**Finding Distance Coordinate Plane**

**Section 1**

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| 00:00:01 | TEACHER: If I gave you this figure in the coordinate plane |
| 00:00:03 | and I gave you the distance of this side and this side, and I asked you to find the distance of that side, you would know you could just use the Pythagorean Theorem to find it. But what if I didn't give you the distances? Maybe I just gave you the locations of these points. How would you then find the distance of that line? We need to know how to handle this situation if we're going |
| 00:00:26 | to answer the question, how can you find distance on the coordinate plane? |

**Section 2**

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| 00:00:00 | TEACHER: In this example, we have two points in the |
| 00:00:03 | coordinate plane to work with. And we want to discuss how to find the distance between these two points. We've been given the point A, negative 3, 1; and B, 2, 4 on the coordinate plane. So we want to talk about what is the distance between these two points. Well, first I need to plot the points in |
| 00:00:21 | the coordinate plane. So we'll plot A at negative 3, 1. And we'll plot B at 2, 4. OK. Now we want to know the distance between these two points. Well, what does that mean? It means we want to find the distance of this line segment |
| 00:00:44 | from this point to this point. Now, if this line was perfectly horizontal, it'd be easy. I would just count the units, right? Or if it was perfectly vertical, I would just count the units up. But unfortunately, I can't do either of those here because the line is on a diagonal. |
| 00:01:02 | I'm going to need to know a little bit more to finish this problem. What I can do is I can construct a right triangle from the two points and find the distances of the legs. So if I start here at A, and I go over this way, and up this way, I have a right triangle. And I know a lot about right triangles. I should be able to find that distance somehow. |
| 00:01:30 | But what I'm going to need is the distance of the legs, so can I find that? Let's call this point C. And this distance is 1, 2, 3, 4, 5. So AC is 5, right? And this distance is 1, 2, 3, so BC is 3. Now that I know the distance of the legs, I can use the Pythagorean Theorem to find the distance of AB, right? |
| 00:02:10 | This distance here. Now, please understand also that I didn't have to create the right triangle below the line. I could have created it above the line, too, right? I could have just counted up this way and over this way. And I would have another right triangle. And I would have found these legs instead on this side. I would have came up with the same values, 3 and 5. |

**Section 5**

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| 00:00:00 | TEACHER: Let's see if we can find the distance between |
| 00:00:02 | these two points in the coordinate plane from A to B which will be the hypotenuse of the right triangle ABC. So we need to know the length of the legs. So from A to C, we have 1, 2, 3, 4, 5 units. And from B to C, we have 1, 2, 3 units. Now that I know the legs, I can use the Pythagorean theorem. Substitute in a 5 in for a. |
| 00:00:30 | Substitute 3 in for b. Now 5 squared is 25. 3 squared is 9, equal to c squared. 25 plus 9 is 34 equals c squared. Solving for c, we take the square root of both sides, and we find that c is equal to the square root of 34. If we were to use a calculator to find the square root of 34, we would find that that is approximately 5.83. |
| 00:01:00 | So the length of c, the length from A to B, is approximately 5.83. |

**Section 7**

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| 00:00:00 | TEACHER: Look at this image on the screen. |
| 00:00:03 | How cool does all of that look? What if I told you that since you understand the Pythagorean theorem, you can easily understand this. Well, let's give it a go and keep answering the question, how can you find distance on the coordinate plane? |

**Section 8**

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| 00:00:00 | TEACHER: Let's see if we can find the lengths of the legs |
| 00:00:02 | of a right triangle in the coordinate plane. So the lengths of the legs of a right triangle can also be found using the coordinates of the points. Since we don't have a scale for this graph, we'll be using the general form of the points, (x sub 1, y sub 1) and (x sub 2, y sub 2). Point 1 will be (x sub 1, y sub 1), and point 2 will be (x sub 2, y sub 2). |
| 00:00:23 | The length of the horizontal leg of this right triangle is the distance from x sub 1 to x sub 2. And we can represent this distance using the absolute value of x sub 2 minus x sub 1 using absolute value, because we're talking about a positive distance. Now, the vertical leg of this right triangle, that distance is the distance from y sub 2 to y sub 1. And we can represent this distance as the absolute value |
| 00:00:51 | of y sub 2 minus y sub 1. We can use that information to generate a formula for distance to be used in the coordinate plane. A distance formula can be developed by substituting the values into the Pythagorean theorem. Looking at the coordinate graph, we're going to let the absolute value of x sub 2 minus x sub 1 be equal to a. And we're going to let the absolute value of y sub 2 |
| 00:01:15 | minus y sub 1 be equal to b. In this case, in this right triangle, our hypotenuse will be the value c. So now, let's interpret these values into the Pythagorean theorem and substitute in the absolute value of x sub 2 minus x sub 1. We're substituting that in for a. So that will be squared. |
| 00:01:34 | b will be the absolute value of y sub 2 minus y sub 1 squared. And that's equal to c squared. Let's solve for c. So we'll take the square root of both sides. So we have the square root of the absolute value of x sub 2 minus x sub 1 squared plus the absolute value of y sub 2 minus y sub 1 squared is equal to c. |
| 00:01:59 | Now, since the square of the absolute value will be positive, I don't need the absolute value bars. So let's drop those out in our final version. So the square root of x sub 2 minus x sub 1 squared plus y sub 2 minus y sub 1 squared. And that's equal to c. And this is your distance formula for points in the coordinate plane. |

**Section 10**

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| 00:00:00 | TEACHER: Let's take a look at this example. |
| 00:00:02 | We have the distance formula now. Let's see how it works. I've been given two points in the plane. And I want to find the distance between them. Which means first I need to construct a right triangle and find the lengths of those legs. OK. So remember that to find the distance of this leg here, I |
| 00:00:29 | need to find the absolute value of x sub 2 minus x sub 1. So what's x sub 2, and what's x sub 1 here? Well, let's name our point so we know what values are what. So this will be our x sub 2 and our y sub 2. And this will be our x sub 1 and our y sub 1. Please understand that I could've made the other point x sub 1, y sub 1 and the other point x sub 2, y sub 2. |
| 00:00:57 | Doesn't matter. You'll get the same answer. Let's continue. So, what is my x sub 2? Well, that is 3. And what is my x sub 1? That is negative 4. OK. |
| 00:01:10 | Well, 3 minus a minus 4 is really 3 plus 4. And 3 plus 4 is 7. And the absolute value of 7 is 7. And that distance there is the distance of that leg. OK. Now, what about my vertical distance? That is the absolute value of y sub 2 minus y sub 1. So what is y sub 2? y sub 2 is 4. |
| 00:01:40 | y sub 1 is 1. 4 minus 1 is 3. The absolute value of 3 is 3. And that distance is the distance of that leg. Now I know the length of these legs, I should be able to find the length of that blue line somehow, right? OK. Let's find the distance. |
| 00:02:03 | In this example, we have our side lengths that we already found. And what I want to do, however, is I want to put in the points to the distance formula and see what I get over there and see if it matches up with our side lengths, and then eventually find the distance. So, if I'm using the distance formula, I need to know what x2, y2 is. |
| 00:02:28 | I need to know what x1, y1 is. Well, we said that this was x2, y2 and this is x1, y1. OK. Now let's come over to the distance formula and put in our values. So x2 is 3, and x1 is negative 4. OK. y2 is 4, and y1 is 1. |
| 00:03:00 | OK. And that's squared as well. So let's simplify a little bit. So the 3 minus a minus 4 was just 3 plus 4. And that was just 7, right. So I just got the 7 squared. 4 minus 1 is 3. And that's just going to be 3 squared. |
| 00:03:19 | Notice, my 7 and my 3 for the distances were the same ones that we found, right. Let's continue with the distance formula. So we're going to get 7 squared is 49. And 3 squared is 9. And if I'm adding those two together-- this is our distance so we don't forget-- 49 plus 9 is 58. |
| 00:03:50 | So we have the square root of 58. And I'm going to take an approximate value on this. So you take out your calculator. And you're going to do square root of 58. And what are we going to get? We're going to get that our distance here is approximately 7.62. And we're all finished. |

**Section 12**

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| 00:00:00 | TEACHER: Now let's see if we can use our distance formula, |
| 00:00:03 | maybe without seeing a coordinate system. All we need is two points, right? So we want to find the distance between the origin-- that's a point-- and 3, negative 5. So here are the points we're working with. And 3, negative 5. Now since I'm using the distance formula, I need to |
| 00:00:26 | say what is x1, y1? What is x2, y2. So I'm going to make this one x2, y2. And this one x1, y1. You could have reversed that if you wanted to. You'll get the same answer. So now let's put these values in our distance formula. So d equals what in our example? |
| 00:00:50 | Well x2 is 3 and we're subtracting x1, squaring. y2 is negative 5 and we're subtracting y1, which is 0 and we're squaring. Let's simplify this. So our distance is 3 minus 0 is just 3, right? So we're going to get 3 squared. Negative 5 minus 0 is just negative 5. So we're going to get the negative 5 squared. |
| 00:01:22 | Continuing. So 3 squared is 9 plus. So we have negative 5. So I have to include the negative when I square it. So it's a negative 5 times negative 5, which is going to give me a positive 25. And 9 plus 25 is 34, square root of 34. And I'm going to take an approximate value on this so |
| 00:01:54 | with our calculators out again and we're going to do the square root of 34. So we find that d is approximately 5.83. So the distance between those two points is approximately 5.83. |