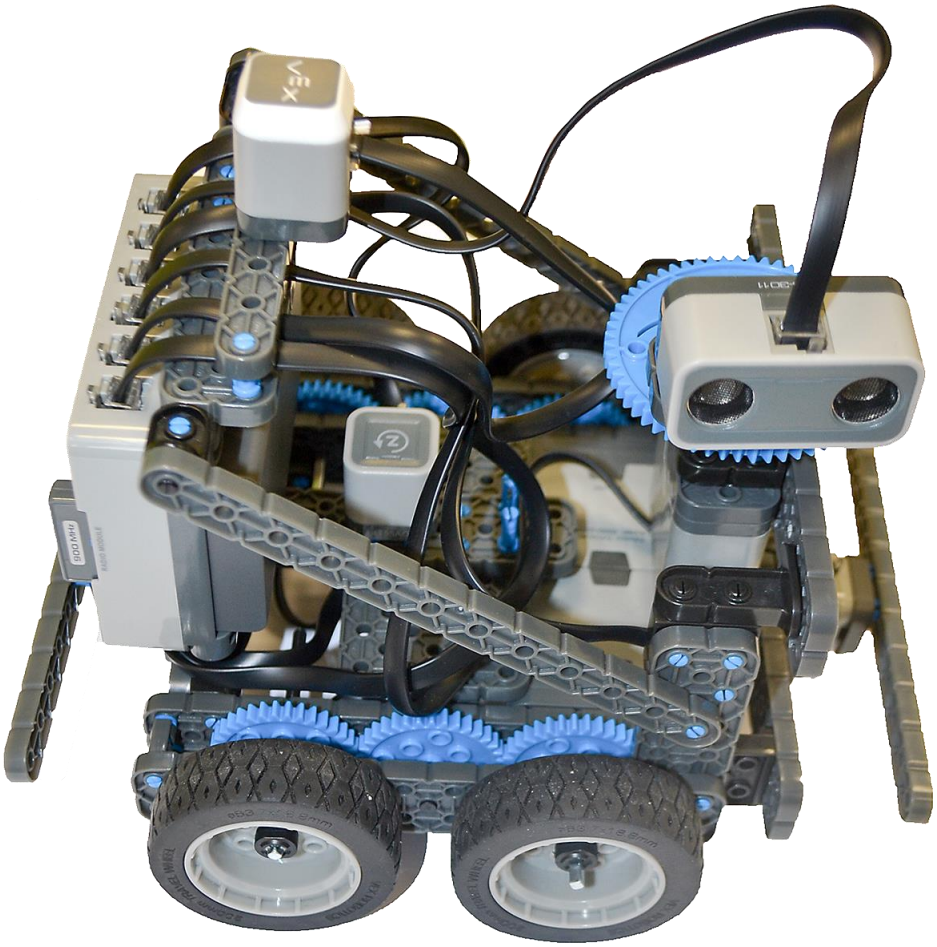
Exploring Robotics with VEX IQ

COURSE OUTLINE



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Week 1: Introduction

Lesson No.	Lesson Name	New Concepts	New Commands	Mission Statement
1	Course Introduction	Safety Guidelines Product Care Guidelines		Welcome to Exploring Robotics with VEX IQ. In this lesson you will be taken on a tour of the course, you'll learn how to work in LearnMate, and review safety guidelines.
2	What are Robots?	Definition of a robot Robot sub-systems: Controller, movement, sensing		Welcome to your first lesson at InteliTank Boot Camp. By the end of today you will be able to answer the question: What is a robot?
3	Driving the Model	Types of Gamepad control (Tank/Arcade) Movement system Gear system		Today you will learn about InteliTank's movement system. You will also practice controlling InteliTank by remote control.
4	Natural and Programming Languages	Natural and artificial languages Algorithms Programming		After today's lesson the terms program, programming language, and algorithm will all mean a lot more to you.
5	Introduction to easyC	The easyC interface Writing the Hello World program	Print String	Today is the final lesson before you receive your first mission. In this lesson you will be introduced to easyC, the programming environment in which you will write programs for InteliTank.

Week 2: Basic Motion

Lesson No.	Lesson Name	Concepts	New Commands	Mission Statement
1	Setting Motor Speed	Movement by setting motor speed Limiting distance traveled by setting a wait period Stopping motors	Motor Control Wait	You've discovered a very narrow tunnel running into one of the Moon's mountains, too narrow for you to enter. You'll need to program InteliTank to drive perfectly straight for five seconds into the tunnel to explore its contents.
2	Setting Motor Time	Movement by setting time to travel Reverse motion	Motor Go Time	Your previous mission was a success! Almost. InteliTank had to be retrieved from the tunnel. Your mission is to program InteliTank to drive forward into the tunnel, spend some time inside, and then reverse out automatically.
3	Setting Motor Rotations	Movement by setting rotations Distance to Rotations conversion Circle circumference	Motor Go Rotations	InteliTank will be used to take soil samples for analysis. Samples will be taken every three feet along a straight path. Your mission is to program InteliTank to travel exactly three feet forward.

4	Model Rotation and Turning	Turning a corner		In preparation for future more complex missions, your commanders are concerned about the InteliTank's agility. You've proven its ability to move in straight lines. Now prove its ability to turn corners.
5	Review and Challenge	Programming the model to travel a predefined route including pauses and right turns		When not exploring the great outdoors on the Moon, InteliTank will have to navigate the complex corridors of your base station. Your mission is to program InteliTank to drive from one end of the main corridor to the other.

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Week 3: Loops and Variables

Lesson No.	Lesson Name	Concepts	New Commands	Mission Statement
1	Forever Loops	Loops Repeat commands in a Forever loop	Forever	Previously you programmed InteliTank to move forward three feet to take a soil sample. The astronaut who had to rerun the program for every new sample has asked you to make InteliTank move forward three feet, pause, and then repeat those actions until the program is stopped manually.
2	Repeat Loops	Repeat commands in a Repeat loop	Repeat	Straight lines, turns, and loops – InteliTank has mastered them all. Now InteliTank has to explore a rectangular path, starting and ending at base camp. How efficiently can you program that path?
3	Variables	Variables Constants Program efficiency	Variables	Previously you programmed InteliTank to explore a rectangular path. Today, InteliTank will have to explore triangular paths. There is one twist though: you need to be able to adjust the size of the triangle traveled easily.

4	Changing Variables	Changing variable values within the program	Assignment	InteliTank is going to spend the day taking soil samples every eight inches along a straight path. Each sample has to be returned to base camp before the next sample can be taken. Each journey will thus be eight inches longer. This will require some smart programming.
5	Conclusion and Challenge			The scientists back on Earth want InteliTank to be able to travel along a wider range of path types. Triangles, squares, pentagons, hexagons and so on could all be useful. Can you write a program that could do it all?

Week 4: Conditional Programming

Lesson No.	Lesson Name	Concepts	New Commands	Mission Statement
1	Writing to the LCD	Displaying text messages and variable values on the LCD screen	Print String Clear LCD Print Line	Today InteliTank will have to travel from base camp towards a massive rock. The astronaut accompanying InteliTank will read off the distance traveled from the LCD screen.
2	Introducing Sensors	What are sensors? Why are sensors needed? Inputs & Outputs The Bumper Switch Writing sensed value to variables	Get Bumper Pressed, While	InteliTank successfully reached the massive rock, and the astronaut was able to read the distance traveled. However, InteliTank drove directly into the rock, and the astronaut also complained that the motors continued running after InteliTank was picked up. Improve the program so that InteliTank will stop gently at the rock, and the motors will stop on their own.

3	Programming Conditions	Conditions and branching Program behavior varies depending on inputs	If	Ground Control would like InteliTank to be able to explore on its own. The first problem they have indentified is that InteliTank will often drive into rocks, and will then have to be manually repositioned. Today they'd like to see InteliTank reverse automatically after hitting an object.
4	Programming Multiple Conditions	Specifying multiple conditions and multiple program reactions	Else-if	Last time InteliTank learned to reverse if it hit an obstacle. During testing though, InteliTank would often hit another obstacle while reversing and would then get stuck. Improve the program so that InteliTank will change direction whenever it hits an obstacle at the front or back.
5	Conclusion and Challenge			InteliTank is going to be sent into a cave from which narrow passages are assumed to lead to additional caves. Program InteliTank to move along the cave wall to locate a side passageway, and then enter that passageway.

Week 5: The Touch LED Device

Lesson No.	Lesson Name	Concepts	New Commands	Mission Statement
1	Introduction to the Touch LED Device	Inputs & Outputs The Touch LED Device Understand that the Touch LED provides input and output functionality		The latest “care pack” from Earth includes a new device for InteliTank – something called a Touch LED. You’ve been given the day to explore how this device works.
2	The Touch LED as a Sensor	Using the Touch LED as a sensor	Get LED Pressed	Today an astronaut will be taking InteliTank along on an exploration walk. She wants a way to control InteliTank, so that InteliTank will only move forward when she wants it to. Program InteliTank to move forward only when the Touch LED is pressed.
3	The Touch LED as an Output Device	Using the Touch LED as an output device that can vary its color and brightness	Turn LED On/OFF Set LED Color Set LED Brightness	As InteliTank often works in dark environments, the astronauts find it difficult to keep track of where InteliTank has gone and what it is doing. Program InteliTank to shine a red light while moving forward, a blue light while stationary, and a green light while reversing.

4	Measuring Motor Rotations	Encoders Using the motor encoders as input devices	Get Motor Rotations Break	Previously InteliTank was used to measure the distance to a massive rock. Ground Control were happy with that, but complained that the measurement was not precise enough – InteliTank could only measure distance in terms of full wheel rotations (i.e. to the nearest 8 inches). Today program InteliTank to measure distance traveled more accurately.
5	Conclusion and Challenge			The astronaut who previously took InteliTank on an exploration walk would like to do so again, but has new instructions for you. She would like InteliTank to move forward on its own, but knows that InteliTank will need help when hitting an obstacle. Program InteliTank to move forward on its own and stop when it hits an obstacle. It should then shine a red light to call for help, and not continue moving again until the astronaut commands it to do so.

Week 6: The Ultrasonic Distance Sensor

Lesson No.	Lesson Name	Concepts	New Commands	Mission Statement
1	Introduction to the Ultrasonic Distance Sensor	Non-contact sensing Distance sensing Echolation Sonar		You've received a new delivery from the engineers back on Earth. This one includes a curious looking device called the Distance Sensor. You've been given the day to play with it and think about how it could make the InteliTank even better.
2	Measuring Distance		Get Distance Set Maxiumum Range Set LED Brightness	InteliTank is again going to accompany an astronaut on an exploration walk. This walk will be different – it will be in a crater on the dark side of the Moon, with no light at all. InteliTank will continually display the distance to the nearest obstacle. It will also shine a red warning light brighter and brighter as it gets nearer to an obstacle.
3	Avoiding Collisions	Collision avoidance		Some time ago you taught InteliTank to reverse automatically after touching an object. However, continually bumping into objects did cause some damage to InteliTank's front end. You've been ordered to use your new Distance Sensor to get InteliTank to start reversing before it hits an object.

4	Seeking Objects	Seeking objects using the Distance Sensor		Today InteliTank will be sent on its own into a dark cave to explore its contents. Program InteliTank to scan its surroundings, identify the closest object, and move up to it to investigate (without bumping into it, of course).
5	Conclusion and Challenge			A group of astronauts will be going on an exploration walk today. Two of them will be taking their InteliTanks with them. To free up hands, they wonder if it would be possible for one InteliTank to be controlled manually with the gamepad, while the second will simply follow behind it. Can you program InteliTank to follow a moving object?

Week 7: Remote Control

Lesson No.	Lesson Name	Concepts	New Commands	Mission Statement
1	Introduction to Remote Control	Defining remote control Benefits and applications Pairing		The astronauts have been impressed by how InteliTank has developed its autonomous abilities, but they're getting bored. They want to control the InteliTank manually again. Spend today revising how the gamepad works. From tomorrow you'll be customizing its operation.
2	Joystick Control	Tank control Arcade control	Tank Control Arcade Control Axis to Motor	Today you have been asked to create your own gamepad control program. Not only must this one control InteliTank's motion, but it must also give the astronaut the ability to rotate the Distance Sensor.
3	Button Control	Reading joystick positions Reading button status	Get Axis Value Get Button Value	The astronauts have been enjoying controlling InteliTank manually. Their commander though has had to reprimand them numerous times for speeding – driving InteliTank too fast over the rough Moon surface has caused much damage. Modify the program so that InteliTank will automatically stop if driven too fast.

4	Combining Manual and Autonomous Control	Switching between manual and autonomous control		Today, the astronauts will be driving InteliTank manually to an exploration zone. Once there, they'd like InteliTank to drive up and down on its own as it explores. Can you add a "switch to auto" button to the gamepad that will initiate automatic motion on command?
5	Conclusion and Challenge			The astronauts will be controlling InteliTank as it explores an exploration zone. However, the exploration pattern requires that InteliTank will only ever need to move straight or make right turns. Using the joysticks for that is difficult. Can you provide gamepad control using four gamepad buttons instead of joysticks?

Week 8: The Color Sensor

Lesson No.	Lesson Name	Concepts	New Commands	Mission Statement
1	Introduction to the Color Sensor	Color Color sensing Grayscale sensing Accuracy of Color Sensor External factors that affect color sensing		Another week has passed and you've received a new delivery from Ground Control. Today's gift is a Color Sensor. Spend the day learning how it works. Identify its strengths and weaknesses, and think how this sensor might be useful.
2	Boundary Detection	Application of color sensing to boundary detection	Color Set Mode Color Get Grayscale Random	InteliTank has been given a new task today – to randomly patrol a marked-off area. The area has been marked with dark tape. InteliTank may not cross the tape, but must instead turn some random angle and continue on its patrol.
3	Object Identification	Application of color sensing to object identification	Color Get Colors	InteliTank is to be used to search for minerals. Your mission is to program InteliTank to move forward, stop when it detects material of a particular color, and signal to its operator that the mineral has been located.

4	Conclusion and Challenge			A long time ago you programmed InteliTank to follow a predefined route through the corridors of your base camp. With new wings being added on all the time, InteliTank is getting lost, and reprogramming continually is taking too much time. Instead, the commander would like to place colored markers along InteliTank's route to tell it which way to turn. Program InteliTank to follow instructions indicated by colored markers on the floor.
5	Introduction to the Gyro Sensor	Gyroscope Direction sensing		The next delivery from Mother Earth arrived early. You'll see that this pack has something you could have used a long time ago – the Gyro Sensor. Spend the day testing it out.

Week 9: The Gyro and Final Project

Lesson No.	Lesson Name	Concepts	New Commands	Mission Statement
1	Creating a Compass	Angular measurement Clockwise and counterclockwise rotation	Gyro Callibrate Gyro Get Degrees	Unlike your home town back on Earth, the Moon does not have a lot of clear landmarks. Astronauts controlling InteliTank have often walked way off course. Add functionality to InteliTank so that it will continually give some indication of its current direction, using the Touch LED to indicate the direction.
2	Maintaining Direction			The astronauts thought the color-compass solution you provided was cute, but the four-color direction indication was too general and they still managed to get lost. They've set you a new mission: pressing a button on the Gamepad should make InteliTank point in the same direction as it did at the start of its journey.

3	Final Project Day 1			You've reached the last few days of your mission before going back home. You were scheduled for some Rest and Relaxation, but you got a glimpse of your commander's wish list and you see he had some additional tasks he would have liked completed. You'll choose one and complete that as your farewell gift to your commander, and to InteliTank.
4	Final Project Day 2			
5	Final Project Day 3			