**Variables on Both Sides**

**Section 1**

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| 00:00:00 | TEACHER: We're answering the question, how can you solve |
| 00:00:02 | equations with variables on both sides of the equals sign? We just reviewed how to use algebra tiles to solve equations. Algebra tiles aren't useful to solve every equation. In the next section, you'll learn the steps to solving equations with variables on both sides. |

**Section 2**

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| 00:00:00 | TEACHER: Let's discuss the steps for solving an equation |
| 00:00:03 | with variables on both sides. Step one is going to be to use the addition or subtraction property of equality to isolate the variable term. Step two, we'll use the multiplication or division property of equality to solve for the variable. So let's see these steps in action on the equation on the right-hand side here. 2x minus 7 equals 4x. |
| 00:00:24 | So to apply step one, we want to isolate the variable on one side of the equal sign. In this case, it's most efficient to move the 2x. So I'm going to use the subtraction property of equality and subtract 2x from both sides. As you can see, this is going to give me negative 7 on the left-hand side, which is equal to 4x minus 2x, which yields 2x. |
| 00:00:49 | I now have negative 7 equals 2x. I'm onto step two, use the multiplication or division property of equality to solve. In this case, since I have 2 times x on the right, I want to use the inverse property of division and divide both sides by 2. This leaves me with negative 7 over 2 equals x, or equally, x equals negative 7 over 2. |
| 00:01:17 | Let's verify that our solution is correct. So the way we can verify this is by plugging our answer into the original equation. So I'm going to replace x in that equation with negative 7 over 2. This gives me 2 times negative 7 over 2 minus 7 equals 4 times negative 7 over 2. I want to simplify this. |
| 00:01:45 | And if both sides come out to be the same number, I know that my solution is correct. So when I multiply a whole number by a fraction, remember that we multiply by the numerator and then divide by the denominator. So 2 times negative 7 gives us negative 14 divided by 2. And 4 times negative 7 gives us negative 28 divided by 2. Negative 14 divided by 2 is negative 7 minus 7 equals |
| 00:02:15 | negative 28 divided by 2 is negative 14. Negative 7 minus 7 is negative 14. And I can see that negative 14, indeed, equals negative 14, verifying that my solution, x equals negative 7 over 2, is correct. |

**Section 4**

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| 00:00:00 | TEACHER: Let's practice solving for a variable with |
| 00:00:02 | decimals on both sides. So there are two steps to solving equations like this. Step 1, isolate the variable term to one side of the equals sign. And step 2, use the inverse operation to remove the coefficient. So let's practice these steps on the equation 5.3x equals 4.1x plus 5.76. |
| 00:00:21 | So first, I need to isolate the variable term to one side of the equals sign. I'll do that by subtracting 4.1x from both sides of the equation. On the right side, that cancels out the 4.1x, and just leaves me with 5.76. On the left, 5.3x minus 4.1x leaves me with 1.2x. So now, I'm on to step 2, use the inverse operation to |
| 00:00:47 | remove the coefficient. Well, the operation that's happening right now between 1.2 and x is multiplication. So the inverse of multiplication is division. I'm going to divide both sides of my equation by 1.2. This leaves me, on the left, with just x; and on the right, I have 5.76 divided by 1.2. So I can make this a little bit easier to divide out by |
| 00:01:12 | multiplying the numerator and denominator by 10. So we multiply 5.76 by 10, and 1.2 by 10. And this leaves me with x equals 57.6 divided by 12. How many times does 12 go into 57.6? Well, it goes in 4.8 times. So my final answer is x equals 4.8. |

**Section 6**

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| 00:00:00 | TEACHER: Let's discuss solving a one-variable |
| 00:00:02 | equation with fractions. Recall that the steps for solving are to use the addition or subtraction property of equality to first isolate the variable term. And second, use the multiplication or division property of equality to solve for the variable. So in this case, we have the equation 8 minus 3 over 4 times x equals 1 over 2 times x. |
| 00:00:23 | So step one, we need to use the addition or subtraction property of equality to isolate the variable. In this case, I'm going to add 3/4x to both sides. Now, recall that when we need to add fractions we need a common denominator. In this case, I'm adding 1/2 plus 3/4. The common denominator for 1/2 plus 3/4 is 4. Since 3/4 already has a denominator of 4, I need to |
| 00:00:53 | multiply 1/2 by 2 over 2 to get the common denominator of 4. This leaves me with 2 over 4 plus 3 over 4, which is 5 over 4. So my equation becomes 8 equals 5 over 4x. Step two is to use the multiplication or division property of equality to solve for the variable. In this case, I'm going to divide both sides by the |
| 00:01:20 | coefficient of 5 over 4. Recall that dividing a fraction is the same as multiplying by its reciprocal. So what I'm really going to do is multiply both sides by 4 over 5. 4 over 5 times 8 equals 4 over 5 times 5 over 4x. Note that the coefficients on the right hand side divide each other out leaving us with just x. |
| 00:01:46 | On the left hand side, we have 4 over 5 times 8. Multiply the 4 by 8, which is 32, and divide by 5. It's OK to leave your answer as an improper fraction as long as it's reduced. |

**Section 9**

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| 00:00:00 | TEACHER: We're answering the question, "How can you solve |
| 00:00:02 | equations with variables on both sides of the equal sign?" Recall that you just learned the steps for solving equations with variables on both sides. Step one, isolate the variable term by using the addition or subtraction property of equality. And step 2, isolate the variable itself by using the multiplication or division property of equality. In the next segment, you'll learn to solve equations with |
| 00:00:25 | variables and constants on both sides of the equal sign. |

**Section 10**

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| 00:00:00 | TEACHER: Let's discuss solving an equation with variables and |
| 00:00:03 | constants on both sides of the equal sign. We can solve equations like this in more than 1 way. First, let's solve the equation by isolating the variable term on the right. So step 1 is to isolate the variable term and then isolate the constant on the other side of the equal sign. So to isolate the variable term on the right hand side of the equation, I'm going to use the subtraction property of |
| 00:00:26 | equality to subtract 3x from both sides. This leaves me with the equation, 4 equals 2x plus 9. I'm then going to subtract my constants to the other side of the equal sign. So we'll subtract 9 from both sides. This gives me negative 5 equals 2x. Finally, I can use the division property of equality to isolate the x. |
| 00:00:54 | So divide both sides by 2 and this gives me x equals negative 5 over 2. Now, let's solve the same equation by first isolating the variable term on the left hand side of the equal sign. So first thing I'm going to do is use the subtraction property of equality to subtract 5x from both sides. This leaves me with the equation negative 2x plus 4 equals 9. |
| 00:01:28 | Now I'll use the subtraction property of equality to isolate the constant on the other side. Subtract 4 from both sides in this case and we're left with, negative 2x equals positive 5. And finally, the division property of equality to isolate x. I'll divide both sides by negative 2, which gives me x equals negative 5 over 2 once again. |
| 00:01:52 | Note that I get the same solution in either case. |

**Section 12**

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| 00:00:00 | TEACHER: Let's practice solving an |
| 00:00:01 | equation with fractions. The riddle, 9 minus 3/4 of a number is the same as 7 less than half of the number, can be modeled by the equation 9 minus 3/4 x equals 1/2 x minus 7. We can solve for x. We can answer the riddle. So in this case to solve for x, step one is going to be to isolate the variable term on one side of the equal sign. |
| 00:00:24 | We'll do that by adding 3/4 x to both sides. Recall that when you add two fractions, you need a common denominator. In this case, that's 4. So I'll rewrite 1/2 x as 2/4 x, which is equivalent, plus 3/4 x is going to give us 5/4 x. So my equation becomes, 9 equals 5/4 x minus 7. Step 2 is to isolate the constant to the other side of |
| 00:01:01 | the equal sign. So I'll do that by adding 7 to both sides. This is going to give us the equation 16 equals 5/4 x. Now, to solve for x we need to divide both sides by the coefficient 5/4. Recall that dividing by a fraction is the same as multiplying by its reciprocal. So what I'm really going to do is multiply both sides by 4/5. |
| 00:01:31 | You can see on the right hand side that 4/5 and 5/4 cancel each other out, leaving me with just x. 16 times 4/5 becomes 64/5. It's OK to leave your answer as an improper fraction, as long as it's reduced. So our final answer is x equals 64/5. Let's check to see if this is correct. We can verify our answer by plugging it back into the |
| 00:02:01 | original equation, and showing that both sides come out to the same number. So I'm going to rewrite my equation as 9 minus 3/4 times 64/5 equals 1/2 times 64/5 minus 7. Simplifying this, we get 9 minus-- and when we multiply 3/4 times 64/5, a quick way to do it is cross divide. So 4 goes into 64, 16 times. |
| 00:02:37 | 4 becomes a 1, 64 becomes a 16. Now 3 times 16 is 48. And 1 times 5 is 5. So I'm left with 9 minus 48/5-- equals multiplying 1/2 by 64/5, again, it's easiest to cross divide. So 2 goes into 64 32 times. 2 becomes a 1, the 64 becomes a 32. |
| 00:03:02 | We multiply straight across to get 32/5 minus 7. Now to subtract a whole number with a fraction, we need to rewrite the whole number as a fraction with the same denominator. So I'll rewrite 9 as 45/5 minus 48/5 equals 32/5. And I can rewrite 7 as 35/5. So now we subtract. And we're going to end up with 45 minus 48 |
| 00:03:38 | gives us negative 3/5. Equals 32 minus 35 gives us negative 3/5. Same number on both sides, verifying that our solution of 64/5 is correct. |