# Module 4: Symmetry and Transformations
## Topic 2 Content: Reflections Transcript

Hi guys. Welcome to Geometry. This topic's going to focus on reflections. I know you've touched on this before in middle school and maybe even a little before that. This time in Geometry, we're going to make our way to the coordinate plane. You ready to get started? Let's go.

Okay, just to jog your memory about reflections. I'm sure you've learned at some point back in middle school or even elementary school that a reflection is a flip. Basically, you can see here I've got a little diagram here. The pre-image, that's your original location and the image is where you land. Your pre-image here, the semicircle flipped and landed here so it's upside down.

A reflection is an isomorphic transformation. What that means, is that a transformation means you're changing a figure in some way. You're changing its size, its shape, or its position. Isomorphic means that its size and its shape stay the same; it's just the position of the figure that changes. That's true about a reflection. The size of our figure will stay the same. The shape of it will stay the same. It's only the position of it, or the location of it that's going to change.

Let's take that background knowledge on reflections and let's look at this first example. Reflect triangle $ABC$ across the $y$-axis. My $y$-axis here, that's our line of reflection. That's the line that we're going to be reflecting across. I'm actually going to trace over it in red. Forgive me if it's not perfectly straight although that's not too bad right there. That's our line of reflection, the line we're going to reflect across.

What that means to us is that when I reflect triangle $ABC$, it's going to be the same distance apart from my $y$-axis, but just on the opposite side of it. That's what that means. Here we go, watch how we can do this. You just want to take every point, I'll start with $B$ here. Right now, $B$ is 1, 2, 3, it's 3 units away from the $y$-axis on the left. I need a mirror image of that. 1, 2, 3, 3 units away but now on the right. That's $B$ prime.

Let's count out $A$. Right now $A$ is 1, 2, 3, 4, 5 units away on the left so 1, 2, 3, 4, 5 units away but now I'm on the right. Then for $C$. Right now I'm 1, 2, 3, 4 units away but on the left side of the $y$-axis so 1, 2, 3, 4 units away but on the right side, $C$ prime. Now I'll freehand, actually close up this triangle, and there you go.

You can actually imagine if you can visualize folding the coordinate plane, those triangles will lay right on top of one another if you just folded it up right along the $y$-axis. Like I said, the $y$-axis here, that's our line of reflection. Keep that in mind and I want you to try this one, let me move that out of your way.

Now I want you to graph the image of this triangle across the line $x = 3$. Now to give you a little hint, if you don't remember from Algebra I, the line $x = 3$ that's a vertical line that passes through 3 on the $x$-axis so that's your line of reflection. Go ahead and press "pause" and take a few minutes to graph that image.

Let's see how you did. First thing I'm going to do is graph my line of reflection, so 1, 2, 3 get as straight as a vertical line as we can. Not too bad 'til the end. Now I'm going to count out how far away from my line of reflection $x = 3$. All of my points are, and I need to make sure they're that same distance away, but on the opposite side of the line of reflection. $D$ right now is 2 units, but on the left side 2 units away so 1, 2. 2 units away opposite side.

$E$ is one unit away on the left, so I'm going to need it one unit away on the right, so there is $E$ prime. F 1, 2, 3 units away so 1, 2, 3 units away. Here's $F$ prime. I'm going to close this triangle up and there you go. If you could visualize folding the coordinate plane along that line of reflection, those triangles would meet. They would overlap each other perfectly. Good job on that.

Take a look at this one. Still working with reflections, but a different line here. Does the graph show the reflection of triangle LMN across the line y=-x? That's a different line here, it's not vertical, it's not horizontal. It actually looks like this, take a look. It's this diagonal line.

You could visualize, like we said, a reflection is a flip across a line or if you could imagine folding the coordinate plane. If you could visualize folding this, those triangles would overlap each other perfectly. Now, if you don't want to visualize it, or you want to verify that folding that we did, that virtual folding, I want to show you how to get this answer algebraically.

Remember, this is the line $y = -x$. What I want to show you first, let's get the coordinates of each of the vertices or each vertex of triangle $NLM$. Let's see, $N$ is at negative 1, 2, 3, 1. Negative 3, 1. $L$ is at negative 1, 2, 3, 4, no. 1, 2, 3, 4 that's right, negative 4 negative 1. $M$ is at negative 1, 2 negative 1. Negative 2, negative 1.

Now what I'm going to do is I'm going to algebraically figure out what the image, what the coordinates of my image the vertices of this triangle should be. Take a look at this equation $y = -x$ or I could think about that is as $y$ equals the opposite of $x$. Really, that also means that $x$ should equal the opposite of $y$. If I can verify that for my image $N$ prime, $L$ prime, and $M$ prime. If I can verify that those coordinates had that relationship to this triangle, then I can also verify that this was a reflection across $y = -x$.

I really think you need to see that, so let me show you what I mean. Here we go. $N$ is at negative 3, 1 so for $N$ prime let's switch colors here. Let's go to black. For $N$ prime, $x$ should be the opposite of $y$ so $y$ is 1, so $x$ should be negative 1 and $y$ should be the opposite of $x$. Negative 3, it should be positive 3.

Let's get $L$ prime. $X$ should be the opposite of $y$, so the opposite of $y$, that'd be positive 1, and $y$ should be the opposite of $x$ so that means it should be a positive 4. Let's get $M$ prime. $X$ should be the opposite of $y$, so $y$ is negative 1, should be positive 1 and $y$ should be the opposite of $x$ so that means $y$ should be positive 2.

Now let's verify since we figured out algebraically what those coordinates should be. Let's verify that they actually were that, so is $N$ prime at negative 1, 3? Yes it is. Is $L$ prime at 1, 4? 1, 1, 2, 3, 4 yes it is. Is $M$ prime at 1, 2? 1, 1, 2, yes it is. You verified algebraically that this was actually a reflection across $y = -x$.

Take that knowledge and I want you to try this one. This time you're verifying that this is a reflection across $y = x$. You can visualize it. You can graph that line and visualize that folding, or verify it algebraically. When you're ready to check, press "play."

Let's see how you did. Let's take a look at what that line looks like, $y = x$. You could visualize that if you were to fold this coordinate plane along that line of reflection, these triangles would overlap each other perfectly. If you don't want to take that route, which I suggest that you could use that route to start but it's a good idea to verify it algebraically and this is what you need to do.

Let's get that red ink. Here's the line $y = x$. What that means, is that after I get these points I know that $y$ should equal $x$ in the same way $x$ should equal $y$. I'm going to get the coordinates of each of these vertices on my pre-image, and then I'm going to see what happened for the coordinates on the image.

$L$ is at 1, 2, 3, 0. Let's switch to blue so it doesn't get too harsh on our eyes 3, 0. $M$ is at 1, 2, 3, 4, 5, 1 and $N$ is at 1, 2, 3, 1, 2. There are my coordinates and I'm going to see what the coordinates should be for the image. $L$ prime, $x$ should equal $y$ and $y$ should equal $x$. Essentially your $x$ and your $y$ are switching positions. They're swapping places in this ordered pair, so $L$ prime should be 0, 3.

$N$ prime is instead of 3, 2 where $N$ started, 2, 3 and then $M$ prime switch those around so 1, 5. Now let's just verify that that's what actually happened here. Is $L$ at 0, 3? Yes it is. Is $N$ at

2, 3? 1, 2, 1, 2, 3 yes it is. Is $M$ at 1, 5? 1, 1, 2, 3, 4, 5 yes it is. That means that this was a reflection across the line $y = x$.

You've reached the conclusion of this lesson in Geometry. I hope you saw how your prior knowledge of reflections made its way to this course. Bye.