Today we're going to talk about substitution and multi-step linear equations. By the substitution property of inequality, we can use substitution to replace the variable with an expression that is also known to be equal to that variable.

So for example, if I know that a variable x is equal to $3.05, which let's say that's the cost of one gallon of gas, then if I want to find the cost of 15 gallons of gas I would use an expression 15 times x. And I can substitute my value for x in for that variable. So this would become 15 times 3.05, which would tell me that my 15 gallons of gas costs $45.75.

So we're going to use this idea of substitution to do some examples of solving multi-step linear equations.

So here's my first example. I've got m is equal to 4n plus 16. And I also have another equation n is equal to 2p minus 9. So because I have an expression for my variable n which is in my first equation, I can go ahead and substitute this expression for n in for n in my first equation. So that look like this.

I'm going to take everything that is equal to n. I'm going to substitute it in for the n in this equation.

So now this is going to become m equals 4, and I'm going to use parentheses because my n has multiple terms and I want to make sure that I'm multiplying this 4 by both of these terms. So it's going to be 4 times both 2p and my minus 9. And then I'm going to bring down the rest of my equation, plus 16.

So to simplify this, I'm going to start by using my distributive property and do 4 times 2p and 4 times my negative 9. So this will be m is equal to 8p minus 36 plus 16.

So now I can simplify by combining my two constant terms. Negative 36 plus 16 is going to give me a negative 20. And to bring down the rest of my equation, this would be equal to m. Now I can't actually solve this equation for either m or p because I have more than one variable, but I've simplified it as much as I can. Let's do another example.

So here's my second example. I've got 66 is equal to 12x plus 3y and a second equation that tells me y is equal to 4 minus x. So because I again have an expression for what my y variable is equal to, I can go ahead and substitute this expression in for y in my first equation.

So I'm going to take all of this that y is equal to, and I'm going to substitute it in for my y variable in my first equation. So when I simplify that, this equation will become 66 equals 12x plus 3 times-- and again I'm going to use parentheses so I make sure that I multiply this 3 by both terms that is in my expression for y.

So 3 times 4 minus x. Now I can go ahead and solve this equation because I only have one variable to solve for, but I need to start by simplifying.

So I'm going to start by distributing my 3 times 4 and 3 times my negative x. So 3 times 4 is 12. And 3 times negative x would be negative 3x. Bringing down the rest of my equation-- now I can do a little bit more simplifying by combining like terms because I have a 12x and a negative 3x. So combining those together-- 12 minus 3 will give me 9x plus my 12, and I still have 66 on the other side.

So now I can go ahead and solve this equation using the order of operations backwards. So I'm going to start by canceling out the adding operation by subtracting 12 on both sides. And these will cancel out, leaving me with 9x on this side and a 54 on the other side.

And then I just need to cancel out the multiplying by 9 by dividing by 9 on both sides. And this is going to give me 6 is equal to x.

So let's go over our key points from today. As usual, make sure you have these in your notes if you don't already so you can refer to them later.

So we started by looking at the substitution property of equality which said that we can substitute an expression that is equal to some variable into another equation or expression containing that same variable.

And then we saw through our examples that after you substitute you can simplify and/or solve the equation or expression.

So I hope that these notes and examples helped you understand a little bit more about using substitution to solve or simplify multi-step equations. Keep using your notes and keep on practicing, and soon you'll be a pro. Thanks for watching.