**Name:** **Date:** **Class:**

# Teacher Guide: Introduction to Cartesian Coordinates, Logic, and Robot Anatomy

**Teacher Script:** Introduction to Cartesian coordinates, logic, and robot anatomy (designed for classes without a robot; emphasizes math and conceptual understanding for future robotics work).

1. **Introduction**

   Today we are going to look at the math that makes robots work—even if we do not have a robot in front of us yet. When engineers design or program a robot, they rely on the same math you already know from algebra and geometry, especially Cartesian coordinates. Understanding coordinates helps us imagine where a robot is in space and how it needs to move.

2. **Review of Cartesian Coordinates (Math-Focused)**

   Let's start with what we already know. A Cartesian coordinate system is a way to describe any point in space using numbers. You are familiar with the x-axis and y-axis from graphing on paper. The x-axis runs left to right. The y-axis runs up and down.

   In robotics, we expand that into three dimensions by adding the z-axis, which represents movement up and down in 3D space. Every point in this 3D world can be described using three numbers: (x, y, z).

   Just like on a math graph, the point (0, 0, 0) is called the origin—that is the place where all three axes meet.

3. **Connecting Coordinates to Robotics (Concepts Only—No Robot Needed)**

   Now, imagine you are building your own DIY robot arm. Even if it is made of cardboard, LEGOs, or a 3D-printed frame, the robot still needs a way to 'understand' where it is.

   Robots use the same coordinate system you learned in math to describe:
   - Where they are
   - Where they need to move
   - How far they need to go

   For example:
   - If a robot needs to move to the right, that is a change in x.
   - If it needs to move forward, that is a change in y.
   - If it needs to lift its hand up, that is a change in z.

4. **Tool Center Point (TCP)** (Explained without requiring a physical robot)

   Robotics engineers use a reference point called the Tool Center Point, or TCP. You can think of the TCP as the 'finger' or 'tip' of the robot arm. It is the part that actually touches or interacts with objects.

   When a robot moves to a location such as (10, 5, 3), that movement describes where the TCP should end up. Even if students only sketch or simulate, it is crucial to think in terms of where the TCP is in space.

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5. **Brief Introduction to Robot Anatomy (Simple, Concept-Only)**
   Next, let's talk about basic robot anatomy. These terms will help you understand robot drawings, videos, and future coding tasks. Most robotic arms, whether in Amazon warehouses or on a DIY project, share a few key components:
   - Base: This is the robot's 'anchor - it stays still and supports everything else.
   - Joints: These are like your elbows or wrists - robots rotate or bend at joints to reach different positions.
   - Links: These are the straight parts between joints, like bones.
   - Gripper or End Effector: This is the tool at the end of the robot - it might grab, lift, pinch, hold, or even draw. The TCP is usually located right at this tool.

6. **Logic: The Brain Behind the Movement**
   Robots do not move randomly—they follow logic, which is a set of rules that tell the robot what to do.

   Logic helps the robot decide things such as the following:
   - 'If the object is on the left, move in the negative x direction.'
   - 'If the camera detects a red block, pick it up.'
   - 'If the gripper is open, close it.'

   Even simple decisions such as move, stop, pick up, and place are based on logical statements.

7. **Why Math Matters**
   The most important idea I want you to take away today is this: Math tells a robot WHERE to move. Logic tells it WHEN and WHY to move. You are learning the same math engineers use every day, including:
   - Plotting points.
   - Measuring distance.
   - Understanding positive and negative directions.
   - Thinking in 3D.

   These are the foundations of robotics—no robot required.