Summary:	Introduction to the 6-Axis Arm, is an eight Unit VEX CTE Workcell course designed to introduce students to industrial robotics. The course begins with an introduction to industrial robotics. Then students will learn to use a Teach Pendant in VEXcode EXP to control the movements of the 6-Axis Robotic Arm from the CTE Workcell Kit. They will use that Teach Pendant as they explore manual movements, jogging the 6-Axis Arm, and moving to specific positions. In the next unit, students will begin coding the 6-Axis Arm to move to specific locations using the (x,y,z) axes individually. In the following Units, students use the pen attachment and draw on the whiteboard in order to explore coding the 6-Axis Arm to move around obstacles and to move in all three axes simultaneously to reach a location. In the final units of this course, students will learn to pick and place cubes on pallets using the Magnet Pickup Tool, first in one layer, and then in stacks. Then they will apply everything they have learned throughout the course to complete a Capstone project using the engineering design process. The following Pacing Guide shows the VEX CTE Workcell STEM Lab Units from the Introduction to the 6-Axis Arm Course. Each week is based on five 50-minute class periods.

Time	STEM Lab	Description	Build Description	Key Concepts
1 week	Unit 1: Introduction to Industrial Robotics	Set up the VEX CTE Workcell, explore the Cartesian coordinate system, and learn about how robotic arms are used in industry.	Direct CTE 6-Axis Arm Base	Introduction to Factory Automation Cartesian Coordinate System Manual Movements
1 week	Unit 2: Using the Teach Pendant	Use the Teach Pendant to control the movement of the 6-Axis Robotic Arm as you pick up and place Disks on the CTE Tile.	No additional building	Teach Pendant Jogging the Arm End Effectors
1 week	Unit 3: Coding Movements	Use block-based coding to code the 6-Axis Robotic Arm to move along the x, y, and z-axes and combine those behaviors to move to locations on the CTE Tile.	No additional building	Introduction to Block-Based Coding Moving Along the X, Y, and Z-Axes
1 week	Unit 4: Controlling the Path	Code the VEX CTE Workcell to draw on the Whiteboard with the Pen and move around obstacles on the CTE Tile.	Direct CTE 6-Axis Arm Base + Whiteboard	End Effectors Path Controlled Movements Identifying Waypoints
1 week	Unit 5: Drawing Shapes	Explore how to code the 6-Axis Arm in all three axes by drawing shapes.	No additional building	End Effectors Using Comments Coding in 3D Space Using Multiple Axes
1 week	Unit 6: Absolute and Relative Movement	Learn how to code the 6-Axis Robotic Arm to use both absolute and relative movements to draw shapes. Then make more complex shapes and patterns by incorporating variables and Repeat loops.	No additional building	Absolute Movement Relative Movement Variables Repeat Loops
1 week	Unit 7: Transporting and Palletizing Objects	Learn to code the 6-Axis Robotic Arm to pick and place multiple Cubes on pallets using a fixed location in combination with relative movements. Incorporate variables and If then blocks into your projects.	Direct CTE 6-Axis Arm Base + Pallets	Relative Movement Variables Repeat Loops If then Blocks
1 week	Unit 8: Stacking Objects	Learn how to make a plan to complete a task, then code the 6-Axis Arm to place all nine Cubes on one pallet.	No additional building	Relative Movement Decomposition Project Planning
2 weeks	Capstone - Engineering Design Process	Apply the skills and concepts learned throughout the Course to code the 6-Axis Robotic Arm to pack orders onto pallets for shipping.	No additional building	All Course Concepts

Summary:	This is an eight Unit VEX CTE Workcell course designed as the second in the sequence of CTE Workcell curriculum. The course picks up where the previous course left off, and introduces students to the concept of a programmable logic controller (PLC). The Brain is used as the PLC to control the CTE Workcell throughout the course. Students move from controlling only the 6-Axis Arm to incorporating additional input and output devices, like sensors, motors, and pneumatics, to create more complex automated workcells. Throughout the course students will learn about the mechanisms and components that make up workcells, the real world connections to factory automation, and the computer science concepts that allow automated systems to function. Then they will apply everything they have learned throughout the course to complete a Capstone project using the engineering design process. The following Pacing Guide shows the VEX CTE Workcell STEM Lab Units from the Workcell Automation Course. Each week is based on five 50-minute class periods.

Time	STEM Lab	Description	Build Description	Key Concepts
1 week	Unit 1: Introduction to Workcells	Learn about factory automation and programmable logic controllers (PLC) and how those relate to the CTE Workcell. Use the Brain as the PLC to control the 6-Axis Arm and move Disks.	Brain CTE 6-Axis Arm Base	Introduction to Factory Automation Downloading and Running Projects on the Brain Coding Movements of the 6-Axis Arm
1 week	Unit 2: Workcell Safety	Explore workplace safety in industrial robotics settings, and how the Signal Tower functions as a safety mechanism on the CTE Workcell.	No additional building	Workplace Safety Controlled Stops
1 week	Unit 3: Sorting by Color	Add the Optical Sensor and learn about how to code the 6-Axis Robotic Arm to sort Disks by color.	Brain CTE 6-Axis Arm Base + Optical	Sensors Coding the Optical Sensor Using Nested Conditional Statements
1 week	Unit 4: Material Transportation	Automate object movement around the CTE Workcell by adding conveyors. Code the motors to transport a Disk on the conveyors and code the Object Sensor to stop the Exit Conveyor when a Disk is detected.	CTE Workcell Base	Conveyors Coding Conveyor Motors Using Time Based Movements Coding the Object Sensor
1 week	Unit 5: Introduction to Pneumatics	Learn about the purpose and components of pneumatic systems within the manufacturing industry, and build a pneumatic system using the CTE Workcell Kit.	CTE Workcell Base + Pneumatics	Pneumatic System Components Diagramming Pneumatics Air Flow Building a Pneumatic System
1 week	Unit 6: Automated Sorting Challenge	Apply your learning to an open-ended challenge in a real world product distribution scenario. Code the CTE Workcell to sort products to two different Loading Docks to fulfill a Shipping Manifest.	CTE Workcell Base + Pneumatics	Coding Conveyor Motors Coding Pneumatics Collaborative Problem Solving
1 week	Unit 7: Pallet Loading Challenge	Build on the previous challenge as you incorporate the 6-Axis Robotic Arm and Distance Sensor to sort products to three Loading Docks. Iterate to fulfill the Shipping Manifest as quickly and accurately as possible.	CTE Workcell Base + Pneumatics + Distance	Coding the Distance Sensor Coding Conveyor Motors Using Time Based Movements Coding Movements of the 6-Axis Arm Project Planning and Pseudocode Collaborative Problem Solving
1 week	Unit 8: Optical Sorting Challenge	Expand on the previous challenges to sort products in any order. Incorporate the Optical Sensor into the CTE Workcell so that you can sort products by color to three different Loading Docks.	Complete CTE Workcell	Sensors Coding the Optical Sensor Using Nested Conditional Statements Project Planning and Pseudocode Collaborative Problem Solving
2 weeks	Capstone: Logistics Sorting Challenge	Apply everything you have learned in your biggest real-world open-ended challenge yet! Fulfill a Shipping Manifest with three types of products from two areas. Sort the products to three Loading Docks as quickly and accurately as possible.	Complete CTE Workcell	All Course Concepts
2 weeks	Extension: Double Dock Challenge	Work together with a partner team to use two CTE Workcells collaboratively. Fulfill a Shipping Manifest to send, receive, and sort products across both systems as quickly and accurately as possible.	Connecting Multiple CTE Workcells	All Course Concepts