

## Module 5: Triangle Relationships

### Topic 2 Content: Triangle Existence Transcript

Hi guys. Welcome to Geometry. This lesson is going to focus on triangle existence. Your knowledge of line segments and adding their lengths is going to come in handy during this lesson. You ready to get started? Let's go.

Okay. You may think that any three lengths, or any three line segments, could be put together to form a triangle. You might think that, or you might not. Who knows, really, for sure. What I'm going to show you here is what actually has to happen with the relationship between those line segments have to be in order for them to come together to form a triangle.

Take a look at this first figure, which we can tell, obviously it's not a triangle. If you look at the two shorter sides in this triangle, you see they're not long enough to come together to meet to form that third vertex in the triangle. Now, take a look at this triangle on the right side. See how on this one, those sides are actually long enough to meet to form the third vertex of the triangle.

There's a special relationship that has to exist between the shorter sides in a triangle, speaking in a shortcut kind of way, but really between all the sides in the triangle, in order for a triangle to exist. Let me show you what that is. It's known as the Triangle Inequality Theorem, that explains it, and it's this. The sum of the lengths of any two sides of a triangle must be greater than the third side. If the sum of the lengths of any two sides is not greater than that third side, that means that you're not going to be able to create a triangle with those lengths.

Let me show you what I mean on the next example. Here, we've been given three lengths: 9 inches, 8 inches, and 10 inches, and we're asked, "Will these three lengths form a triangle?" What we need to figure out is if we add any two sides in the triangle, will it always be greater than the third side, than the side we're leaving out, or the length we're leaving out? Okay, so let's check it out here. We have 9 inches and 8 inches. 9 plus 8 is 17, and 17 is greater than 10, than that third side that we left out, so the first case works, so far.

Let's try another pair. Let's take 8 and 10 this time. 8 plus 10, that's 18, and 18 is greater than 9, so the second case works. So far, we're looking good. Now, let's take the final combination, 9 inches and 10 inches. 9 plus 10, that's 19. 19 is greater than 8, so yes. All three combinations worked. Any pair of sides, any pair of lengths that we added together was always greater than that third length. That means that these three lengths will form a triangle.

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I showed you kind of the long way, because I'm showing you every single combination that you could put together, but a shortcut way is, you could just take the two shortest sides. If your two shorter sides, if those lengths, add up to be greater than that third length, then that means that your three lengths have to form a triangle, because you've taken that really important case. If those two shorter sides won't work, when you sum those or add those together, if they're not greater than that third side, then you definitely know you don't have lengths that will form a triangle. You could work out all the combinations, just to verify, or you could take just those two smallest lengths.

All right, let me show you what I mean on this one, on the next example. Okay. Here, given another set of three lengths: 5 cm, 6 cm, and 11 cm. I'm going to take the two smallest lengths this time: 5 and 6. 5 plus 6 is 11, and 11, is it greater than 11? It's not. I can tell right now, from my two shortest lengths, that these three sides will not form a triangle. I can tell that right away, just from taking the two smallest sides.

If you wanted to check the other sides, you still could. In this case, I believe those are the two cases that work. Let's see here. 6 plus 11, that's 17, and 17 is greater than 5. That case worked. 5 plus 11, that's 16, and 16 is greater than 6. Those other two cases actually worked, but if you use that shortcut, if you just take those two smallest lengths, add those up, and see if they're greater than the third one, you can tell right there if those lengths will form a triangle. Because we had one case that failed, this one's a no. These three lengths will not form a triangle.

All right, it's your turn. I've given you a couple of examples here to try. You've got a couple of choices. You could use the shortcut, and just take those two smallest lengths, and figure out from there, will you be able to form a triangle, or you can try all three cases, all combinations of lengths, and tell will you be able to form a triangle that way. Okay? Completely up to you. You've got the option. Press pause, take a few minutes, and work your way through this one. Press play when you're ready to check your answer.

Okay, let's see how these turned out. For *a*, let's reveal what that was. That's a no. Those three lengths will not form a triangle. Now, *b*, that's a yes. Those three lengths will form a triangle. All right, let me show you how I got that, and I'll show you both ways, the shortcut, or if you tried all the combinations. All right, here if I tried the shortcut, I would add the two smallest lengths, and see, are they going to be greater than that third length. 4 plus 3 is 7. Is 7 greater than 10? Uh-uh, it's not. You can tell right there, these won't form a triangle, these lengths.

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Now, if you tried all the cases, then you would have found that this was the case that didn't work, but the other combinations, those did work. You saw, okay, 4 plus 10 was 14, and 14 was greater than 3. You saw 10 plus 3 was 13, and 13 was greater than 4, but it just takes one case to give you a no from the whole problem. We had here our shortcut example, when we tried the two smallest lengths, those did not work. These three lengths will not form a triangle.

Okay, now let me show you part *B*, how I got that one. I'll show you the shortcut first, if you take the two smallest lengths. In this case, 5 meters and 10 meters. 5 plus 10 is 15, and 15 is greater than 12. I can tell now, yes, these lengths will form a triangle, because I've taken the two smallest ones, and they work out okay. When I find out the sum of the two smallest lengths, they're greater than the third length.

If you did try all the cases, just to verify completely, then you also would have had 12 plus 5, which is 17, and 17 is greater than 10. So far, that's working out, and 12 plus 10, which is 22, and 22 is greater than 5. Either way, whether you used the shortcut or you tried all 3 cases, you would see on this one, these three lengths will form a triangle. All right?

Okay, you've reached the conclusion this lesson of triangle existence. I hope you saw how your use of the Triangle Inequality Theorem helped you get through this lesson. Bye.