PROBLEM STATEMENT

FIRST® needs you to design a path for a robot using only Cartesian coordinates to get from point A to point B. As a designer Cartesian coordinates are useful for planning paths for different planes of a design.

You will explore Cartesian coordinates and how they are used in everything from 3D printers to video games. Then you will design an object and make your robot draw out the path from A to B using only the Cartesian coordinates as instructions.

CRITERIA & CONSTRAINTS

- Choose a 3D object and turn it into a 2D drawing on a coordinate plane.
- Draw a sketch of your solution using the Cartesian Coordinate plane provided.
- Determine the some of the coordinate points that intersect with that image.
- Use materials to layout a grid using tape, chalk, paper, or other materials.
- Create a program for your robot to get from point A to point B using only coordinates.
- The robot must cross over the y axis to get from point A to point B.
- A diagonal line through (0,0) is not allowed.
- Provide the coordinates used to get from A to B

## ENGINEERING DESIGN PROCESS & *FIRST* CORE VALUES

FIRST Engineering Design Process | Explore *FIRST* Core Values

BUILDING THE BACKGROUND & BRAINSTORMING

- Watch Understanding Cartesian Coordinates
- Consider Cartesian Coordinates and how they affect technology and many different things today.
- Read the article on how 3D printers rely on Cartesian Coordinates.

Designing directions that use Cartesian Coordinates can be important. 3D printers have code called G-Code that allows them to print on specific paths using Cartesian Coordinates. And video games use Cartesian Coordinates in 3 dimensions and 2 dimensions which is what allows game objects to move from one position to another. Using an objects dimension on specific coordinates is the basis for Computer Aided Design.

PRACTICE APPLYING CARTESIAN COORIDINATES
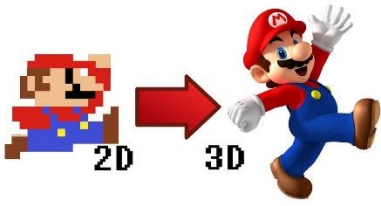
Find an object that you can find around your house. It can be a block, or any other household item. It will be your robot for you to use in your design challenge. Look at the object from a single angle and draw on the coordinate plane below. Draw it only from one angle to create a 2D drawing of the object. As you look at the object and draw the item from the top using cartesian coordinates this is your x, and y coordinates. Then look at the item from the side the x coordinate should be the same as your top drawing, but you will have a third coordinate which is the height this is the z coordinate.
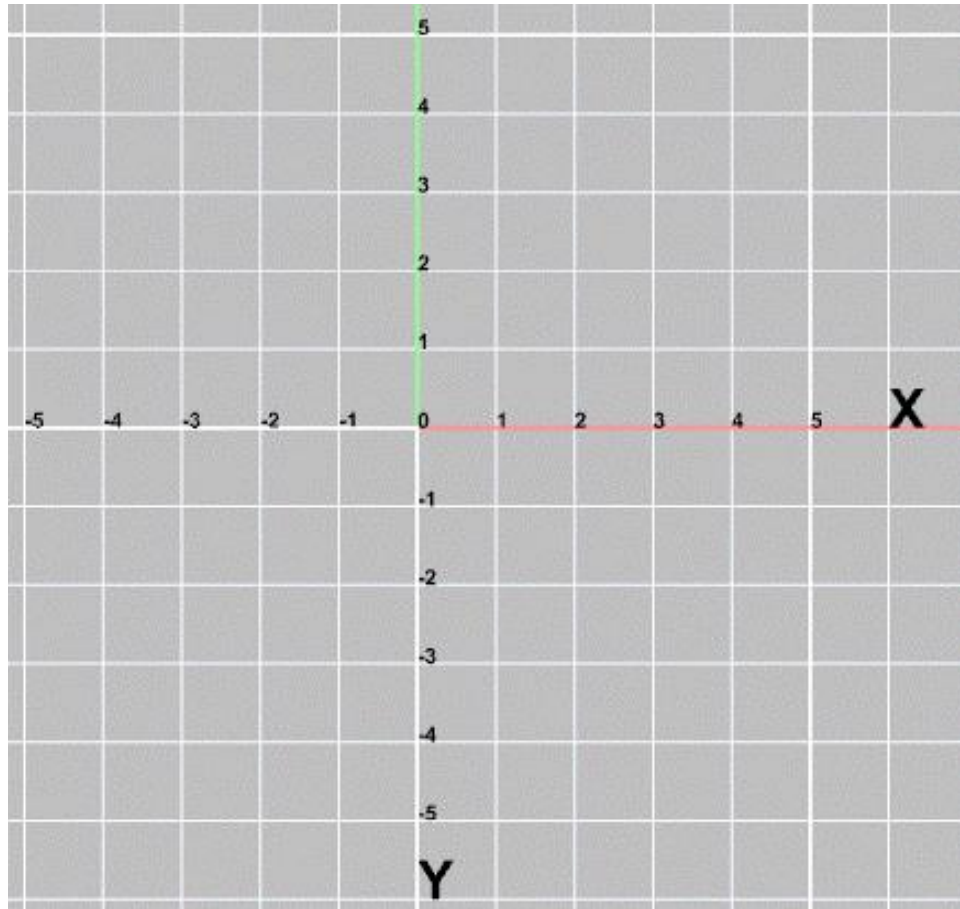

What type of drawing with the object be if you included the Z access in the drawing?

How does this relate to what you learned about how 3D printers work?

PROGRAMMING WITH CARTESIAN COORIDINATES
- Now you will have your robot move on a grid and get from point A to point B.
- Lay out an x y grid on your floor, driveway, or paper.
- Test out these coordinates before you get started using the grid below.
- Place markers at point A () and point B ()
- Decide how to get from point A () to point B () and write down the coordinates.
- How do different coordinates effect the path your robot travels?
- How could you use these coordinates to create your autonomous mode?

SKETCH YOUR DESIGN
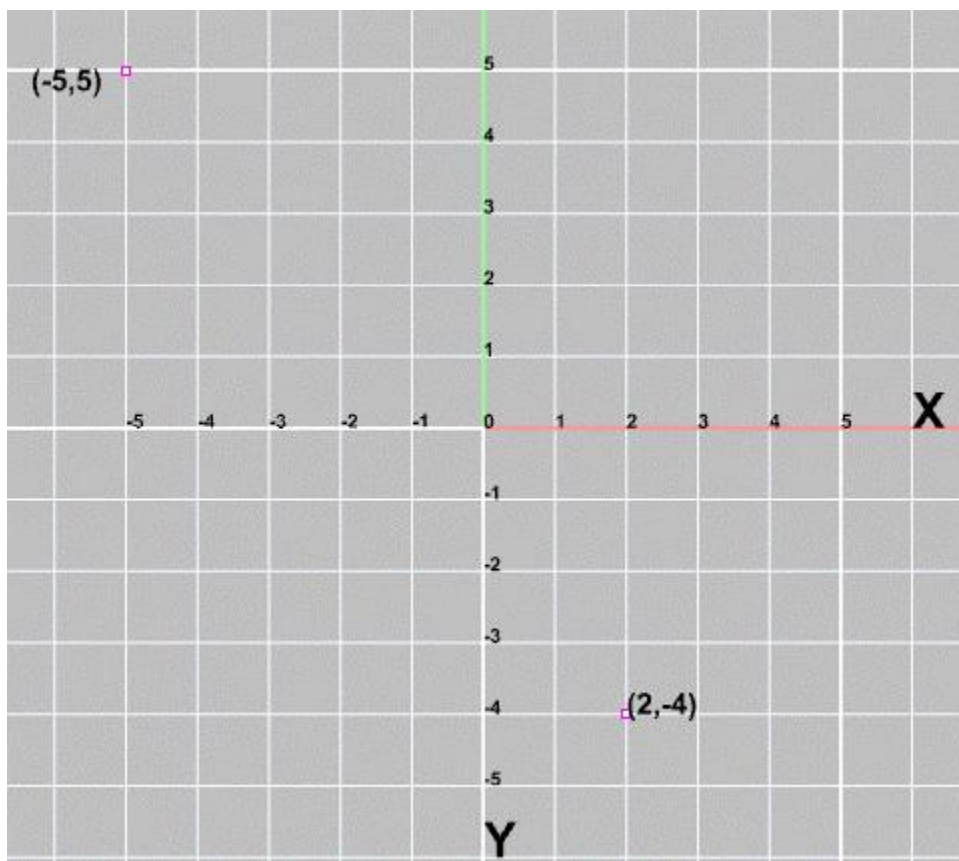
WRITE OUT THE COORDINATES

Take a picture of your grid along with the path your robot will take to get from point A to point B.

REFLECTION QUESTIONS

1. Does the Cartesian coordinate system give you a better understanding of planning a path or design?
2. Did you learn a new way to see the playing field?
3. What ways will the Cartesian coordinate system effect your future designs?
4. What skills did you use or learn in this activity?

GO FURTHER!

Choose a CAD program to practice layout using coordinates. Create a 2D shape using the Line tools and Cartesian coordinates. Send just the coordinates to a friend to create your design.

CORE VALUES SELF-REFLECTION

	Amazing Skill	Great Job	Making Progress	Could Be Better
Discover	I approached the tasks looking for all possible answers independently and used perseverance to discover the answer on my own.	I approached the tasks and asked questions from one other person but persevered to discover the answer on my own.	I approached tasks but needed assistance multiple times to reach a point of discovery.	I depended on others to make the discovery for me.
Innovation	I used creativity and perseverance to solve problems on my own, coming up with unique solutions for the tasks I was given.	I used creativity and perseverance to solve problems on my own coming up with different solutions for the tasks I was given.	I used creativity but struggled with perseverance to solve problems on my own.	I struggled with being creative and only used the information given and needed a lot of encouragement from others to complete the task.
Impact	I approached the tasks applying understanding of the information with the impact it can have on me and my future as well as how I could help others.	I approached the tasks knowing and applying the information with impact it can have on me and my future.	I understand the tasks but struggle to apply how it will help me in my future or to influence others.	I understand the tasks but did not approach it with understanding the impact it can have on my future or others.
Inclusion	I approached all tasks with inclusion of others' ideas, I showed tremendous kindness by including others' views in my projects and work. I approached my solution thinking how all people would interact with the solution.	I approached most with inclusion of others' ideas, I tried to understand others' views and include them in my projects and work. My solution mostly incorporates needs of others.	I approached some tasks with inclusion of others' ideas, I tried to understand others' views and include them in my projects and work. My solution meets only a few needs of others.	I did not approach tasks with inclusion of others' ideas, I tried to understand others' views and include them in my projects and work. My solution is not inclusive of different types of people.
Teamwork	I used collaboration, communication and project management to get all tasks accomplished for myself as well as the others.	I used collaboration, communication and project management to get most tasks accomplished for myself as well as the others.	I used collaboration, communication and project management to get some tasks accomplished for myself as well as the others.	I only sometimes used collaboration, communication and project management and accomplished a few tasks for myself as well as the others.
Fun	I kept a positive attitude throughout and found opportunities to have fun even through struggle. I looked for additional opportunities to have fun in my tasks.	I kept a positive attitude throughout and found opportunities to have fun even through struggle.	I saw the enjoyment and fun after the activity but struggled to see it during.	I only saw struggle in completing my tasks and did not look for times to have fun.