Nasco education LESSON PLAN

K TO Career solutions

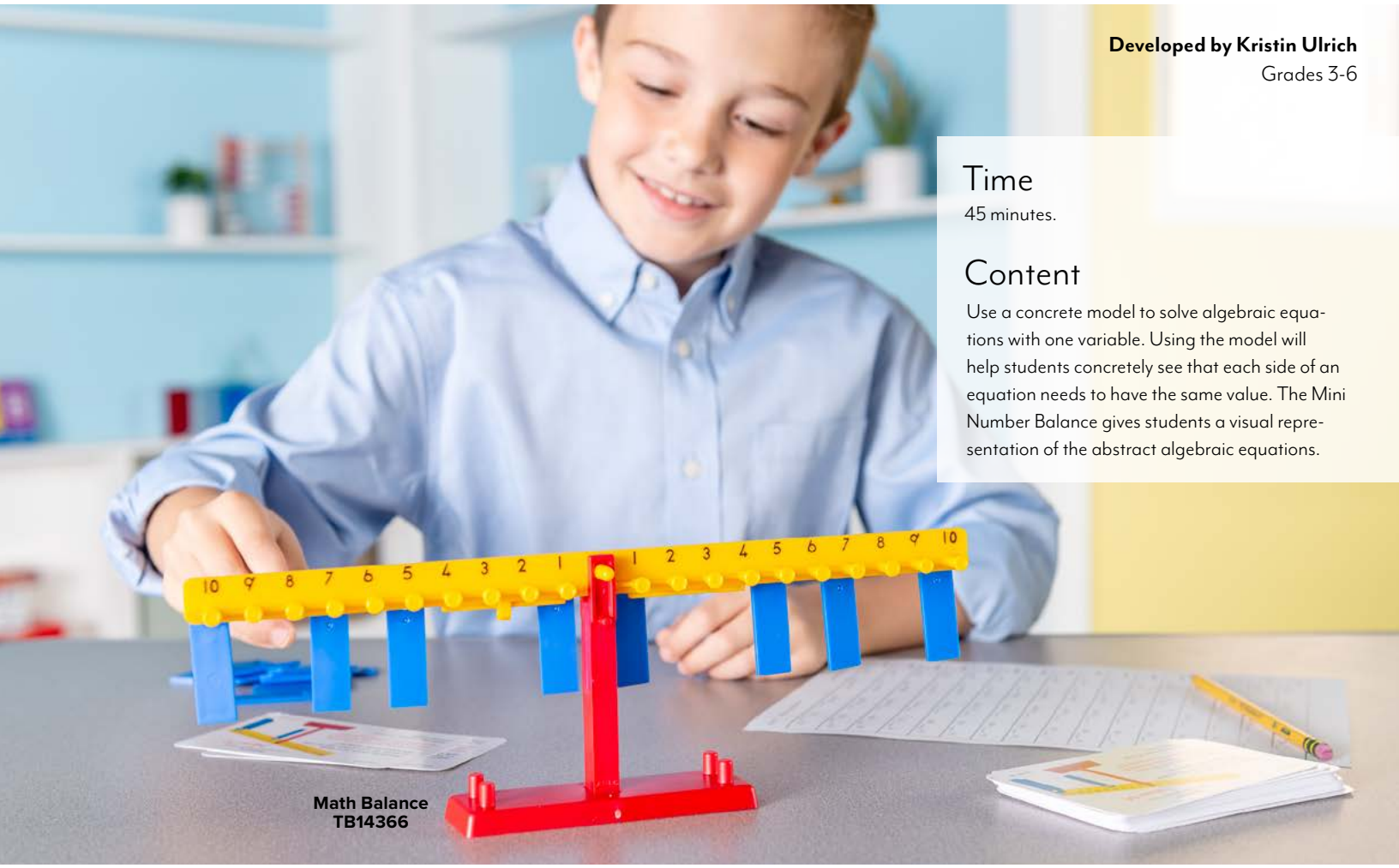
mathworks

USING MINI-NUMBER BALANCE TO SOLVE EQUATIONS WITH VARIABLES

Volume 17

Developed by Kristin Ulrich

Grades 3-6



Math Balance
TB14366

Time

45 minutes.

Content

Use a concrete model to solve algebraic equations with one variable. Using the model will help students concretely see that each side of an equation needs to have the same value. The Mini Number Balance gives students a visual representation of the abstract algebraic equations.

Objectives

Students will be able to...

- Create numbers in a variety of ways.
- Solve addition and subtraction algebraic equations.
- Compare an equals sign to a balance.

Materials

- Math Number Balance Classroom Kit (Cat. No. TB26381), Math Balance (TB14366), or Mini Number Balance (TB24474)
- Worksheet and answer key (attached with lesson plan download)

Common Core State Standards

CCSS.Math.Content.3.OA.D.8 — Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

CCSS.Math.Content.6.EE.A.2 — Write, read, and evaluate expressions in which letters stand for numbers.

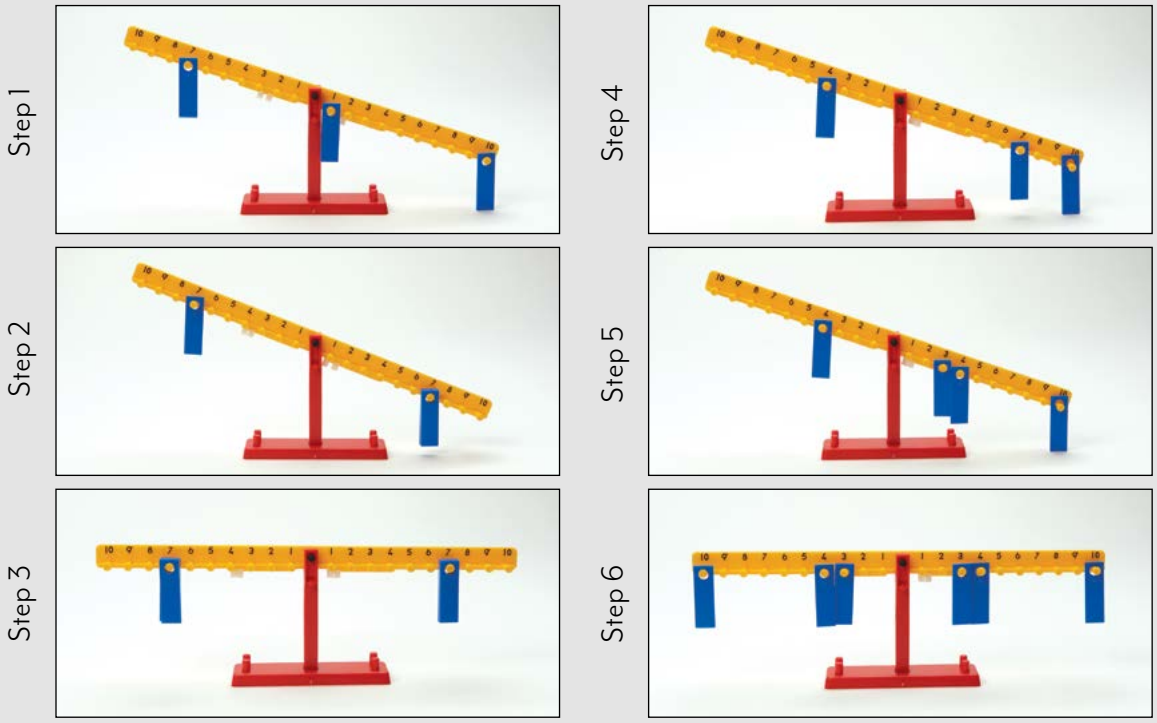
Teacher Notes

The lesson plan calls for each student to use their own Mini Number Balance, but the plan can easily be adapted for students to work in groups of up to three students using one Mini Number Balance.

Introduction

1. Have students put a weight on the 7 on the right side of their balance. Ask why the balance drops to the right *(because the weight on the right side of the balance is not equal to the weight on the left side)* and what can be done to the left side of the balance to make both sides equal *(put a weight on the 7 on the left side)*.
2. Have students come up with ways to make the balance equal by putting two weights on the left side, then three weights, and finally four weights. For example, a student could put a weight on the 1 and the 6, two weights on the 2 and one weight on the 3, or one weight on the 1 and three weights on the 2. Students should be able to realize that there are many different ways to make the balance equal that don't include having the same number of weights on each side.
3. Have students put 12 on the right side of the balance by putting a weight on the 2 and the 10. Give students a couple of minutes to write down all the ways they can come up with to make the balance equal. Be sure to tell them that they can use as many weights as they want. When a couple of minutes have passed, have students tell you what they came up with and record the results on the board.
4. Tell students that when solving equations, the equals sign can be thought of as a balance. When the equation is solved, whatever is on the left side of the equals sign will have the same exact value as whatever is on the right side of the equals sign. Relate this back to what students were just doing with their balance. They had 12 on one side, therefore they needed to add weights to the other side of the balance until the balance was equal and the weights added up to 12.

Activity #1



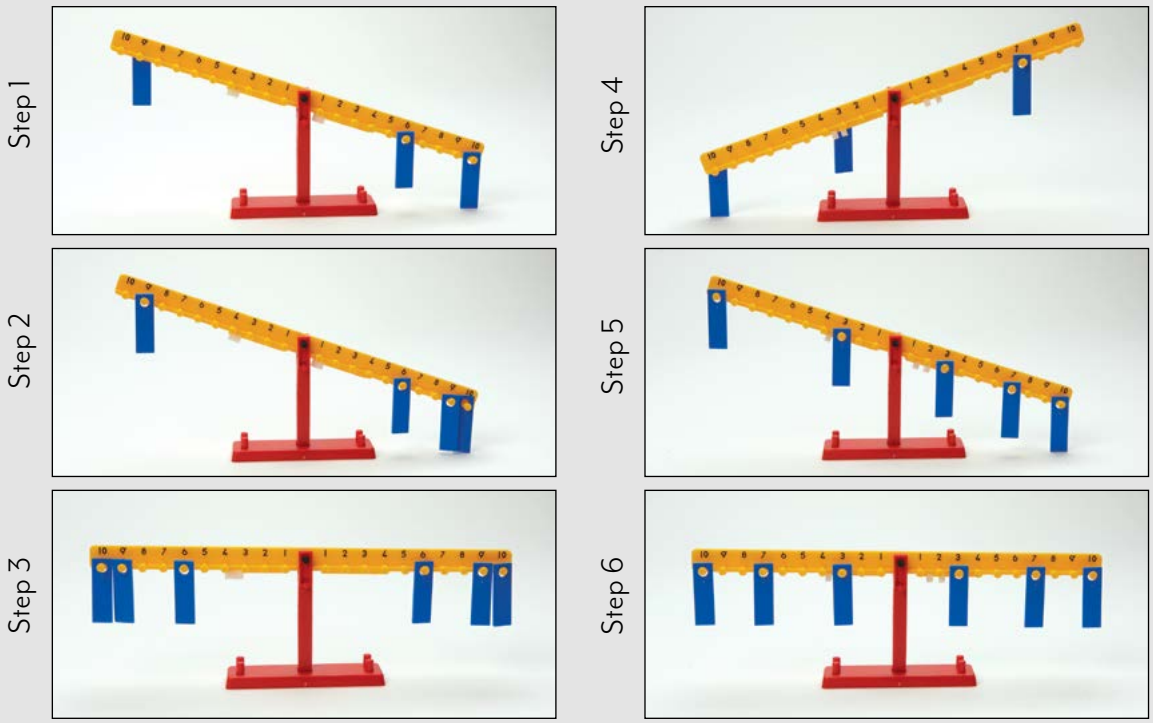
1. Write the problem **x + 7 = 21** on the board. If the equals sign can be thought of as the center of the balance, ask students what needs to go on first the left side of the balance *(7)*, then the right side of the balance *(21)*. The quickest way to make 21 on the balance is with two weights on the 10 and one weight on the 1.
2. To solve the problem, students need to change 21 so it includes a 7 in the make-up, since 7 is on the left side of the balance. Make 21 on the right side of the balance by placing three weights on the 7.
3. Once this is done, students should be able to see that if they add two more weights to the 7 on the left side, the balance will be equal. Have students do this, then ask what the total value of the two added weights is *(14)*. Have students replace the **x** in the problem with 14 and check to see if the answer works.
4. Write **a + 4 = 17** on the board. Students should put 4 on the left side of the balance and 17 on the right side. 17 can be made by placing a weight on the 10 and the 7.
5. The composition of the number 17 will need to be changed to include the number 4, since 4 is the number on the left side of the balance. Ask students how they can make the number 17 on the right side of the balance while using a 4 *(place a weight on the 10, the 3, and the 4)*.
6. Since both sides of the balance now have a weight on the 4, and the right side of the balance also had a weight added to the 10 and the 3, once students add a 10 and 3 to the left side of the balance, the balance will be equal. Students can now add up the added weights to get 13, which they should use to replace the **a** in the equation and check the equation to see if it is correct.
7. Review with students the steps they need to go through while solving each addition problem (these can be written on the board for reference):
    1. Set up the balance using the numbers given in the problem.
    2. Change the right side of the balance to include the number on the left.
    3. Determine what needs to be added to the left to make the sides of the balance equal.
    4. Make that number the value for the variable.

Checking for Understanding #1

Write **k + 9 = 32** on the board, then give students a few minutes to work on the problem on their own or in a small group. If students get stuck, spend time brainstorming as a group different ways to make 32 using a 9 or give students a sample set *(9 + 10 + 10 + 3)*. After students have had some time to work on the problem, ask the following questions:

1. When you started solving this problem, what did you do first? *(Put the 9 on the left side and the 32 on the right side of the balance.)*
2. How did you make 32? *(Put 3 weights on the 10 and one weight on the 2.)*
3. What did you do next? *(Change 32 on the right side to include a 9.)*
4. What set of numbers did you use? *(Students may have a variety of answers. Ask for different combinations to reinforce that there is not just one way to get to the correct answer.)*
5. After you made 32 in your new way, what did you need to do? *(Add what was missing on the left side of the balance.)*
6. What was the total of the weights that you needed to add to the left? *(23)*
7. What is the value of the variable in this equation? *(23)*
8. What's the last step we need to work through? *(Plug 23 in for the variable to make sure the problem is correct.)*
9. 23 + 9 = 32. Is that a true statement? *(Yes.)*

Activity #2



1. Write **x – 9 = 16** on the board. Tell students that subtraction problems are solved differently than addition problems, and that the first difference is that they will hang the weight for 9 on the back of the left side of the balance instead of the front. This is to show that the problem is a subtraction problem. Students will set up the 16 on the right side of the balance as they would in addition, with a weight on the 10 and the 6 on the front part of the balance.

2. To get rid of the subtraction sign, instead of subtracting 9, students will add 9. To do so, they should move the weight from the 9 on the back of the balance to the 9 on the front. Since a change was made to the left side of the balance (equation), the same change must be made to the right side, so students should add a weight to the 9 on the front of the right side.

3. Looking at the balance, students should see that the right side has a weight on the 6 and the 10, and the left side does not. To make it even, they need to add a 6 and 10 to the left side. At this point, the equation has been changed from x – 9 = 16 to x = 6 + 9 + 10. Solving this equation will give students the total amount of mass that is on each side of the balance *(25)*. Students should now plug 25 in for the variable in the original equation to see if it is correct.

4. Write **y – 13 = 7** on the board. Have students guide you in setting up the balance *(a weight should be hung on the 10 and the 3 on the back of the left side of the balance to make 13, and 7 should be hung on the front of the right side of the balance)*.

5. Next, students should tell you to add 13 to the left side of the balance to make the problem an addition problem. Remind them that to do this, they should move the weights that make up 13 from the back of the balance to the front. Students should now tell you that since they added 13 to the left side of the balance, 13 needs to be added to the right side of the balance.

6. Now, students will see that 7 is missing on the left side and that they should add 7, making the equation y = 3 + 7 + 10. When solving that equation, they should come up with 20, which should be plugged in for the variable in the original equation to make sure the equation is true.

(continue to next page)

Activity #2 (continued)

7. Review with students the steps they need to go through while solving each subtraction problem (these can be written on the board for reference):
    1. Hang the number on the side with the variable on the back of the balance.
    2. Hang the answer on the front of the other side of the balance.
    3. Add to the variable side by moving the back number to the front.
    4. Add the same amount to the other side of the balance.
    5. Make both sides of the balance equal.
    6. The amount of mass on either side of the balance is the correct answer.
    7. Check your work by plugging the answer into the original equation.

Checking for Understanding #2

1. Write **z – 8 = 25** on the board. Give students a minute to set the equation up on their balance. Circulate to make sure they have done this correctly.

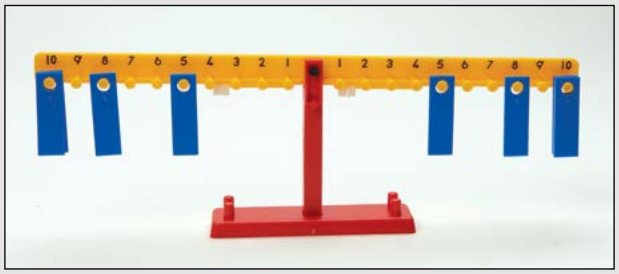
2. Tell students they have done the first two steps and that they should now do steps 3 and 4. Circulate to make sure students are doing these steps correctly.

3. Have students complete Step 3 from the review. Ask the students what they need to do to make both sides of the balance equal *(add 25 to the left side of the equation by adding a weight to 5 and two weights to 10)*.

4. Ask what the total amount of mass is on each side of the balance *(33)*.

5. Have students check their work, then ask if 33 – 8 = 25 is a true statement *(yes)*.

6. Hand out the worksheet. Remind students as you do so that their goal is to make sure their balance is even on both sides.



Intervention

- If students are struggling with the steps required to solve the different types of equations, teach the addition equations during a separate lesson than the subtraction equations. In doing this, students will get a firm grasp of the steps required to solve both. They then may even be able to work on more challenging problems in that particular discipline.

Extension

- Have students create their own problems and challenge their friends. They could also create word problems that correlate with each of the given equations.

Nasco education
1.800.558.9595
NascoEducation.com

Name: _____

Using a Mini Number Balance to Solve Equations with Variables Worksheet

Directions: Use the Mini Number Balance to solve each equation. In the first box, draw what your balance looks like when you've solved the problem. In the second box, check your work.

	Equation	What My Balance Looked Like	My Checked Work
1.	p + 12 = 27		
2.	t + 17 = 23		
3.	f + 9 = 42		
4.	m + 14 = 51		
5.	k + 8 = 47		
6.	g – 7 = 19		
7.	r – 5 = 38		
8.	y – 16 = 27		
9.	p – 15 = 25		
10.	a – 13 = 46		

Name: _____

Using a Mini Number Balance to Solve Equations with Variables Answer Key

Note: Answers in the What My Balance Looked Like column may vary, but should always show each side of the balance with the total amount given in the problem.

	Equation	What My Balance Looked Like	My Checked Work
1.	p + 12 = 27		p = 15 15 + 12 = 27
2.	t + 17 = 23		t = 6 6 + 17 = 23
3.	f + 9 = 42		f = 33 33 + 9 = 42
4.	m + 14 = 51		m = 37 37 + 14 = 51
5.	k + 8 = 47		k = 39 39 + 8 = 47
6.	g – 7 = 19		g = 26 26 – 7 = 19
7.	r – 5 = 38		r = 43 43 – 5 = 38
8.	y – 16 = 27		y = 43 43 – 16 = 27
9.	p – 15 = 25		p = 40 40 – 15 = 25
10.	a – 13 = 46		a = 59 59 – 13 = 46