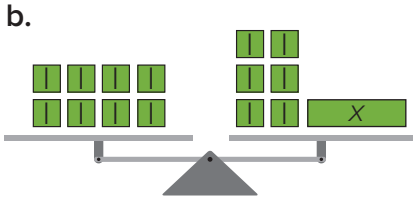
1. Write an equation to match each pan balance.

a.



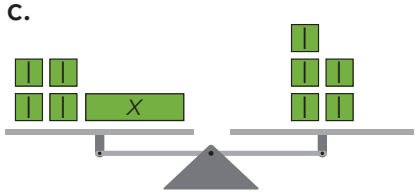
$x + 1 = 11$

b.



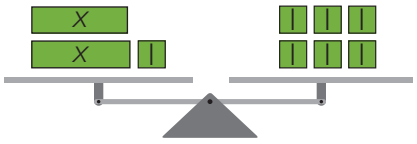
$8 = 6 + x$

c.



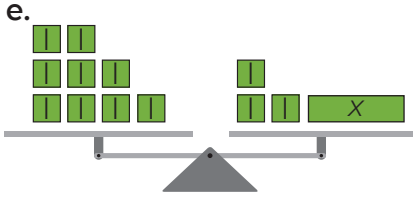
$4 + x = 5$

d.



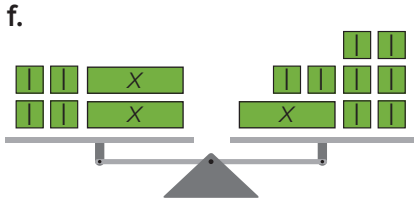
$2x + 1 = 6$

e.



$9 = 3 + x$

f.



$4 + 2x = 8 + x$

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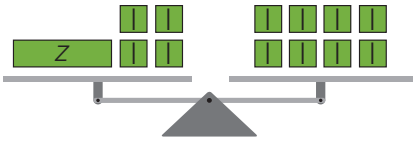
2. Write an equation to match the picture. Then calculate the value of the variable. Cross out algebra tiles to show your thinking.

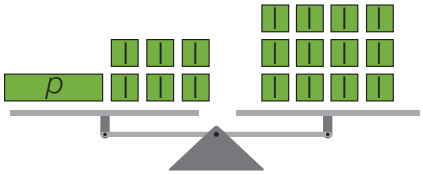
a. If $z + 4 =$ ☐

Then $z =$ ☐



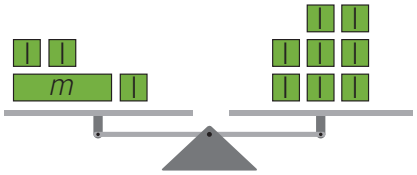
b. If ☐ = ☐

Then $p =$ ☐



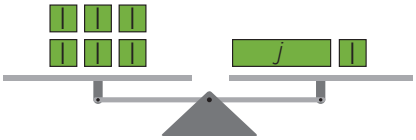
c. If ☐ = ☐

Then $m =$ ☐



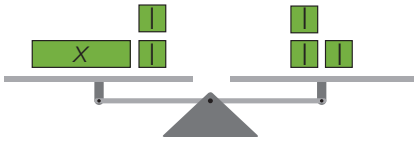
d. If ☐ = ☐

Then $j =$ ☐



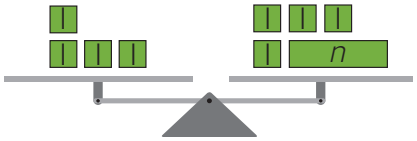
e. If ☐ = ☐

Then $x =$ ☐



f. If ☐ = ☐

Then $n =$ ☐



3. Draw algebra tiles on the pan balance to match the equation. Then cross them out to show the solution.

a. If $x + 2 = 7$

Then $x =$ ☐

b. If $14 = y + 6$

Then $y =$ ☐

Step Ahead

Calculate the value of each variable. Show your thinking.

a. If $m + 4 = 7.5$

Then $m =$ ☐

b. $11 = w + 5.2$

Then $w =$ ☐

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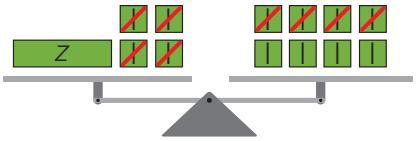
2. Write an equation to match the picture. Then calculate the value of the variable. Cross out algebra tiles to show your thinking.

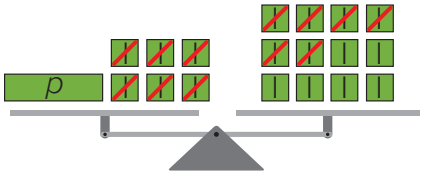
a. If $z + 4 = 8$

Then $z = 4$



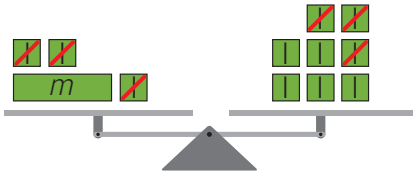
b. If $p + 6 = 12$

Then $p = 6$



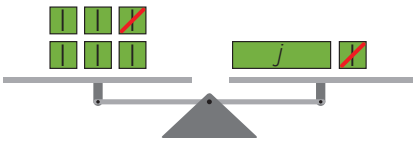
c. If $m + 3 = 8$

Then $m = 5$



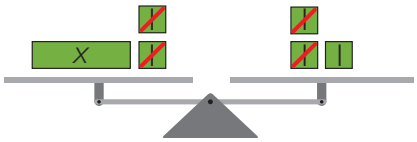
d. If $6 = j + 1$

Then $j = 5$



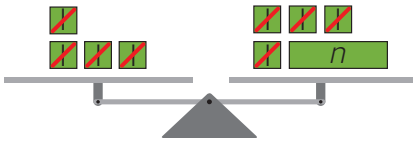
e. If $x + 2 = 3$

Then $x = 1$



f. If $4 = 4 + n$

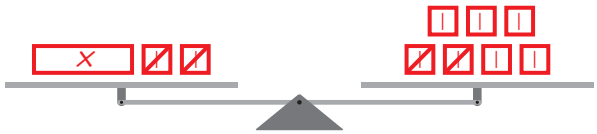
Then $n = 0$



3. Draw algebra tiles on the pan balance to match the equation. Then cross them out to show the solution.

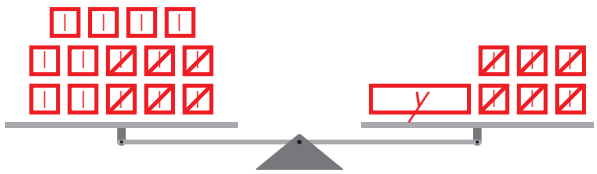
a. If $x + 2 = 7$

Then $x = 5$



b. If $14 = y + 6$

Then $y = 8$



Step Ahead

Calculate the value of each variable. Show your thinking.

a. If $m + 4 = 7.5$

Then $m = 3.5$

✻

b. $11 = w + 5.2$

Then $w = 5.8$

✻

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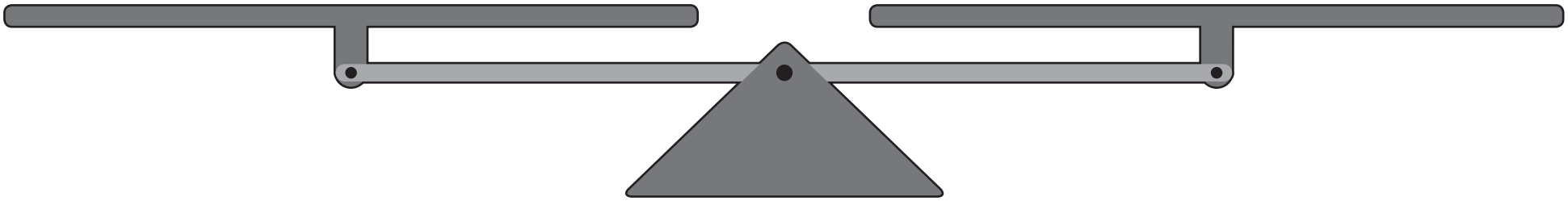
✻ Answers will vary.

Pan balance 7.10



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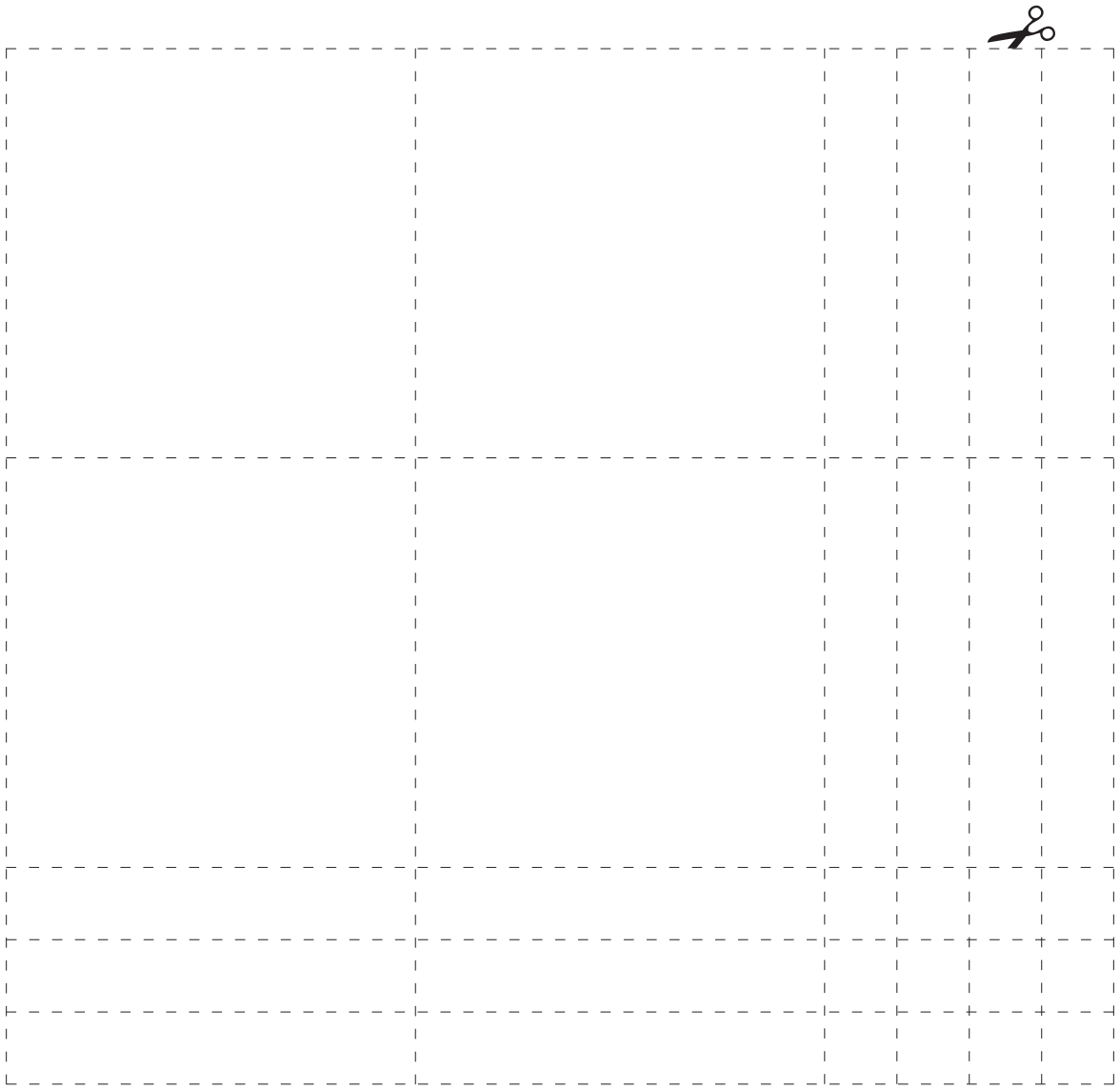
7.11 Algebra tiles



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