**Combining Like Terms to Solve**

**Section 1**

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| 00:00:01 | TEACHER: How can you solve linear equations by combining |
| 00:00:04 | like terms? In the warm up, you reviewed identifying and combining like terms. Before you start solving equations, let's review the properties of quality and inverse operations. |

**Section 2**

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| 00:00:01 | TEACHER: Let's talk about inverse operations and how |
| 00:00:03 | they relate to the properties of equality. Inverse operations are operations that undo each other, such as addition and subtraction or multiplication and division. Let's start with the addition property of equality. We can think of an equation as kind of a balance scale. And anything we do to one side, as long as we do the same thing to the other side, we can maintain that balance. |
| 00:00:26 | It's especially understandable with addition. If we add something to one side of the balance scale, it'll tip in that direction. If we add the same weight to the other side, it'll even out and maintain that balance. So as long as we add the same thing to both sides of an equation-- in this case, c-- |
| 00:00:42 | we still maintain that true equality. So we can use that in conjunction with inverse operations to help us solve equations involving subtraction. So look over here on the right. I have x minus 4.3 equals 0.55. To undo the subtraction, I'm going to add 4.3 to both sides. |
| 00:01:06 | On the left, the minus 4.3 and plus 4.3 will cancel each other out, leaving just x. And on the right, I have 0.55 plus 4.3, which will give me 4.85. So x equals 4.85. The subtraction property of equality works very much in the same way. As long as I subtract the same things from both sides of an |
| 00:01:32 | equation, I'll still end up with a balance, or a true equality. So I can use that to solve an equation involving addition. Here I have x plus 2/5 equals 8. So I'll go ahead and subtract 2/5 from both sides. Now to evaluate 8 minus 2/5, I can get a common denominator, or I can just evaluate it by inspection, which means think of 2 over 5 as 2/5 of a whole. |
| 00:02:02 | I have 8 whole parts here. If I take away 2/5 of a whole, I'll be left with 7 whole parts and 3/5 of a whole. So x equals 7 and 3/5. All right. So let's move on to the multiplication property of equality that works basically in the same way. As long as I multiply both sides of the equation by the |
| 00:02:22 | same number, I still maintain a true equality. I maintain balance in my scale. So I can use that to solve an equation involving division. Here I have x divided by 3 equals 6, or x/3 equals 6. These mean the same thing. To solve this, I'll just multiply both sides of the equation by 3. On the left, the division undoes the multiplication, or |
| 00:02:47 | vice versa. On the right, we have 6 times 3, which is 18. So x equals 18. Finally, we have the division property of equality, which works the same way as the other properties. As long as we divide both sides of the equation by the same thing, we maintain equality in our equation. However, we do make need to make one note. |
| 00:03:08 | We can't divide by 0. Dividing by 0 is undefined. So as long as c is not equal to 0, we're good. We can use that to solve this equation. 5.5 times x equals 33. I'll just go ahead and divide to undo the multiplication. I'm dividing both sides by 5.5. I'm left with x equals 6. |

**Section 5**

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| 00:00:01 | TEACHER: Let's talk about how to combine like terms to solve |
| 00:00:03 | an equation. This equation might look a little different than the one-step equations you've been solving in this lesson so far. But we can handle it as long as we remember how to identify and combine like terms. That's step one to solving an equation like this. So as you can see, we have 5x plus 6x. 5x and 6x are like terms, since the variables are the |
| 00:00:23 | exact same. So when we combine those, 5x plus 6x will make 11x, which is equal to 66. We can then use the properties of equality and inverse operations that we've been talking about to isolate the x. So since I have 11 times x, the operation that undoes multiplication is division. |
| 00:00:44 | I can divide both sides by 11 using that division property of equality. And I end up with x equals 6, because 66 divided by 11 is 6. The last step to a problem like this is to check our answer by plugging the value you got for your variable back into the original equation. So I get 5 times 6 plus 6 times 6 equals 66. 5 times 6 is 30. |
| 00:01:10 | 6 times 6 is 36. 30 plus 36 is 66. Since I end up with a true statement, I know that I got the answer correct. So we can use inverse operations and combining like terms to help us solve real-world problems such as this one. Mrs. Garner needs to arrange 28 desks into rows on each |
| 00:01:37 | side of her classroom with an aisle in the middle. There's room for 4 rows on the left side, but only 3 rows on the right side. How many desks should be in each row on the right? Now first thing you want to do is identify your variable and make a note of it. So I'm going to call my variable x. x is the number of desks in each row on the right. |
| 00:02:08 | Next thing we want to do is write an equation involving our variable. Well, I know she needs to arrange 28 desks, so that's what goes on the right-hand side of the equal sign. Since there are four rows on the left, I'll use 4 times x to represent the number of desks on the left. And there are three rows on the right, so 3 times x to represent the number of desks on the right. |
| 00:02:32 | So 4x plus 3x equals 28. I now have an equation like we had in the previous slide. So I'm going to go ahead and combine like terms. 4x plus 3x are like terms, which gives me 7x equals 28. Then I can use inverse operations to solve this. So since I have 7 times x, I'll divide both sides by 7 to undo the operation. And I'm left with x equals 4. |
| 00:02:58 | And of course, the last step is to go ahead and check your answer in the original equation. So the original equation is 4 times x, which in our case, we got to be 4, plus 3 times x, which again we're replacing with 4, equals 28. So what we have now is 16 plus 12 equals 28, which gives us 28 equals 28. We know our answer is correct. |
| 00:03:30 | So x equals 4. There should be 4 desks in each row on the right. |

**Section 7**

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| 00:00:00 | TEACHER: You're answering the question, how can you solve |
| 00:00:02 | linear equations by combining like terms? So far, you've learned how you can use inverse operations and properties of equality to solve one-step equations. You've also learned that you can combine like terms to help solve two-step equations like you see here on the right. Next you're going to learn how to solve two-step equations in which there are no like terms on one side of the equation. |

**Section 8**

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| 00:00:00 | TEACHER: We can use an interactive algebra tiles |
| 00:00:03 | slide, to help us model equations, such as 4 x minus 3 equals 5, where we don't have like terms on one side of the equation. So remember that the orange plus squares represent 1 constant unit. And the blue minus squares represent negative 1 constant unit. The orange rectangular x squares represent 1x. |
| 00:00:24 | And the blue rectangular negative x squares represent 1 negative x. Here, we have 4 positive x squares grouped together, making 4x, 3 negative constant squares grouped together, making the minus 3. You can see the equals. And then, we have 5 positive constant squares grouped together, making 5 on the |
| 00:00:49 | right-hand side of our equation. So it gives us the equation 4x minus 3 equals 5. The first thing we want to do is cancel out the constants on the left side of the equal sign. So we need to bring down 3 orange constant squares, to cancel out the 3 blue negative constant squares. If we're going to do that on the left, we also need to do that on the right of the equation, to |
| 00:01:13 | maintain our balance. So you can see what we've essentially done here is use the addition property of equality. We've added 3 to both sides of the equation. On the left, the minus 3 cancels with the plus 3 and just leaves us with 4x. And on the right we have 5 plus 3, which when we group the styles together, gives us 8. |
| 00:01:40 | So we now have 4x equals 8. We're now we're going to apply our knowledge of inverse operations to isolate the x. Remember that 4x equals 4 times x. So to get rid of the 4 coefficient, we'll do the opposite operation and divide both groups by 4. And we can double click the button below that says divide both groups by 4. |
| 00:02:01 | And we're left with x equals 2. |

**Section 10**

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| 00:00:00 | TEACHER: Let's talk about how to solve 2-step equations. |
| 00:00:03 | When we were modeling these type of equations using algebra tiles, our coefficients were whole numbers. In this case, you can see that we have a rational coefficient. This is much more difficult to model using algebra tiles. So let's talk about what's going on mathematically here. When you want to solve a 2-step equation, the first |
| 00:00:21 | thing you want to do is isolate your variable term. So you want to undo the addition or subtraction going on in conjunction with your variable term. In this case, we want to undo the minus 4 by using the inverse operation of addition. I'll add 4 to both sides. What I'm left with is 3.25x equals 19.5. Next, I want to undo the multiplication or division by |
| 00:00:46 | using its inverse operation. In this case, I have 3.25 times x. So I'm gonna use division and divide out the 3.25. What I'm left with is x equals 19.5/3.25, which comes out to x equals 6. Last, of course, we always want to check our answers. So plug your value for your variable back into the original equation. |
| 00:01:11 | In this case that's 3.25 times 6 minus 4 equals 15.5. And make sure you come out with a balanced equation. 3.25 times 6 is 19.5. Then 19.5 minus 4 is 15.5. So since 15.5 does indeed equal 15.5, I know that x equals 6 is the correct answer. So we can use these steps to help us solve a word problem. In this case, Morgan wants to buy a new |
| 00:01:44 | smartphone that cost $172. She already has saved $70. And she makes $8.50 per hour babysitting. How many hours will Morgan have to babysit to earn the rest of the money? So since our unknown is the number of hours, I gonna make a variable for that. h will represent the number of hours she has to babysit. |
| 00:02:09 | First thing we're going to do is write an equation using that variable. So I've underlined some of the important information. Her new smartphone cost $172. So that's what we'll set this equation equal to. She's already saved positive $70. And she makes $8.50 babysitting per hour. So the term that'll represent how much money she brings home |
| 00:02:33 | babysitting will be $8.50 times h, the number of hours she babysits. This gives us the equation 8.50-- $8.50-- times h plus 70 equals 172. We can now apply our steps for solving 2-step equations. So first, we want to go ahead and use subtraction to undo the addition and isolate the variable term. |
| 00:02:56 | So I'm gonna subtract 70 from both sides, leaving me with $8.50 times h equals 102. Then I want to use division to undo the multiplication and isolate the variable. So, divide 8.50 on both sides, and I'm left with h equals 12. And before we get excited and circle our answer, let's check to make sure it's correct by plugging it back into the original. |
| 00:03:24 | So my original was 8.50 times h, which in this case came out to 12, plus 70 equals 172. So 8.50 times 12 comes out to 102, plus 70 equals 172. So 172 equals 172. Since that is true, we know that our answer was correct. Morgan will have to work 12 hours to save up for her new smartphone. |

**Section 12**

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| 00:00:00 | TEACHER: Let's talk about how to solve multi-step equations. |
| 00:00:04 | So let's take a look at the equation on the right here. We have negative 3x plus 6x plus 4 equals 13. Multi-step equations are generally more than two steps. So the first thing you want to do is identify and combine like terms. So you can see, on the left side of the equation, we have two like terms. We have negative 3x plus 6x. |
| 00:00:23 | So we'll ahead and combine those first. When we add negative 3x to positive 6x, we're left with positive 3x. So think back to the algebra tiles. Three of those negative x tiles would have cancelled out 3 of the positive x tiles in the group of 6x, leaving us with 3 positive x tiles. So 3x plus 4 equals 13. |
| 00:00:47 | We're now down to, basically, a 2-step equation. So we'll go ahead and isolate the term with the variable. So I'm going to use the inverse operation of subtraction to undo the plus 4. So subtract 4 from both sides, I'm left with 3x equals 13 minus 4, which is 9. Finally, the last step is, use multiplication or division to isolate the variable. |
| 00:01:11 | In this case, we have 3 times x. So I'm going to use division to undo that multiplication. Divide both sides by 3, and I'm left with x equals 3. Before I commit to this answer, I want to check the answer in the original equation. So I'm going to plug in 3 for x in the original equation. Here, i have negative 3 times 3 plus 6 times 3 plus 4 equals 13. |
| 00:01:36 | This is going to give me negative 9 plus 18 plus 4 equals 13. So we can go ahead, bring it over here to simplify a little bit further. Negative 9 plus 18 is going to give us positive 9 plus 4 equals 13. 9 plus 4 is 13. So 13 equals 13. |
| 00:01:58 | Our answer checks out. Now I'm ready to commit. |