# CODING AND ROBOTICS
# CURRICULUM GUIDE SECONDARY (REVISED)

## FORMS 1 - 3

## SEPTEMBER 2021

**MINISTRY OF EDUCATION, TECHNOLOGICAL AND VOCATIONAL TRAINING**

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## INTRODUCTION

Across the globe, educational systems have become aware of the increasing relevance of new ICT tools and digital applications to school curricula, to provide students with the core knowledge and skills needed for life and work in the 21st century. In its current thrust for Education Reform, Barbados has prioritized exposure to new age technologies and digital literacies, so that students can be equipped with the competencies and skills required to thrive in the digital age. The 21st Century digital citizen who will be competent on the regional and global stage, must be one who is skilled in critical thinking, problem solving, communication, collaboration, creativity and innovation.

Barbados' earlier document on education reform, Curriculum 2000 (MOE 2000), delineated a process of reform which sought to give students opportunities to:

- have their individual needs met
- experience multiple methods of learning and assessment
- think divergently
- apply knowledge gained to real-life situations

These core tenets of reform are still applicable today and provide a foundational rationale for the introduction of a Coding and Robotics (C&R) programme which will expose students to core 21st Century competencies. The knowledge and skills gained from C&R are capable of positioning Barbados further along its journey towards technological development in a 21st Century global, digital revolution.

## Rationale

A C&R programme within the context of education reform, can bring added value to Barbados' development in key areas including:

- Re-training and re-tooling of teachers for a more robust and relevant educational system
- The development of a cadre of students capable of developing Barbados' digital and technological capacity thereby pushing the island further on to the world stage
- The development of a Caribbean 21st Century digital citizen
- Diversification of the national economy
- Further building out of the knowledge and entrepreneurial economy

The changing dynamics of 21st Century employment require skilled knowledge workers, adept at demonstrating core competencies in a range of industries and sectors. These competencies include the ability to: work collaboratively, work with diverse groups in inclusive environments, think divergently, create and innovate, practice digital safety and well-being and reimagine a new future. A programme like C&R can leverage these competencies and skills through its various curricular levels and through obvious links to other components of digital technological development. A related positive of this programme, is also the building of teacher capacity in the areas of content knowledge and pedagogy.

C&R will act as a springboard to improve the nation's human capital, as students will be taught the basics of digital communication and electronics, while gradually building knowledge and skills in the C&R field, through interactive, practical sessions. Through manipulation, discovery learning, creation and problem solving, the C&R programme will endeavor to make learning fun, while fostering, through authentic learning, the development of real-world skills.

The concept of the ideal Caribbean person as touted in the 2000 Caribbean Education Strategy involves the development of someone who "*demonstrates multiple literacies, independence and critical thinking; values and displays the creative imagination in its various manifestations and nurtures its development in the economic and entrepreneurial spheres in all other areas of life."* The C&R programme is designed to foster the development of such a citizen and is, therefore, applicable, and relevant for both a present and future Barbados.

The digital age has already ushered in an era where the urgent demands for change require that students be prepared for jobs not yet created (World Economic Forum, 2016). These jobs will be developed through using enhanced technology in new and emerging fields. These include but are not limited to: Green Energy, Biotechnology, Telecommunications and Coding and Robotics

The introduction of a C&R programme from Nursery to Secondary level, can, therefore, assist Barbados in leveraging its technological competitiveness as students will not only be prepared to manipulate and utilize the technology, but more importantly, to participate in its development.

# AIMS

## Goals

The general goals of a C&R programme, therefore, are:

- To expose students to relevant digital competencies in a 21st Century digital age
- To expose students to new and emerging technologies
- To encourage student development of future technologies
- To promote students' divergent and critical thinking
- To expose students to of the rudiments of good digital citizenship and well-being
- To promote active and authentic learning
- To promote the transformational and economic growth and development of the country

## Expected Outcomes

The expected outcomes of a C&R programme are:

- A built capacity in digital literacies for both teachers and students
- Exposure to new and emerging technologies for both teachers and students
- The development of specific competencies for individual and societal transformation

· The promotion of active and authentic learning

· The development of key 21st Century skills (creativity, communication, collaboration, innovation, digital citizenship).

**Requirements**

The success of an implemented C&R programme will require the following:

· The development of system-wide age-related syllabi

· The procurement of relevant resources

· The training and on-going professional development of teachers

· A flexible approach for curriculum placement of the programme

· An integrated curricular approach towards skill and competency development, so that C&R is not isolated from other technologically based, authentic learning experiences in other disciplines

· A robust system of monitoring and evaluation across all levels

## OVERVIEW OF CURRICULUM GUIDE

**To the Teachers:**

As we embark upon this journey of implementing Coding and Robotics into our Secondary School curriculum, this document is provided as a guide to make the transition seamless. This Curriculum Guide is meant to be used as a road map for instruction. Although the curriculum material is presented in sequential modules, it is intended to be used in a very flexible way, depending upon your desire and the entry level of your students. Some of the materials are prescriptive lessons that follow specific instructions while others are more open-ended challenges that can be taken on as time and experience allow.

This curriculum is geared towards the Lower Secondary Forms, as it is believed that the Upper Secondary will most likely be focused upon their external certification subjects. A glossary of terms has been included at the end to aid in the definition of key terminologies which the students are expected to become familiar with. The VEX IQ Robotics Education Guide and its use of STEM Labs have been integrated into each of the four (4) Modules.

***Module 1: Fundamentals of Technology*** is designed to ensure that students gain an understanding of the use of Technology in everyday life.

***Module 2: Operating a Computing Device*** aims to ensure that all students are capable of performing basic necessary tasks on a computer, laptop, or mobile device, while adhering to the safety rules of operation. We cannot take anything for granted as we are aware that everyone who knows how to use social media via texting does not necessarily know how to save a file in, or retrieve a file from, a folder on a device.

***Module 3: Coding With Blocks*** introduces block coding with Scratch and VEXcode VR. Not everyone will be scientifically inclined to pursue Robotics or Computer Science but some may be interested in entering the world of gaming, mobile apps, and other forms of design. hence the exposure to both.

***Module 4: Robotics Using VEX IQ*** embraces the VEX IQ Curriculum, STEM Labs and Project-Based Learning to further develop teamwork skills as the students design, build and program robots. They are also exposed to text based programming languages and see how to transition from one to the other.

| MODULE 1: FUNDAMENTALS OF TECHNOLOGY (6 hrs)<br>1.0 Value the role technology plays in everyday life<br>2.0 Contribute positively to society through responsible use of technology. | | |
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| **SPECIFIC OBJECTIVES** | **TEACHING AND LEARNING ACTIVITIES** | **CONTENTS** |
| **BEGINNER**<br>1. Investigate the use of technology in everyday life and in one's environment. | Research and discuss the daily use of technology in one's environment, especially in the home, school, church, supermarkets/stores, businesses, and e-governance.<br><br>Recognize that coding is used in the technology of everyday life. | Discussion to include a look at technology related but not limited to:<br>• traffic lights<br>• GPS systems<br>• transportation, driverless cars<br>• household appliances<br>• mobile computing devices<br>• wearable technology<br>• entertainment (music, videos)<br>• Internet of Things<br>• smart homes, internet activities<br>• cashier and pricing machines<br>• online bill payment, banking<br>• electronic voting<br>• tax payments (TAMIS)<br>• Passport and Visa applications |
| 2. Identify the roles that technology plays in society. | Discuss technology in a wider context in manufacturing, farming, communication, commerce, etc.<br><br>Conduct physical or virtual Field Trips to local industries. | Observe technology at work through the use of robotics in automobile construction, product creation, and so on. Investigate technologies and robots in use at companies in Barbados such as:<br>• Pine Hill Dairy<br>• BBC<br>• Banks Breweries<br>• Rum Distillery<br>• Roberts Manufacturing |

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| 3. Discuss computing technologies that have changed the world.<br><br>4. Investigate how the use of technology has influenced social behaviour.<br><br>5. Identify problems which were solved or ameliorated by the creation of technological devices.<br><br>6. Recognize one's own contribution to the future of technological advancement and to the development of one's country. | Students, with guidance from their teacher, should discuss topics that relate to the changes in the world due to technology.<br><br>Students should engage in guided discussions leading to the discovery of which problems were solved by the design of technology devices such as traffic lights, mobile phones, GPS systems, Google maps, microwaves, televisions, social media apps, etc.<br><br>Discuss technological use in agriculture, forecasting, communication, medicine, community, crime, etc.<br><br>The teacher will lead students in discussion to highlight their awareness of their own possible contribution to the future of technological advancement and to the development of one's country. | • Preconco Limited<br>• West Indian Biscuit Co Ltd<br>Topics could be based on current news content, such as robotics, wireless Internet, mobile computing devices, GPS systems, wearable technology.<br><br>Social Media apps to discuss: WhatsApp, Facebook, Twitter, Skype, Instagram, IMO, online meetings, etc. New computing technology is created and existing technologies are modified for many reasons , including to increase their benefits, decrease their risks, and meet societal needs.<br><br>Hurricanes, volcanoes, earthquakes, green housing, aqua and hydroponics, lasers, x-rays, video surveillance, search and rescue etc<br><br>Digital citizens |
| **ASSESSMENT**<br>Q & A, Research Project, Oral presentation | | |
| **Resources**<br>Technology in our Lives Today https://aginginplace.org/technology-in-our-life-today-and-how-it-has-changed/<br>Tech And Its Impact On Behaviour:<br>https://www.forbes.com/sites/forbestechcouncil/2019/09/18/tech-and-its-impact-on-behavior/?sh=106260f2b64b | | |

| MODULE 2: OPERATING A COMPUTING DEVICE (4 hrs)<br>1.0 Carry out the initial steps needed to use a PC, and make use of common types of hardware and software while complying with relevant safety and security requirements.<br>2.0 Use different types of hardware, software and communication technologies effectively. | | |
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| **SPECIFIC OBJECTIVES** | **TEACHING AND LEARNING ACTIVITIES** | **CONTENTS** |
| **BEGINNER**<br>1. Students should be able to use a computer safely. | Have students discuss and list problems which would be avoided by shutting down computers and devices safely. Recognize the importance of caring for and working safely with computers.<br><br>Students can create posters / podcasts / videos / jingles or other forms of media encouraging peers to use computers safely. | Turn on, use and shut down a personal computer or device<br><br>The use of the personal computer or device to open, save, delete, and retrieve files. |
| 2. Recall basic personal safety rules when working with computers. | Investigate personal safety rules and their benefits.<br><br>Guided discussion on best practices to avoid health and safety issues associated with computer use. | Ergonomics, posture related issues:<br>• back support and correct positioning of wrists and eyes<br>• time spent looking at screens<br>• exercise breaks |
| 3. Describe the primary function of the key components that constitute a computer system. | Draw and label a diagram of a computer system<br><br>Students will use an interactive presentation (e.g ThinkLink) that shows the main components of a computer system and how they function. | Highlight main computer components. These include:<br>• monitor<br>• keyboard<br>• CPU<br>• mouse<br>• printer<br>• drives<br>Categorize input and output devices in the computer system |

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| 4. Demonstrate the ability to assemble a basic computer system.<br><br>5. Use a login identity (ID) and/or password or PIN to access computer systems.<br><br>6. Examine the need for privacy and data security when using computing devices. | Students will practice connecting the basic components of a computer system.<br><br>Discuss the need to secure IDs and passwords when using a computer system.<br><br>Students will research the importance of securing one's ID and Password in a technological world.<br><br>Have students research privacy and data security and discuss it in class. | Basic computer system assembly - CPU, monitor, keyboard, mouse, printer, drives. Associating various device media<br>Recognize issues in technology with unsecured passwords such as hacking. The infringing on one's privacy and the stealing of assets (e.g. a hacker gets into:<br>1. a person's facebook account and accesses their personal data;<br>2. a person's bank account and steals their money).<br><br>Consider a few examples in the news of hacks and the impacts of these hacks on societies.<br>In the 21st century, we share and store our most sensitive personal information on phones, computers and even in "the cloud." Today more than ever, a strong privacy program, which includes data security, is essential to the safety and welfare of people. |

**ASSESSMENT**

Q & A, Research Project, Exercises, Quizzes, Demonstration - Open, type, save, delete and retrieve files

**Resources**

Inside the computer: https://edu.gcfglobal.org/en/computerbasics/inside-a-computer/1/

Cyber Security: https://www.oreilly.com/library/view/computer-security-basics/0596006691/ch01.html

Internet Safety: https://edu.gcfglobal.org/en/internetsafetyforkids/teaching-kids-about-internet-safety/1/

Setting up a Desktop: https://www.youtube.com/watch?v=RnM3u99xIf4

| MODULE 3: CODING WITH BLOCKS<br>01. Use Scratch 3.0 and VEXcode VR as a programming software to learn coding with blocks | | |
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| **SPECIFIC OBJECTIVES** | **TEACHING AND LEARNING ACTIVITIES** | **CONTENTS** |
| **BEGINNER**<br>1. Define 'coding'. | • Students will use the online resource to write a definition of coding. https://code.org/educate/resources/inspire | Coding is defined as the process or activity of writing computer programs |
| 2. Explain why we code | • Students will collaborate in groups to create a presentation of the benefits of coding and its application and use in programming | The benefits of coding include<br>- Develops problem-solving skills<br>- Increases creativity<br>- Improves teamwork<br>- Improves understanding of related subject areas such as mathematics |
| 3. Identify the characteristics of computer programming languages. | • Students will research the characteristics of computer programming languages using online and offline resources https://www.bbc.co.uk/bitesize/guides/zgmpr82/revision/1<br><br>https://www.geeksforgeeks.org/introduction-to-programming-languages/ | A programming language must be simple, easy to learn and use, have good readability and be human recognizable. A programming language should be well structured and documented. A **programming language** is a set of rules in which symbols represent actions. Programming languages follow step-by-step instructions that a computer executes in order for a project to run. |
| 4. Examine the historical significance of coding languages | • Present students with historic and recent examples of programming languages https://excelwithbusiness.com/blog/say-hello-world-in-28-different-programming-languages/ | Examine the historical significance of coding languages such as ADA, LISP and COBOL. Contrast these with "modern" languages C, Java, Visual Basic, Scratch, VEXcode VR and Python |

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| 5. Explain what is an algorithm | • Have students write instructions they would give to someone to help them get ready for school.<br>• Guide students to the understanding that everything they do each day is an algorithm.<br>• Have students create algorithms for making breakfast, doing homework, taking a bath, going to bed, washing the dishes, watching TV, taking transportation to school, etc. | An algorithm is any set of instructions that will solve a problem, once followed in the correct sequence or order.<br><br>A **programming algorithm** is a computer procedure that is a lot like a recipe (called a procedure) and tells your computer precisely what steps to take to solve a problem or reach a goal. |
| 6. Describe the features of Scratch and VEXcode VR as programming languages | • Use a presentation to introduce programming with Scratch and VEXcode VR. | Scratch and VEXcode VR are visual programming languages |
| 7. Navigate the Scratch 3.0 and VEXcode VR interfaces | • Have students launch the Scratch 3.0 application on the computing device.<br>• Provide links to apps in the Scratch community for students to explore and interact with. https://scratch.mit.edu/ideas<br><br>• Student will set up accounts on the Scratch 3.0 community at scratch.mit.edu for their online programming environment | Scratch and VEXcode VR use colourful, drag and drop interfaces.<br>There are four main **elements** of **Scratch**<br>**stage** (background of the project),<br>**sprite** (an object in the project controlled by the script),<br>**script** (created by combining a group of interlocking blocks) and<br>**programming palette** (containing groups of blocks).<br>Main **elements** of **VEXcode VR**:<br>**Web based** (no software installation needed)<br>**Virtual Robots** (pre-built robots which use drivetrains, sensors and a pen)<br>**Virtual Playgrounds** (3D playgrounds include a grid world, an art canvas and a walled maze<br>**Live Dashboard** (visualize data)<br>**Challenges & Activities** (in Google Docs) |

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| 8. | Explain the block types used in Scratch 3.0 and VEXcode VR and their usage. | • Teacher will state the names of the block types and explain their usage | There are **six block types in Scratch**, and **five** in **VEXcode VR,** each with a unique shape, that will only connect to blocks that contain a matching slot made for that specific shape.<br>**Hat** blocks - used to start the script<br>**Stack** blocks - used to perform the main tasks in the script<br>**Reporter** blocks - used to report numeric, string or boolean values<br>**Boolean** blocks - used to pass conditional values in the script<br>**C** blocks - used to perform conditions and loops in the script<br>**Cap** blocks (Scratch) - used to stop the script or project from running |
| 9. | Explain the categories of blocks used in Scratch 3.0 and VEXcode VR | • Teacher will familiarize students with the block categories/groups in Scratch 3.0 and VEXcode VR<br>• Teacher will demonstrate the use of **blocks, sprites,** and **events** and the method of "drag and drop" coding with blocks in Scratch 3.0 and VEXcode VR | **Block categories** based on functionality, each with a different colour are:<br>Scratch ONLY: Motion, Events, Sound and List<br>VEXcode VR ONLY: Drivetrain, Magnet and Comments<br>Common to Both: Looks, Control, Sensing, Operators, Variables, and My Blocks |
| 10. | Create simple programs in Scratch 3.0 to perform a specific task | • Familiarize students with the coordinate X-Y grid for the Scratch 3.0 stage. Using the X-Y grid stage, the student can create a battleship-type game.<br>○ Use the random number function to generate x and y coordinates to place 4 sprites (ships) on the stage.<br>○ Hide the sprites before starting the game | The x and y-axes on a grid behind the Stage shows the location of the Sprite on the Stage.<br><br>Scratch Basics - Episode 6: Gliding From One Point to Another<br><br>Scratch Basics Episode 7: Make Your Sprite Move Left & Right |

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| | | ○ Have the player attempt to 'fire' a salvo by providing the x,y coordinate of each shot<br>○ A hit occurs when the coordinates of a shot coincide with the location of a sprite<br>○ The game ends after a set number of attempts or when all ships are 'hit'<br><br>● Demonstrate the use of blocks to control the movement of sprites<br>- https://en.scratch-wiki.info/wiki/Move_()_Steps_(block) | |
| 11. | Improve a program by remixing an existing program to incorporate new features | The student can remix the SCENES project https://scratch.mit.edu/projects/2042673/ by making use of four images of locations from across Barbados as backgrounds for the project. Two sprites or their choosing or design can be used to identify the location of each scene. | Remixing is the term used by Scratchers for downloading another Scratch project from the community and adding their own code to enhance the project. The student can explore, experiment and modify the existing project with the aim of developing their own refined version of the finished product. |
| 12. | Use a block-based coding environment to code a virtual robot. | Students will learn how to launch VEXcode VR and identify the features of the Robot and Playground. | VEXcode VR is the programming language for a VR Robot.<br>VEXcode VR is itself powered by Scratch blocks.<br>To launch VEXcode VR, go to vr.vex.com.<br>The VEX VR Robot is equipped with sensors, controls, and many physical features. In VEXcode VR, the robot is already preconfigured.<br>A Playground is a virtual space in which your VR Robot can interact and move. |
| 13. | Describe how a robot's behaviour is changed. | Students will use various commands to change the robot's behaviour. | **Behaviours** are the actions performed or to be performed by a robot. Moving forward, stopping, turning, looking for an |

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| | | obstacle — these are all behaviours. Behaviours are defined by the programming language.<br><br>To change the behaviours of a VR Robot, you can change the blocks in a project. These programming blocks are also called **commands**. |
| 14. Describe the correct sequence of VR Robot behaviours needed to complete a basic movement task.<br><br>**INTERMEDIATE** | The **Castle Crasher Challenge** in VEXcode VR will be used to help students discover the importance of sequencing when programming. | **Sequence** is the specific order in which behaviours are performed. An action or event leads to the next ordered action in a sequence. |
| 15. Identify the blocks needed for coding operational statements. | Students are guided through the use of blocks for comparing quantities. =, <, >, and or not using the web resource pages https://thestempedia.com/tutorials/conditional-programming/<br><br>https://en.scratch-wiki.info/wiki/Operators_Blocks<br><br>https://thestempedia.com/encyclopedia/operator-block/<br><br>https://kb.vex.com/hc/en-us/articles/360042621911-Block-Shapes-and-Meaning-Tutorials-VR-Blocks | The group of blocks known as operators are needed to perform conditional programming in Scratch. The blocks are for creating expressions that will evaluate as True or False during the execution of a script e.g.<br>distance < 200<br>Answer = Yes<br><br>Sensing blocks may also be used in conditional programming e.g.<br>Key (Space) pressed?<br>Touching(Mouse Pointer)? |
| 16. Distinguish between the use of sequencing and selection to create functional programs in Scratch 3.0 | Teachers will guide students in discussion on how they plan and sequence daily tasks, such as (1) getting dressed for school, (2) eating breakfast, (3) travelling to school.<br>Teacher will explain that while students perform these steps without thinking they do it with a goal in mind, that is, arriving at school on time. | Each statement in a sequential program is performed directly after the completion of the previous statement.<br>-Ask for the users name<br>-Accept the user's names<br>-Ask for the user's age<br>-Accept the user's age |

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| | Explanations will be given so that students see the importance of sequencing code in a step-by-step way to achieve a particular goal in mind. Students can be directed to examples of sequencing and selection https://edu.gcfglobal.org/en/computer-science/sequences-selections-and-loops/1/<br><br>Students will use the Art Canvas Playground in VEXcode VR to identify how to use the [Repeat] block to repeat the blocks inside of it for a set number of times. | Selection statements use the outcome of testing conditional blocks (true/false) to determine the next statement to perform: If…Then https://en.scratch-wiki.info/wiki/If_()_Then_(block)<br><br>If…Then…Else https://en.scratch-wiki.info/wiki/If_()_Then,_Else_(block) |
| 17. Demonstrate the use of looping to create functional programs in Scratch 3.0. and VEXcode VR | Student will be directed to the following web sites: https://en.scratch-wiki.info/wiki/Making_a_Script_Repeat_for_a_Set_Amount_of_Time<br><br>https://en.scratch-wiki.info/wiki/Repeat_Until_()_(block)<br><br>https://en.scratch-wiki.info/wiki/Forever_(block) | Looping statements are used so that a set of statements can be performed more than once when necessary to achieve a solution.<br><br>Blocks which perform loops are **repeat** (**number**) a C block which can perform a set of statements for a specific number of times.<br>**repeat until** (**condition**) a C block which performs statements until the stated condition becomes true.<br><br>**Forever** a C block which performs statements without ending https://sites.google.com/a/psdschools.org/codinginmathclass/home/middle-school/loops-in-scratch |
| 18. Demonstrate the use of variables in developing Scratch programs and using VEXcode VR | Teacher introduces the **variables** group of blocks by demonstrating using the **my variable** block and **make a variable** option Students can be directed to tutorial https://en.scratch-wiki.info/wiki/Variables_Tutorial | |

**ASSESSMENT**

Q & A, Creation of Scratch Projects

**Resources**

Teaching guide from scratch.mit.edu
https://resources.scratch.mit.edu/www/guides/en/EducatorGuidesAll.pdf

Introduction video"Getting started" on https://scratch.mit.edu/projects/editor/?tutorial=all

Google for Education 'CS First' https://csfirst.withgoogle.com/s/en/home

Introduction to Scratch 3.0
https://www.stemdetectivelab.com/scratch-coding-camp/introduction-to-scratch-3-badge/

Animal Antics
https://www.stemdetectivelab.com/scratch-coding-camp/animal-antics-badge/

Runners Take Your Mark
https://www.stemdetectivelab.com/scratch-coding-camp/runners-take-your-mark-badge/

Movement of the Sprite
Scratch Basics Episode 7: Make Your Sprite Move Left & Right
https://pinnguaq.com/learn/scratch-basics-episode-7/

| MODULE 4: ROBOTICS USING VEXcode IQ<br>01. Promote open communication within teams and increase student engagement.<br>02. Establish procedures for cooperative learning. | | |
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| **SPECIFIC OBJECTIVES** | **TEACHING AND LEARNING ACTIVITIES** | **CONTENTS** |
| **BEGINNER**<br>1. Give a brief explanation of what a robot is. | **(8 STEM Labs included)**<br>Question students to determine their understanding of what a robot is. | A **robot** is a type of automated machine that can execute specific tasks with little or no human intervention and with speed and precision. The field of **robotics**, which deals with **robot** design, engineering and operation, has advanced remarkably in the last 50 years. |
| 2. Identify the different types of robots. | Have students use online resources to list at least four different types of robots. | There are as many different types of robots as there are tasks.<br>**Pre-programmed**<br>**Humanoid**<br>**Autonomous**<br>**Teleoperated (Telechir, Telepresence)**<br>**Augmented**<br>**Androids**<br>**Industrial**<br>**Swarm**<br>**Smart** |
| | Have students view the online video Robot of the Week on the following website ROBOTS: Your Guide to the World of Robotics | Perseverance - NASA's new robot has landed on Mars. |
| | Allow students to interact freely as they scroll down the page, open links, look at pictures and videos to discover much information on the many robots sited on the website. | Fifteen (15) groups of robots to view which were created all over the world |

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| 3. Explore the use of robots today. | Have students research the use of robots in different sectors of today's world and present their findings to the class for discussion and sharing of information.<br><br>Have each group create a project on robots used in a different sector. | Robots are used today in many ways: **Workplace**: From food delivery and disinfecting offices to retail services and surgeries, robots are increasingly sharing our workplaces. Robots perform various repetitive and demanding tasks quickly and reliably. Robots also increase safety in the workplace by performing tasks that would be dangerous to humans. For example, they handle corrosive acids or extremely hot materials.<br><br>**Environment**: robots are used in dangerous environments (including inspection of radioactive materials, bomb detection and deactivation), manufacturing processes, or where humans cannot survive (e.g. in space, underwater, in high heat, and clean up, etc).<br><br>**Medicine**: A medical robot is a robot used in the medical sciences. They include surgical robots which are well known for the collective use of robots, computers and software to accurately manipulate surgical instruments through one or more small incisions for various surgical procedures.<br><br>**Food manufacturing and delivery**: commonly used in the dispensing, feed placement, cutting, packaging or casing of **food**, pick-and-placing products into containers, and sorting. **Robots** are equipped with intelligent vision systems allowing the very specific placement of |

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| | | products on a belt to be done with incredible accuracy. |
| 4. Explain the VEX robotic ecosystem | Have students watch the video: The VEX Ecosystem<br><br>Discuss the VEX robotic ecosystem with the students | The VEX ecosystem is a modular plug and play robotics system The VEX Ecosystem |
| 5. Investigate gears and concepts related to gears while building a VEXcode IQ robot. (**STEM Lab 1)** | Students will work together in teams of four (4) to build the **M.A.D. Box** robot.<br><br>• Learn about simple gear ratios.<br><br>• Meshing large and small gears on a 'gear board'.<br><br>• Interchanging the driving and driven gear | The **M.A.D. Box** is a **Mechanical Advantage Device** designed with different gear ratios to create mechanical advantages.<br>Concepts taught:<br>**1. Gear Ratios**<br>**2. Mechanical Advantage**<br>**3. Torque**<br>**4. Speed** |
| 6. Identify how to calculate gear ratios and their importance when designing a robot. | Students will explore and see what the robot can do, and then answer the questions asked.<br><br>(**Inter-departmental Contribution** - have **Industrial Arts** and **General Science** Departments address topics which deal with Gears, Torque and Speed.<br>Have the **Mathematics** Department address topics which deal with Fractions, Ratios and Speed). | The build uses two types of gears in its design. How many teeth are on each type of gear and what are these gears called?<br><br>The VEX Super Kit also includes a 60 Tooth Gear. Why do you think it was not used in the build?<br><br>How does the M.A.D. Box work? Explain with details. |
| 7. Demonstrate an understanding of how to use gear ratios to determine mechanical advantages. | Students perform calculations of two and three gear ratios and determine the mechanical advantages. | Mechanical advantage is defined as the change of input force within a machine ((Gear Ratio - Driven:Driving) power transfer - 1:1, torque - 3:1 or speed - 1:3). |

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| 8. Apply the knowledge gained about gears, torque and speed to everyday life.<br><br>9. Create a build that can alter its size by using scissor linkages. (**STEM Lab 2)** | Have students use the STEM Lab to guide their identification of where they have seen torque and speed in everyday life.<br><br>Students will build the **Grabber** robot, a device that uses scissor linkages to convert the direction of motion and explore the mechanics of a scissor linkage.<br><br>Students will explore and see what the robot can do, and then answer the questions asked. | Include three scenarios where gear ratios are used: power transfer, increase torque (low speed), and increase speed (high speed).<br><br>Examination of the chain and sprockets of a bicycle, etc.<br><br>Concepts taught:<br>**Linkage**<br>**Force**<br>**Motion**<br>**Scissor Lift**<br><br>What does the Grabber do? Explain with details.<br><br>How might the Grabber be used? Explain with details and sketches.<br><br>A mechanical advantage is an advantage gained by the use of a mechanism in transmitting force. Does the Grabber have a mechanical advantage(s)? If so, what is the mechanical advantage? Explain with details.<br>Explain this build, using common engineering terminology, to someone who hasn't seen it. Use at least 3 of the following terms in your description: beams, connectors, levers, pivot points, fulcrum, and simple machines. For example, I could say that beam is an engineering term that describes this build because the build requires beams to form its "structure." You may need to look up these terms if you need clarification. |

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| 10. Collaborate and work as a team to build a VEXcode IQ robot. **(STEM Lab 3)** | Students will work in teams of no less than four (4) to perform the **Tallest Tower** VEX STEM Lab.<br><br>Students will have the opportunity to build an Earthquake Platform as a team. Discuss how other situations like Hurricanes can affect the stability of a building. | **Stability (to be stable) -** To be unlikely to move or change.<br>**Earthquake -** A violent shaking of the ground caused by volcanos or movements in the earth's crust.<br>**Hurricane** - A tropical cyclone with winds of 74 miles (119 kilometers) per hour or greater that is usually accompanied by rain, thunder, and lightning, and that sometimes moves into temperate latitudes.<br>**Weight -** The heaviness of an object.<br>**Gravity -** The force that attracts a mass towards another mass.<br>**Conventional -** Based on acceptable standards or what is generally done.<br><br>What are the science and benefits of the stability of structures? How does weight and gravity affect tall structures such as buildings, skyscrapers, bridges, etc. |
| 11. Create new blocks projects in VEXcode IQ | Demonstrate how to open new templates and blank projects in VEXcode IQ | |
| 12. Save projects in VEXcode IQ | Demonstrate different ways to save projects in VEXcode IQ | The recorder will write the responses of the group to the following questions. |
| **INTERMEDIATE**<br>13. Investigate the VEX IQ Sensors. **(STEM Lab 4)** | Students will work in small groups to build the **Testbed - VEX IQ Sensors** robot.<br><br>Students will explore its design, see what the robot can do, and then answer the questions asked. | How many sensors are included in the Testbed and what are their names?<br><br>Why are all of the sensors attached to the VEX IQ Brain?<br><br>Why is the Gyro Sensor mounted on a 2X Pitch Standoff instead of directly on the Testbed? |

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| | | Vex IQ Sensors<br>• VEX Limit Switch. ...<br>• VEX Bumper Switch. ...<br>• VEX Potentiometer. ...<br>• VEX Ultrasonic Range Finder. ..<br>• VEX Line Trackers. ...<br>• VEX Optical Shaft Encoders. ...<br>• VEX Yaw Rate Gyroscopic Sensor. |
| 14. Strategize with peers in building an **Autopilot Robot.** | Students will work in groups of 3 or 4 and select all parts needed from the VEX IQ kits required for the Autopilot build. Using the build instructions, the students will assemble the Autopilot.<br>The student designated as builder will prepare the hardware. The builder will ensure motors and sensors are correctly plugged in, smart cables are fully plugged into motors and sensors, the brain is turned on and the battery is charged.<br><br>The teacher will allow students to express themselves in reflecting on the autopilot build. They will draw out students on such questions as 'Were they any challenges you encountered? Did it help working as a team?<br><br>Students will discuss their findings and answer questions asked. | After the autopilot build, have students write down they answers to the following questions in their notebooks:<br><br>How do you think the Autopilot could be used as a tool for measurement?<br><br>If you didn't have a ruler to measure how far the Autopilot robot moved, which VEX piece would you choose to act as a measuring stick? Why?<br><br>Looking at the Autopilot robot, how many pieces do you think you used to build it?<br><br>Record your guess and why you chose that number in your notebook, then discuss reasons for your choice with the members of your class. |
| 15. Explore robot behaviours and create code to drive the **Autopilot robot forward and in reverse**. **(STEM Lab 5)** | Students will explore robot behaviours and create code to drive the **Autopilot robot forward and in reverse**.<br><br>To assist in delivering STEM Lab 5 the teacher should review and use VEXcode IQ STEM Labs teachers' resources. Link | Steps will be followed from VEXcode IQ STEM Labs in moving the Autopilot build forward and in reverse.<br><br>Motor Shafts include a flange that will capture the shaft when a Smart Motor is |

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| | | https://education.vex.com/parent-wrapper-teacher.php?id=drive-forward-reverse<br><br>To accomplish this objective the teacher will group students in 3 or 4. Groups will be composed of a Builder, a recorder, and programmer. The builder will get the hardware (the autopilot), the recorder (notebook), and the programmer (VEXcode IQ Blocks software). The builder will also check that (1) all the motors and sensors are plugged into the port, (2) smart cables are fully inserted into all the motors and sensors, (3) the brain is turned on, and (4) the battery is fully charged.<br><br>The programmer in each group, with help from the group, will thereafter follow the steps in VEXcode IQ STEM Labs in programming the autopilot to drive forward and in reverse. (Link to VEXcode IQ STEM Labs forward and reverse drive Drive Forward and Reverse | mounted directly to a 2X Beam or 4X Plate.<br><br>The programmer in each group will program the Autopilot to move forward and in reverse at various distances.<br><br>Steps will be followed from VEXcode IQ STEM Labs in remixing the Autopilot build. |
| 16. | Delineate improvements to the Autopilot build (i.e. drive remix) | After students have successfully programmed the autopilot to move forward and reverse the teacher will ask students how they could make improvements to their programming of the Autopilot behaviour. Through guided questioning students will be guided to delineate that they can program the autopilot to move forward and in reverse at various distances. Link to VEXcode IQ STEM Labs for steps in using Drive Remix https://education.vex.com/parent-wrapper.php?id=drive-forward-reverse | Do you think it is easy or difficult to think like a robot? Why? |

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| 17. Perform conversions of required units of measurement, after a period of investigative research.<br><br>18. Create code using VEXcode IQ Blocks for the Autopilot robot to perform left and right hand turns. **(STEM Lab 6)** | The teacher will have students do further research to convert mm and cm measurements to inches and vice versa - [since VEXcode IQ drive forward and reverse blocks use inches measurement the teacher will ask students to determine the inch value they would input if they had mm or cm measurements].<br><br>To assist in delivering STEM Lab 6 the teacher should review and use VEXcode IQ STEM Labs teachers' resources. Link https://education.vex.com/parent-wrapper-teacher.php?id=turning<br><br>To accomplish this objective the teacher will group students in 3 or 4. Groups will be composed of a Builder, a recorder, and programmer. The builder will get the hardware (the autopilot), the recorder (notebook), and the programmer (VEXcode IQ Blocks software).<br><br>The programmer with assistance from the group will use the instructions in the VEXcode IQ Stem Lab to program the Autopilot robot to perform a left and right turn Turning.<br><br>The STEM Lab includes activities for groups to have the Autopilot create complex maneuvers around obstacles. Groups will plan, discuss, and execute robot behaviors in making turns around obstacles and in other complex activities. | Each group will investigate through a google search, asking their maths teacher, or some other means how to convert from mm to inches and from cm to inches.<br><br>Why is it important to make precise measurements?<br><br>Steps will be followed from VEXcode IQ STEM Labs in having the Autopilot make left and right turns.<br><br>Do robots always make 100% accurate turns?<br><br>**Key Concepts:**<br>• Robot Behaviours<br>• Decompose the steps needed to solve a challenge<br>• Spatial Reasoning<br>• How to create, download and run a project<br>• Programming a sequence of movements<br>• How to save a project<br><br>**Autopilot**<br>The robot build that is used for the STEM Lab. This robot is the result of the first hands-on lesson the students will accomplish. It is used to complete the rest of the STEM Lab activities.<br>VEXcode IQ Blocks<br>A block-based programming language used to program a VEX IQ robot. |

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| 19. Delineate improvements to the Autopilot behaviour by remixing the robot's VEXcode program | From this activity the students can brainstorm to identify the applications for this behaviour of robots. | **Behaviour**<br>An instruction that is downloaded to a robot brain, which is then executed. Programs usually consist of several behaviors combined in a logical succession.<br>**Parameter**<br>A limit or boundary that defines the scope of a particular process or activity.<br>**Spatial Reasoning**<br>Thinking about how spaces and objects relate to each other.<br>**Scale**<br>A mathematical concept used to change the relative size relationship of objects from a smaller to larger size.<br>**Sequencing**<br>Arranging code blocks in a specific arrangement in order to achieve a goal.<br><br>**[Problem- Based Learning Activities]** - once students know how to program the robot for movements and turns, have them program multiple movements and turns to navigate a set path.<br><br>**Activity 1:** Drive around a box!<br>The goal of this activity is to program the Autopilot to drive around a box. This task will require multiple steps.<br><br>**Activity 2** - The problem might be that they are obstacles along the way to move the robot to a particular location. Students can work together to plot a suitable path for the robot. |

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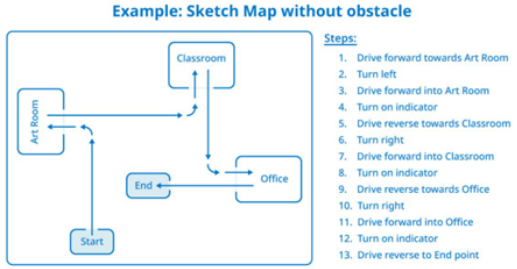
| | | The students can then explore improvements to their code using the VEXcode IQ Stem lab to perform the remixing challenges https://education.vex.com/parent-wrapper.php?id=turning<br><br>The student designated as builder will prepare the hardware. The builder will ensure motors and sensors are correctly plugged in, smart cables are fully plugged into motors and sensors, the brain is turned on and the battery is charged. |  <br><br>**Activity 3** - Discuss with students a solution to getting to their home if one of the main streets leading to their home is blocked off **(Unplugged activity)**.<br><br>**Activity 4** - Discuss other scenarios where there is a problem and the steps taken to arrive at a solution (Unplugged activity). |
| 20. | Create code using VEXcode IQ Blocks for the Autopilot robot and explore **changing the velocity** by driving forward, reversing, and turning.<br>**(STEM Lab 7)** | The programmer with assistance from the group will use the instructions from the VEXIQ Stem Lab to program the Autopilot to drive forward, reverse and turn while changing the velocity Changing Velocity<br><br>The group will engage in additional activities using the VEX IQ Stem Lab https://education.vex.com/parent-wrapper-teacher.php?id=changing-velocity<br><br>Students will work in groups of 3 or 4 and the student designated as builder will prepare the hardware. The builder will ensure motors and sensors are correctly plugged in, smart cables are fully plugged into motors and sensors, the brain is turned on and the battery is charged. | Students might be asked to explain the sequence of tasks below in changing the robots velocity.<br><br>  |

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| 21. Create code using VEXcode IQ Blocks that will utilize an Autopilot robot that will detect objects using the **Vision Sensor**. **(STEM Lab 8)**<br><br>22. Execute the required steps to connect the Vision Sensor to a VEX IQ Robot Build and the VEX IQ Brain. | The builder will attach the vision sensor to the Autopilot following the instructions Vision Sensor<br><br>Encourage students to gain a better understanding of what a **Vision Sensor** is and what it is used for.<br>Students will engage in configuring, tuning and programming the **Vision Sensor**.<br><br>The group will test their build by following the instructions provided in the VEXcode IQ Stem Lab Vision Sensor<br><br>The group will brainstorm to identify real-world applications of this behaviour in the real world. | The **Vision Sensor** provides the robot with data from the sensor's field of view. It can be used to see objects and allow your robot to interact with the world around it. |
| **INTERMEDIATE**<br>23. Demonstrate the ability to use VEXcode IQ Blocks to program an Autopilot to perform **Movement Challenges**. **(STEM Lab 9)**<br><br>24. Decompose problems into smaller subproblems to facilitate the program development process | **(5 STEM Labs included)**<br>Students will program their Autopilot to drive on a designated path through a sequence of movements using VEXcode IQ Blocks.<br><br>Students will configure the Smart sensors of the robot.<br><br>Students will compare and refine algorithms for the same task and determine which is the most appropriate<br><br>Student will describe choices made during program development using comments and presentations | They are capable of lifting heavy loads without injury.<br>They are more precise in their movements.<br>They can produce more products in a shorter amount of time.<br>They can work at a constant speed with no breaks.<br>They can perform tasks that are dangerous to humans.<br>They can work in hazardous conditions, such as poor lighting, toxic chemicals, or tight spaces. |

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| 25. | Design a plan and create a robot to solve a specific problem identified at school. | Students will discuss how robots are used in the real world to complete tasks humans do not want to do and improve the environment, like picking up trash.<br><br>Students will create a plan, or blueprint, for a Recycle Robot and then create a project to execute it.<br>The Programmer will start a new project with the Autopilot (Drivetrain) template, name, and save it. Since they will be creating a path for a recycle robot, rename the project “Recycle Run.”<br><br>Students will use the Comment Blocks to list steps needed.<br><br>Students will translate the Comments into sequential code and then test run their project. | **Project-Based Learning task (1-6 weeks duration)** |
| 26. | Create code using VEXcode IQ Blocks, employing the correct programming sequence of steps, that will utilize an Autopilot robot to perform the tasks necessary to solve the problem. | Students will use the STEM Lab Real World Connection and other online resources to read about Italy’s Trash Robot and other similar robots, and state some benefits for using robots. | VEXcode IQ Blocks - "Moving the Arm" Tutorial<br><br>VEXcode IQ Blocks - "Opening the Claw" Tutorial<br><br>Measure distances to travel, determine angles arm will have to turn through and how high to raise to carry the object, move in reverse before putting down the object. |
| 27. | Engage in reflection and state benefits of using robots in real life situations. | Students will review their code and use troubleshooting techniques to refine it so as to correct any sequencing, coding or efficiency challenges identified. | Some of the benefits of using warehouse robots instead of humans are:<br>● Better accuracy in selecting the correct items<br>● More efficient (speed) |

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| 28. Determine the most efficient solution. | Students will discuss other possible solutions to the problem and then determine which would be the most efficient solution (using the least code). | • Reduction of utility costs like air conditioning<br>• Less workplace theft<br>• Reduction of labor cost (fewer workers needed) |
| 29. Build a Clawbot and program its Claw and Arm to grab and move packages to a loading dock for delivery. **(STEM Lab 10)** | Students will follow the building instructions to build a robot to perform the **Speedy Delivery** STEM Lab. Students will program a robot to navigate a warehouse and prepare packages for delivery. | **Project-Based Learning** - Goal: to complete the building of the Clawbot IQ. |
| 30. Demonstrate the ability to work together on an assembly line, collaborate and create as a team. | Each member of the group will build a different section of the robot and then assemble them and wire it together (Drivetrain and Distance, Robot Frame, Robot Arm, and Robot Claw). | Refer students to Robot Repetition - Using Loops to Repeat Robotic Actions in the Loop, There It Is STEM Lab. |
| 31. Program a well documented sequence of VEXcode IQ Blocks to make a robot grab, lift and move an object. | The students will watch and discuss tutorials on Moving the Arm and Opening the Claw, as a guide, before writing their own pseudocode that will allow their robot to grab, lift and move a bottle, can or similar object. | **Pivot point** - the point the robot rotates about.<br><br>**Repetition** - performing routine tasks multiple times. |
| 32. Demonstrate the ability to use the drive, spin for, and spin to position blocks when creating a project. | Students will use the drive, spin for, and spin to position blocks to create the project based on their pseudocode. | |
| 33. Make use of troubleshooting skills and knowledge base articles to solve potential problems with VEX IQ Sensors and Smart Motors. | Students will test their project, troubleshoot, and make any adjustments needed for its success. | |
| 34. Apply knowledge gain to real life situational use of robots for meeting consumer needs or playing games. | Research use of warehouse robots and list benefits of using them instead of humans in this instant. | |

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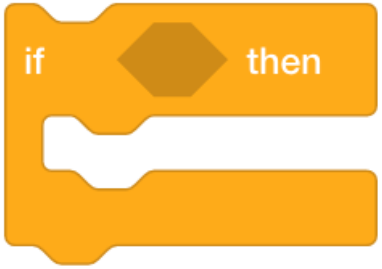
| 35. Experiment using **Looping Structures** in projects and the Clawbot IQ robot. **(STEM Lab 11) Loop, There It Is!** | Students will experiment with using loops in their projects by completing several mini-challenges. | Conditional statements are powerful programming statements that use a boolean (TRUE or FALSE) condition and allow you to develop projects that have the robot behave differently depending on what it senses |
| 36. Demonstrate the ability to work together on an assembly line, collaborate and create as a team. | If not done before, each member of the group will build a different section of the robot and then assemble them and wire it together (Drivetrain and Distance, Robot Frame, Robot Arm, and Robot Claw). (Students can change roles and build a different part of the robot than they did before). |  |
| 37. Analyze building directions and create a robot to complete a specific task. | | |
| 38. Analyze directions to configure and program a robot to complete a series of tasks. | Students will collectively investigate and solve their own hardware, software and programming related problems. | |
| 39. Explain and use loops to create a project with repeated movements. | Students will explore repeating movements in their project. Compare and contrast the **forever** and **repeat** looping blocks. | |
| 40. Create a project that follows a specific student created pseudocode that will direct their robot to dance. (STEM Lab). | Students will brainstorm, design, create pseudocode, and implement a project which will use loops to make a robot dance. | The example may be used below:<br><br>if the Brain Up button is pressed (TRUE) the robot will drive forward. If the Brain Up button is not pressed (FALSE) the robot will stop driving. This shows the robot only driving forward when the Brain Up button is pressed, otherwise the robot stops. |
| 41. Explore **Conditional Statements** and the use of button presses to provide input for the program to decide if the conditional statement is True or False. **(STEM Lab 12) To Do, or Not To Do** | Students will explore the logic of if…then…else.<br><br>Students will create a project that uses conditional statements to make decisions based upon a boolean input. The code will use the if…then or if…the…else statements to make choices of movement | |

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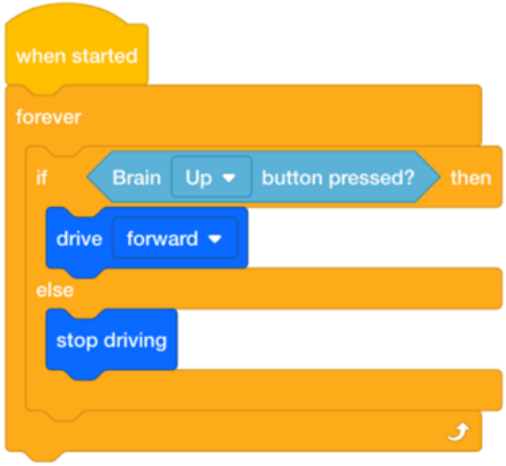
| | | based upon the user's input via button press, or sensors, etc.<br><br>Students will use the STEM Lab To Do, or Not To Do to further their experience of using conditional statements. |  <br><br>Use the robotics concepts learned and features of the VEX IQ ecosystem to showcase your understanding of the following robotics concepts.<br><br>i) Control<br>ii) Input - Sensors<br>iii) Output - Actuators<br>iv) Communication - Teleoperated and Autonomous |
| 42. | Encourage discussion to help students to understand how the use of bumpers can help robots. | Ask leading questions which will stimulate thought and have students think about the use of a controller on a robot. | |
| 43. | Analyse different ways to program the **Controller**.<br>**(STEM Lab 13) Clawbot With Controller** | Students will use the STEM Lab Clawbot With Controller to learn how to pair and calibrate the controller.<br><br>Students will program the VEX Controller to direct the Clawbot IQ through several engaging challenges using the concept of loops. | |
| 44. | Build a VEX IQ Clawbot and configure its Smart Sensors | Using either the VEX IQ Autopilot Robot or VEX IQ Clawbot, design and showcase a project to solve a problem at your school or in your community. | |
| 45. | Pair and Calibrate the Controller | | |
| 46. | Explore programming blocks used to program the Controller in Tank Mode and test student created programs. | For a fun activity, ask students to race their robots. One team can use the Left Arcade Control example project, and the other team can use the Tank Drive Control example project. Ask the students after the race if they felt one was easier to control the robot with and why. | |
| 47. | Demonstrate the ability to strategize, collaborate, design, code, and implement a robot that can be used to solve a problem or be used for personal use. | | |

**ASSESSMENT**

Q & A, Robotic Projects

**Resources**

Types of Robots https://searchenterpriseai.techtarget.com/definition/robot
https://builtin.com/robotics

ROBOTS Your Guide to the World of Robots https://robots.ieee.org/

Advantages and Disadvantages of Robots https://www.wisehealthynwealthy.com/blog/advantages-and-disadvantages-of-robots

Medical Robots That are Changing the World https://interestingengineering.com/15-medical-robots-that-are-changing-the-world

VEX-IQ Get started https://www.vexrobotics.com/iq/support/iq-guide

Teaching 1:1 with VEX IQ - Teaching this fall https://kb.vex.com/hc/en-us/articles/360047113471-Teaching-1-1-with-VEX-IQ

VEX-IQ Robotics Education Guide -
https://education.vex.com/xyleme_content/legacy/iq/iq-curriculum/228-3319-750-Rev14-HQ.pdf

Video for VEX-IQ base units https://www.youtube.com/watch?v=uSb-tPGtsl0

VEX-IQ Robotics Education Guide - Teacher Supplement
https://education.vex.com/xyleme_content/legacy/iq/iq-curriculum/228-4339-750-Rev10-HQ.pdf

**Project-Based Learning (PBL)**

Here are steps for implementing PBL:

1. Start with the Essential Question
2. Design a Plan for the Project
3. Create a Schedule
4. Monitor the Students and the Progress of the Project
5. Assess the Outcome
6. Evaluate the Experience

Recommended projects to guide teachers:
https://www.edutopia.org/project-based-learning-guide-implementation
https://blog.vex.com/tag/project-based-learning/
https://www.stem.org.uk/resources/community/resource/164436/vex-iq-robotics-project

**Glossary**

| Term | Definition |
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| Algorithm | A finite set of instructions when carried out in sequence leads a specific problem being solved |
| Autopilot | This is a first-build VEX-IQ robot which is designed to be built quickly and can be guided by using the Controller or by using VEX-IQ code. |
| Behaviour | An instruction that is downloaded to a robot processor system which is then performed by the robot. |
| Block | A puzzle-like graphic which represents an instruction to be carried out using a programming languages such as Scratch |
| Code | The instructions which are written in a program for a computer to carry out as software |
| Coding | Creating the software for a computer by writing the instructions carry out using a programming language such as Scratch or VEX-Code |
| Digital Citizen | An individual who uses technology in a responsible manner to interact with society. |
| Drivetrain | A Drivetrain enables the robot to be programmed to move forward, in reverse, left, and right without programming each motor separately |
| Event | Events are triggers that make actions happen. In Scratch these are yellow blocks of codes such as “When Sprite Clicked” |

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| GPS system | Global Positioning System - a information and communication system based on the use of satellites for identifying the location of persons and objects anywhere on Earth |
| Internet of things | This describes a network of devices that are connected via the internet. Often this term is used to refer to devices such as smartphones, sensors, wearables and appliances connected within the home. |
| Mobile computing | The use of network connected, lightweight computer devices such as tablet computers, cellular phones and laptops for productivity |
| Playground | A work area used by the virtual robot in VEX-VR when executing a set of instructions written in Vex-Code or other programming language |
| Programming Language | The software instruction set used by the programmer to perform coding. Languages used include Scratch, VEX-Code, C++, Python. |
| Project-Based Learning | Project-Based Learning (PBL) is a student-centered model that organizes learning and studying around projects.<br>https://www.edutopia.org/project-based-learning-guide-implementation |
| Pseudocode | Pseudocode is an informal way of writing your computer instructions in plain English so it's readable by anyone who understands the problem |
| Robot | A machine powered by electricity which can carry out specific tasks by following programmed instructions and by using data collected automatically by sensors. |
| Robotics | The study of the design, programming, operation and application of robots |
| Sensor | A device designed to capture data automatically from the surrounding environment. |

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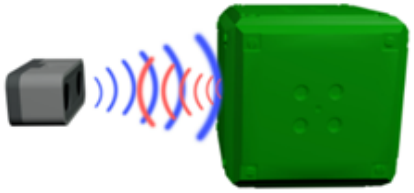
| Sensor, Color | A color Sensor can report an object's color, hue value, grayscale value, and/or proximity |
| Sensor, Distance | The Distance sensor reports the distance between it and the nearest object. It calculates distance by using the time it takes for ultrasonic waves to bounce off of an object and return to the sensor. |



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| Smart motors | Smart Motors not only enable the robot to drive forward, in reverse, and turn but are also used to move other parts of the robot such as a claw or arm for grabbing, raising, and moving objects |
| Sprite | A character or a moving object within a computer game |
| Stage | The background used as the setting for a program running in Scratch |
| Switch | Also known as a bumper switch, sends data to the robot automatically to indicate when the switch has been pressed usually when the robot touches a solid object |

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| Troubleshooting | Troubleshooting is a systematic, logical search for the source of a problem in order to solve it. |
| Wearable Technology | This refers to mobile electronic devices that are worn or attached to an individual's clothes |
| Wireless Internet | This is the use of the Internet and its services through a mobile computing device which is connected to a network by WiFi or mobile Internet Service Provider |