**Real World Multi Step Equations**

**Section 1**

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| 00:00:00 | TEACHER: How can you solve multi-step equations that |
| 00:00:03 | represent real-world scenarios? During the Olympics, sometimes you pay attention to your own country's medal counts, but you're not paying attention to other countries' medal counts. We can use equations to help solve for those countries' medal counts. You reviewed writing expressions to represent real-world scenarios. |
| 00:00:20 | Now you'll use those expressions to write and solve equations. |

**Section 2**

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| 00:00:00 | TEACHER: Let's talk about the procedure for solving real-world |
| 00:00:02 | problems using multi-step equations. Step one is to determine the variable. Step two, identify keywords and translate the meaning. Step three, write the multi-step equation. Step four, solve for the variable. And step five, use the value of the variable to solve the problem. And we've reviewed steps one through three. |
| 00:00:23 | This lesson we'll learn steps four and five, solving the variable and using the value of that variable to solve the problem. So let's practice steps one through three. In the 2012 Summer Olympics, Great Britain won 21 more medals than Germany. Russia won 6 fewer medals than 2 times the number of medals Germany won. |
| 00:00:44 | And the three countries won a total of 191 medals. Now first, we want to determine the variable. In this case, it make sense to make the variable g for the number of medals that Germany won. The reason is that the other countries medal counts are given in terms of the number of medals that Germany won. So g represents the number of medals Germany won. Step 2, we want to identify the key words and translate |
| 00:01:15 | the meaning. So we have some key phrases here. Great Britain won 21 more medals than Germany. So let GB represent the medal count for Great Britain. And since they won 21 more than Germany, we can represent that with the expression lower case g plus 21. So the number of medals Germany won plus 21 more. Another key phrase, Russia won 6 fewer than 2 times the |
| 00:01:41 | number of medals Germany won. We use R to represent Russia. And since they won 6 fewer, that's subtraction of 6, then 2 times the number of medals Germany won. So we can use the expression 2g minus 6 to represent the number of medals Russia won. Now we're on to step three, we have enough information to write the multi-step equation based on the last statement. |
| 00:02:07 | The total medals are 191 for all three countries. So that means, if we add up the number of medals Germany won g, plus the number of medals Great Britain won, which is represented with the expression g plus 21, plus the number of medals Russia won, which is represented by 2g minus 6, it should equal the total of 191 medals. Giving us our equation representing this scenario. |

**Section 4**

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| 00:00:00 | TEACHER: Previously, we wrote the equation g plus g plus 21 |
| 00:00:04 | plus 2g minus 6 equals 191 to represent the total number of medals that Germany, Great Britain, and Russia won at the 2012 Summer Olympics. Remember that g represents Germany's total medal count. So let's take it to the next step, step four, which is to solve for the variable. So the first thing I'm going to do is drop the parentheses because there is nothing to distribute. |
| 00:00:27 | So I'm left with g plus g plus 21 plus 2g minus 6 equals 191. Now step one to solving this is going to be combine like terms on either side of the equal sign. So, on the left I have like terms of g, g and 2g. And when I combine those they give me 4g. I also have like constant terms of 21 and negative 6. Combining those gives us positive 15. |
| 00:00:57 | So 4g plus 15 equals 191. Now, to isolate the variable, let's use properties of equality. So first, let's use the subtraction property of equality, and subtract 15 from both sides. This leaves us with 4g equals 176. And to get rid of the coefficient of 4, we'll divide 4 from both sides, isolating the g. |
| 00:01:20 | Leaving us with our answer, g equals 176 divided by 4, which is 44. So, Germany earned 44 medals. Now, it's important to note that just solving for the variable does not always mean you're done with the problem. Like in this case, the question is how many medals did Russia win, if it's athletes won 6 less than 2 times as many medals as Germany. |
| 00:01:43 | Remember that the expression we came up with a number of medals Russia won was R equals 2g minus 6. Since we've solved for g, we can plug that back in to solve for the number of medals that Russia won. So, R equals 2 times 44 minus 6, which is 88 minus 6, or 82 medals. So Russia won 82 medals. Let's answer the question how many medals did Great Britain |
| 00:02:19 | win, if its athletes won 21 more medals than Germany? So just to review Germany won 44 medals, Russia won 82 medals, and now we're going to solve for how many medals Great Britain won. We'll remember that our expression for the number of medals Great Britain won was g plus 21, since they won 21 more than Germany. And since we know g, we can plug that value into the |
| 00:02:44 | expression and solve for the number of medals Great Britain won. So that gives us 44 plus 21, or Great Britain won 65 medals. Well, since now we know the medal count for all three countries, we can add them up to ensure that our solutions were correct. Because remember, the total should be 191. |
| 00:03:07 | So Germany won 44, plus Great Britain won 65, plus Russia won 82. And it's easy to verify that 44 plus 65 plus 82 does add up to 191. Since 191 equals 191, our answers checked out. |

**Section 7**

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| 00:00:00 | TEACHER: We're answering the question, how can you solve |
| 00:00:02 | multi-step equations that represent real world scenarios? An equation that compares two quantities has the variable on both sides. In the previous section, you solved multi-step linear equations with the variable on one side of the equal sign. Next, you'll learn how to set up and solve multi-step linear equations with a variable on both sides, such as equations |
| 00:00:23 | that model the prices between two competing shuttle companies. |

**Section 8**

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| 00:00:00 | TEACHER: Let's practice the steps for writing a multi-step |
| 00:00:03 | equation for a real world scenario. So Ride-n-Fly Shuttle charges $16 for a pick up and an additional $0.20 for each mile traveled. Speedy Shuttle charges $4 for a pick up and an additional $0.50 for each mile traveled. At what number of miles is the cost of both shuttle services the same? So step one, we want to identify the variable. |
| 00:00:25 | In this case it makes sense to use m as the number of miles, which is the unknown. Step two, let's identify some key information and translate it. So Ride-n-Fly Shuttle charges $16 for a pick up and $0.20 for each mile. So we can represent that using the expression, the total cost for Ride-n-Fly is equal to $0.20 for each mile, so 0.20 |
| 00:00:54 | times the number of miles, which is m, plus a flat fee of $16 just for the pick up. Some other key information, Speedy Shuttle charges $4 for a pickup and an additional $0.50 for each mile. So the total cost of Speedy Shuttle is $0.50 for each mile, or 0.50 times the number of miles, m, plus a flat rate of $4 for the pick up. Now we move on to step three, which is write the equation. |
| 00:01:25 | And we'll use some key information for that. The question is, at what number of miles is the cost of both shuttle services the same? The same means equals, so we're looking for when the cost of Ride-n-Fly is equal to the cost of Speedy Shuttle. Or when 0.20m plus 16 is equal to 0.50m plus 4. And so this is the equation representing the scenario. Let's go ahead and take it to step four, and solve the |
| 00:01:59 | equation for our variable. So first I'm going to subtract 0.20m from both sides using the subtraction property of equality. This leaves me with 16 equals 0.30m plus 4. I'll then move my constants to the other side, the left hand side in this case. Again subtracting, in this case, 4 from both sides. So this leaves me with 12 equals 0.30m. |
| 00:02:29 | Now I'll use the division property of equality to get rid of the coefficient on m. So divide both sides by 0.30. And since 12 divided by 0.3 comes out to 40 equals m, or equivalently, m equals 40, which is the number of miles at which we would have to travel for the price of each shuttle to be the same. So that's step 5, we've interpreted our answer. |
| 00:03:00 | So let's verify our answer. We can do that by plugging the value of m back into the equation for m and verifying that we end up with a true statement. So that's 0.20 times 40, plus 16 equals 0.50 times 40, plus 4. 0.20 times 40 is 8, plus 16 equals 0.50 times 40, is 20 plus 4. |
| 00:03:33 | Simplifying this, 8 plus 16 is 24, 20 plus 4 is 24. We have a true statement, and thus our solution is correct. |

**Section 10**

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| 00:00:00 | TEACHER: Let's practice using a model of a |
| 00:00:02 | mathematical problem. So here, a regular pentagon and a rectangle have the same perimeter. The side of the pentagon is 2 units less than the length of the rectangle. The width of the rectangle is 5 units more than the length of the rectangle. What is the perimeter of each figure? |
| 00:00:18 | So step one, let's define our variable. Since everything is given in terms of the length of the rectangle, let's call the length of our rectangle x. And then, we can come up with expressions for everything else based on that. So step two, we'll identify some key information and translate it. So one piece of key information is that the side |
| 00:00:36 | of a pentagon is 2 units less than the length of the rectangle. So I can represent the side of the pentagon as x minus 2. Also, the width of the rectangle is 5 units more than the length of the rectangle, which means I can represent the width of the rectangle by x plus 5. As you can see, on the left-hand side, we're given the formulas for the perimeters of each figure. |
| 00:01:01 | For the rectangle, the perimeter is 2l plus 2w, or 2 times the length plus 2 times the width. Let's translate that into the expressions using our variable. So 2 times the length would be 2x. Plus 2 times the width would be 2 times x plus 5. For the pentagon, the perimeter formula is 5 times s, s being the length of a side. |
| 00:01:27 | So in terms of our variable, that would be 5 times x minus 2. OK, we're ready to move to step three, which is write the equation. And we can do that by understanding that both figures have the same perimeter, meaning equal perimeters. So the perimeter of the square is equal to the perimeter of |
| 00:01:51 | the pentagon. Or in terms of our variable, 2x plus 2 times x plus 5 is equal to 5 times x minus 2. Now we're ready for step four, which is solve. So first, let's distribute, get rid of the parentheses. This will leave me with 2x plus-- I'm going to distribute the 2. 2 times x gives me 2x, and plus 2 times 5 is 10. |
| 00:02:24 | And on the right-hand side, I'll distribute the 5. 5 times x is 5x. Minus 5 times 2 is 10 as well. So let's combine like terms on the left. My like terms are 2x and 2x, which make 4x plus 10 is equal to 5x minus 10. So now I'm going to use my properties of equality to isolate the variable on one side. |
| 00:02:49 | So I'll start by subtracting 4x from both sides. That leaves me with 10 equals x minus 10. So one more step. I need to get my constant to the other side, in this case, the left. So I'm going to use the inverse property of addition here, add 10 to both sides. And that leaves me with 20 equals x, or |
| 00:03:12 | equivalently, x equals 20. Now, step four is done. Remember that there's one more step. The value of the variable is not always your answer. Our question is, what is the perimeter of each figure? So we want to plug the value of our variable back into our perimeter formulas and solve for the perimeter of each figure. |
| 00:03:33 | So the perimeter of the rectangle was 2x plus 2 times x plus 5. So plugging in 20 for x, we have 2 times 20 plus 2 times 20 plus 5. This is going to simplify to 40 plus 2 times 25. And let's take it over here where there's a little more space. The perimeter of the square is then 40 plus 2 times |
| 00:04:07 | 25 is 50, or 90. For the perimeter of the pentagon, we have the formula 5 times x minus 2. Plugging in 20 for x, we have 5 times 20 minus 2. And again, let's bring it over where we have a little more space. So the perimeter of the pentagon is 5 times 18, which is also 90. |
| 00:04:37 | Since the perimeters came out the same, and our equation stated that the perimeters must be the same, we know that we have the correct answer. |