Hi and welcome. This is Anthony Varela. And today, I'm going to introduce quadratic equations. Now, quadratic equation's a big topic. So I'm going to introduce a lot of stuff, but not in a lot of detail. So feel free to look up these concepts in greater detail by seeking out other videos.

So we're going to talk about quadratic relationships. Then we're going to look at different forms of quadratic equations. We'll look at what quadratic equations are like on graphs and, finally, some methods for solving quadratic equations.

So first, let's talk about quadratic relationships. Well, a quadratic is a second-degree polynomial with an x squared term as its highest degree term. So you're not going to see x cubed. You're not going to see x to the fourth or anything higher than x to the power of 2. That's what defines a quadratic. So here's an example of a quadratic, x squared plus 3x minus 1.

Now, quadratic relationships can be recognized from a table of values. So I'm going to look at consecutive x-values. Let's plug in 0, 1, 2, 3, and 4 into x.

So when x equals 0, we have 0 plus 0 minus 1. So that's a negative 1. When x equals 1, we have 1 plus 3 minus 1. So it'd give us a positive 3. When x equals 2, we have 4 plus 6 minus 1. So that gives us a positive 9. When x equals 3, we have 9 plus 9 minus 1. So that gives us 17. And finally, when x equals 4, we have 16 plus 12 minus 1. So that gives us a total of 27.

Now we're going to be finding the difference between these numbers here. So the difference between negative 1 and 3 is 4. The difference between 3 and 9 is 6. The difference between 9 and 17 is 8. And maybe you're already seeing the pattern. The difference between 17 and 27 is 10.

Now, in linear relationships, if you took this difference, you would get the same value, a common difference, as you went down the rows. But in our quadratic relationships, we have to find the second difference. So the difference between 4 and 6 is 2, between 6 and 8 is 2, and between 8 and 10 is 2. So we have the same second difference in our quadratic relationships.

So now let's talk about forms of quadratic equation. So the first form that we use is standard form. And this is y equals ax squared plus bx plus c. So we have an x squared term, an x-term, and our constant, c.

So a is the coefficient of the x squared term. B is the coefficient of the x-term. And our constant is c. And we use the standard form if we would like to solve a quadratic equation using the quadratic formula. And we'll get to that in a minute.

Another form is called vertex form. And this is y equals a times x minus h, quantity squared, plus k. And we use equations in vertex form if we'd like to easily identify the vertex of a parabola. And we'll talk about parabolas and vertices in a minute as well.

And lastly, we have the factored form of a quadratic equation, which is y equals a times x minus x1 times x minus x2. And we use equations in factored form if we'd like to easily identify x-intercepts. So there are our different forms of our quadratic equation-- standard form, vertex form, and factored form.

Now I'd like to talk about parabolas, which are quadratic equations graphed on the coordinate plane. So a parabola is the shape of a quadratic equation on a graph. It is symmetric at the vertex. So we're going to talk about symmetry. And we'll talk about the vertex as well.

So the vertex of a parabola is the maximum or minimum point of a parabola. And it's located on the axis of symmetry. So here in the graph, I have marked the red dot. That's the vertex to this parabola. It happens to be a minimum point because this parabola opens upwards. It's a U-shaped parabola.

And we see that dotted vertical line. That's the axis of symmetry. And we can think about that as a line of reflection. So notice that our parabola is symmetrical. So what this means is you can take a point on the parabola and reflect it across that line. And you'll still be on the parabola.

Now, I said that the vertex represents a maximum or a minimum point. Here we see it's a minimum point. This is what the vertex looks like as a maximum point. So you notice here the parabola opens downward. And we still have that axis of symmetry that acts as a line of reflection.

So when do we have parabolas that are the U shape, opening upwards? And when do we have parabolas that have that upside down U shape, opening downward? Well, that depends on our variable a. If a is a positive number, our parabola opens upward. If a is a negative number, our parabola opens downward.

So lastly, I'd like to talk about solutions to quadratic equations and how we can solve quadratic equations. Well, first, there are a couple of different names for solutions. We can call them roots. And we can also call them zeros. And these represent x-intercepts on our graph of a parabola. So they're x-values that make y equal 0.

So when we're solving a quadratic equation, we have our quadratic expression set equal to 0. And when we solve for x with y equals 0, we've found our solution. So there are two common ways to solve quadratic equations. We could solve by factoring. And we can solve by using the quadratic formula.

So when we're factoring, we're taking our quadratic equation and we're writing it as factors. So one factor here is x plus 1. And another factor is x plus 2. And if you're interested, you can FOIL this out. And you'll get this expression.

But in general, you notice that x could have coefficients here. And the great thing about solving by factoring is that once you have it written in factors, you can set each factor equal to 0 and solve for x.

So we're going to do that over here on the left, just separating this into two equations, setting each factor equal to 0. So I can see that x equals negative 1 and x equals negative 2 are solutions to this equation.

Now, we could also solve by using the quadratic formula. And the quadratic formula is useful because you can use this for any quadratic equation. If you can't factor an equation or you don't know how, you can always use the quadratic formula. And the quadratic formula relies on our variables a, b, and c in our standard form set equal to 0.

So the quadratic formula is x equals negative b plus or minus the square root of b squared minus 4ac, all over 2a. So like I said, this could be used for any quadratic equation. The trade-off is that it's kind of messy algebraically. But if we plugged in-- let's see-- a would be 1, b would be 3, and c would be 2-- into our quadratic formula and did our simplification, we would get that x equals negative 3 plus or minus 1, all over 2.

So what you would do then is evaluate negative 3 plus 1 over 2 and negative 3 minus 1, all over 2. And we would get x-values of negative 2 and negative 1, same solutions as before.

So let's review our introduction to quadratic equations. We talked about how a quadratic is a second-degree polynomial. We have a couple of different forms of quadratic equations-- standard form, vertex form, and factored form.

When graphed, quadratic equations are parabolas. And we can have parabolas that open upward or downward, depending on the value of a, if it's positive or negative. And we also talked about common ways to solve quadratic equations, either by factoring or using the quadratic formula.

So thanks for watching this introduction to quadratic equations-- hope to see you next time.