

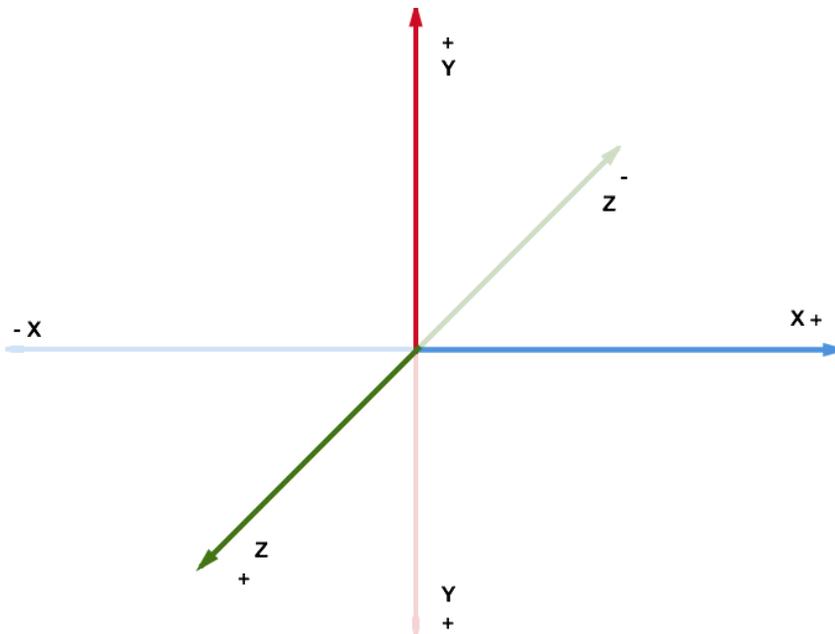
Coordinate Plane

Corresponding Material

Your First VR World, Lesson 2

Discussion

Shapes in a virtual reality environment must be placed using their 3D coordinates. Coordinates in 3D are similar to a Cartesian plane. In addition to the x-axis and y-axis, there is now a z-axis.

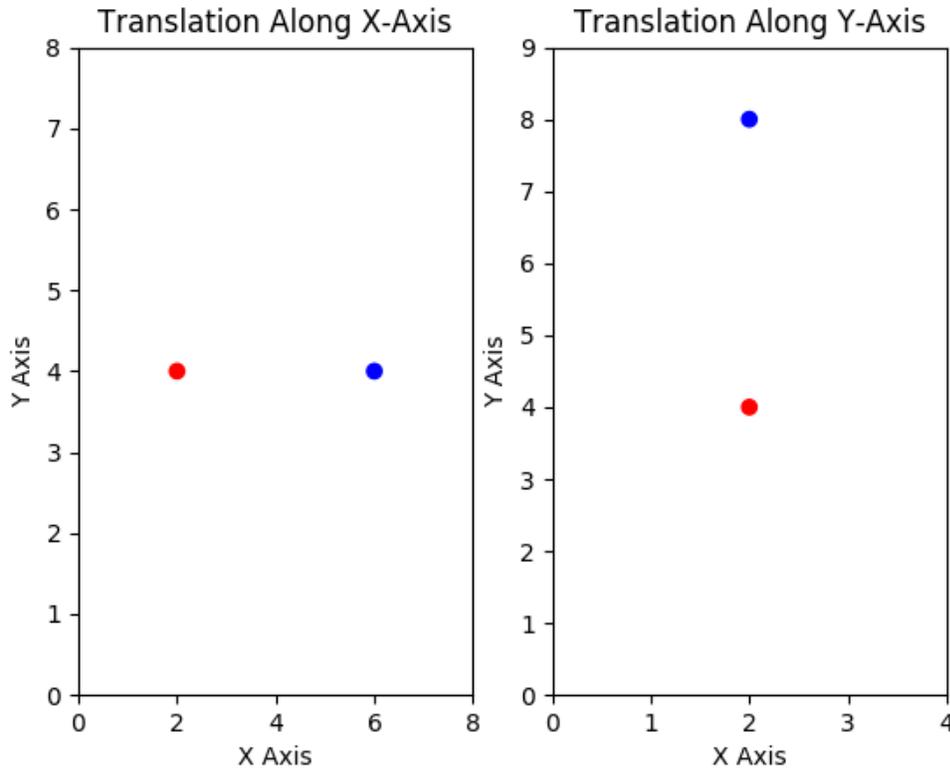


As you can see, the x-axis runs horizontally, the y-axis runs vertically, and the z-axis comes straight out of the page. In your VR worlds, this means the x-coordinate will control how far left or right an object is. The y-coordinate will control how far up or down an object is. The z-coordinate will control how far away or how close an object is.

Example

A *translation* is moving a point from one location to another. The plots below show a translation along the x-axis and a translation along the y-axis. A translation along the x-axis means we've changed the x-coordinate, and left the y-coordinate the same. The red point has

been moved from $(2, 4)$ to $(6, 4)$. In the right plot, the red point has been moved from $(2, 4)$ to $(2, 8)$.



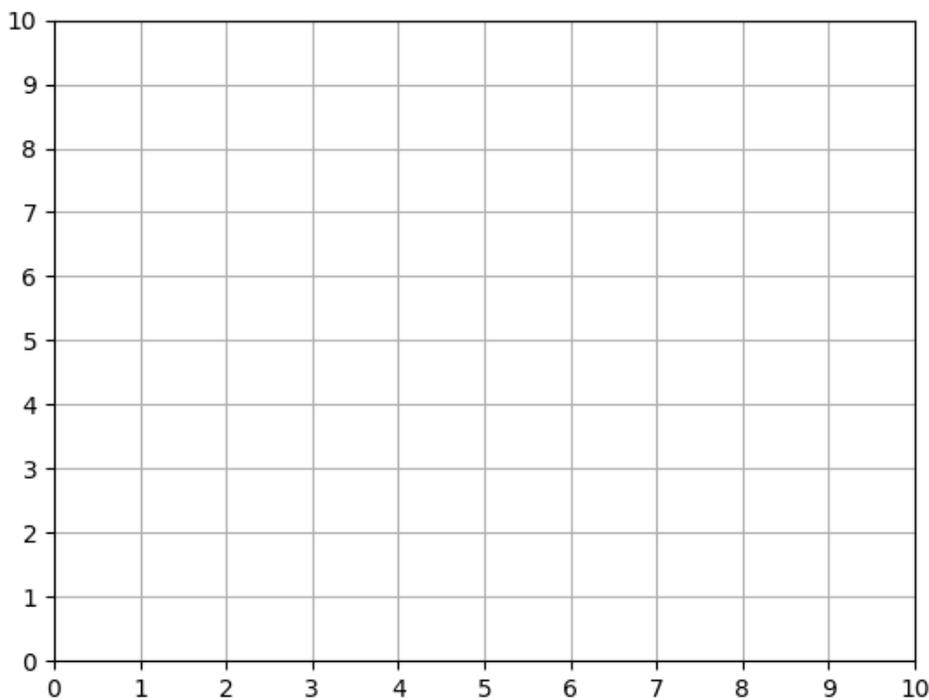
Take a careful look at what we've done to accomplish this. To move the point to the right, we added 4 to the x-coordinate. To move the point up, we added 4 to the y-coordinate.

1. How would you move a point to the left by 6 units?
2. How would you move a point down by 2 units?
3. How would you move a point to the right by 4 units *and* down by 1 unit?
4. Extending this line of thinking to a 3D coordinate, how would you move a point to be closer to you? (*Hint: you can't do this in 2D.*)

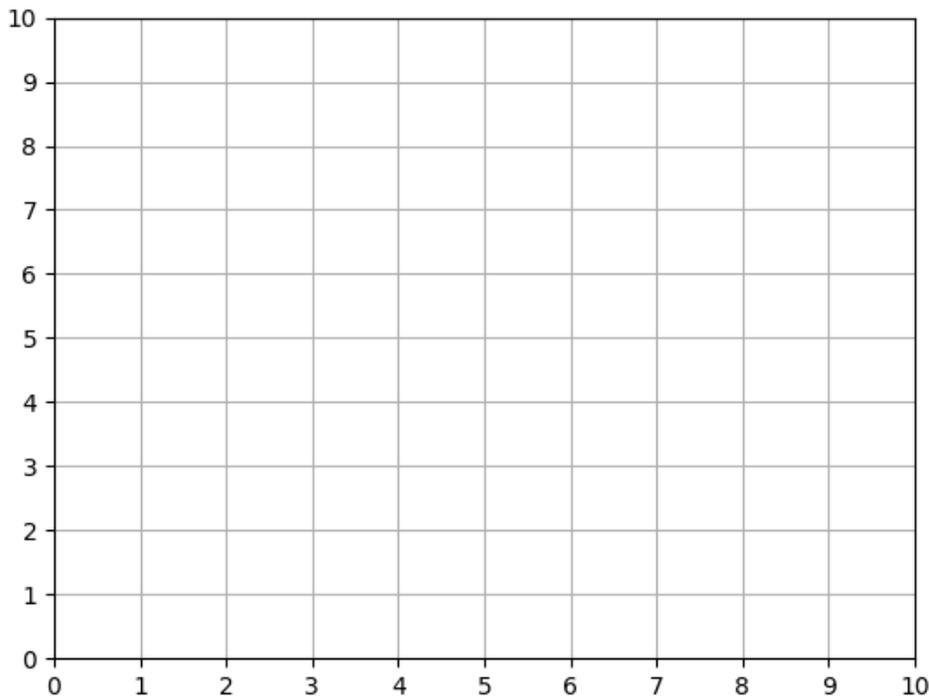
Exercise

Let's extend this idea even further. Instead of translating single points, you will be translating whole shapes. How do we translate a whole shape? By translating each vertex! For each of the questions below, first sketch the original triangle by plotting the points given. Then compute and plot the new position after translating the triangle as indicated.

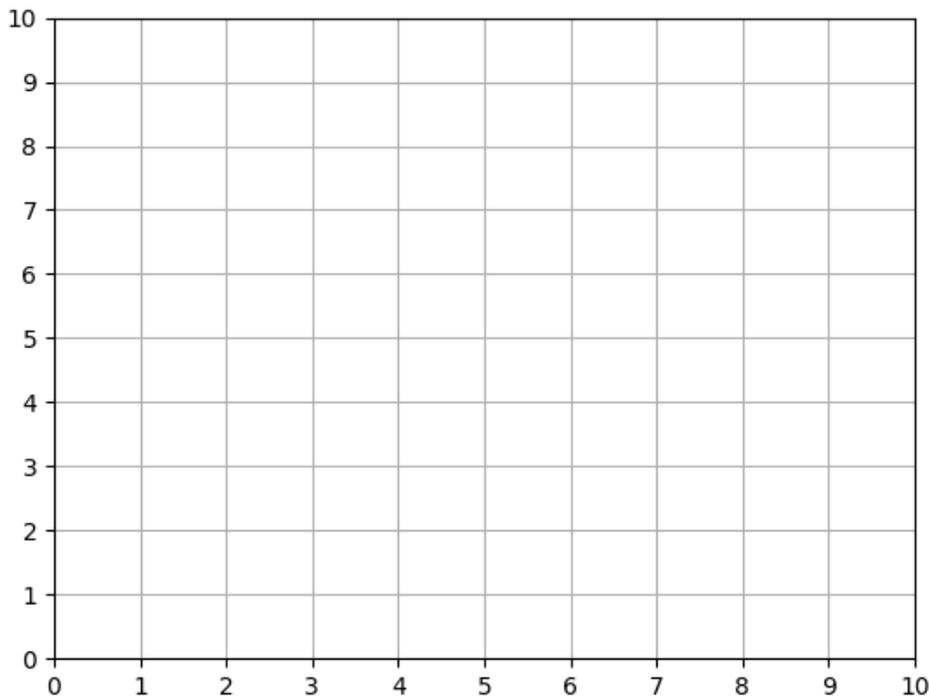
1. Triangle's vertices: $(1, 1)$, $(3, 5)$, $(5, 1)$. Translate the triangle 5 units to the right.



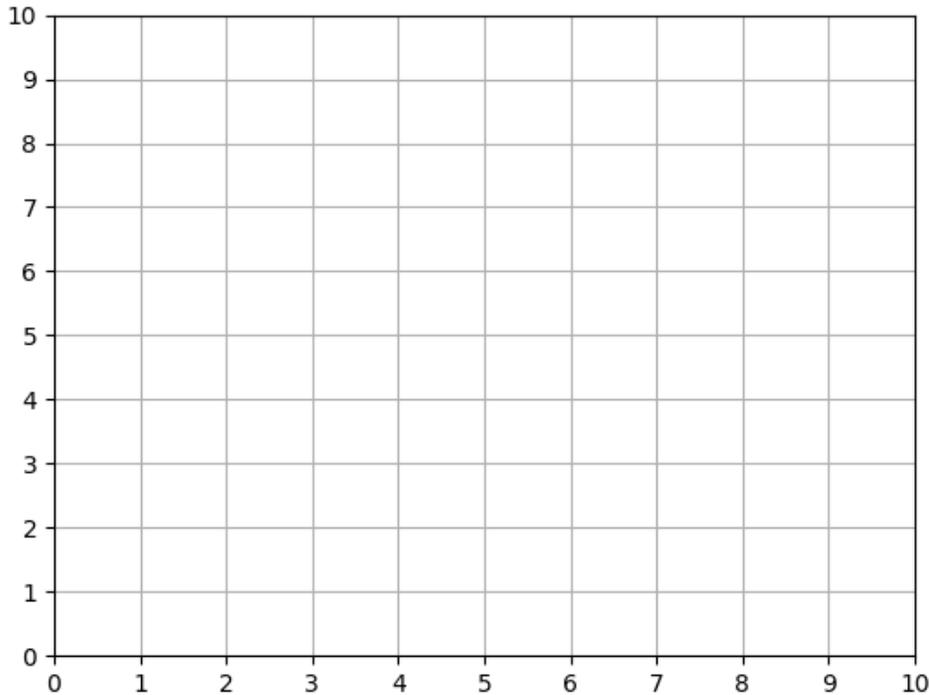
2. Triangle's vertices: $(3, 7)$, $(5, 7)$, $(5, 9)$. Translate the triangle 4 units down.



3. Triangle's vertices: $(0, 1)$, $(1, 4)$, $(2, 2)$. Translate the triangle to the right 4 units and up 2 units.



4. Triangle's vertices: $(3, 2)$, $(4, 5)$, $(6, 2)$. What are the coordinates to make another triangle that is centered on the current triangle's top vertex if the new triangle's base is 4 units long and 2 units high?



5. **Challenge** What would the coordinates be of a $1 \times 1 \times 1$ cube in 3D space if the front lower-left corner is placed at $(0, 0, 0)$ and the back top-right corner is placed at $(1, 1, 1)$?