VEX GO - Mars Rover-Surface Operations

Unit Overview

Teacher Portal

Overview

Grades

3+ (Ages 8+)

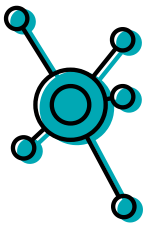
Time

40 minutes per lab

Unit Essential Question(s)

- How do I solve a challenge with the Code Base and VEXcode GO?

Unit Understandings



The following concepts will be covered throughout this Unit:

- How students can work together with VEXcode GO and a Code Base to solve problems.
- How to create a plan that correctly orders behaviors in a sequence to solve a challenge. This can be done both individually and collaboratively.
- How to communicate behaviors, through words and gestures, that the Code Base will need to execute in order to accomplish a task.

Lab Summary

Lab 1 - Collect a Sample

Main Focus Question: How can I drive my Code Base to an object?

- Students will discuss what they know about Mars and how scientists can learn more about the Red Planet. They will build the Code Base 2.0 - LED Bumper Top, to act as the Mars rover.
- Students will then build a project in VEXcode GO, together with their teacher, to drive and collect a sample with the Code Base.
- Students will then add blocks to their projects to turn the Code Base around and drive it back to the base. As students test their projects, they will place a small object, like an eraser, on top of the Code Base, to represent the sample, when the robot pauses to collect it.

Lab 2 - Collect and Bury Mission

Main Focus Question: How can I drive my Code Base to multiple objects?

- Students will start by discussing things they know that change over time and connect those to testing on Mars. They will walk through building a VEXcode GO project together as a class to drive the Code Base to collect a sample, return to the base, and "bury" the sample.
- In the Play section, students will be challenged to create a project where the Code Base drives to collect a sample, returns to the base, and "buries" the sample three times.
- Because groups will approach this problem in different ways, students will share their projects and explain why they chose that path and that code for their Code Base.

Unit Standards

Unit Standards will be addressed in every Lab within the Unit.

Computer Science Teachers Association (CSTA)

CSTA 1A-AP-10: Develop programs with sequences and simple loops, to express ideas or address a problem.

How Standard is Achieved: In Lab 1, students will build a VEXcode GO project to drive the Code Base to collect and return a sample. They will need to sequence the project so that the Code Base drives to the location, signals that the sample is being collected by having the LED Bumper Sensor glow red for 3 seconds. After the sample is collected, the LED will stop glowing, the Code Base will turn around and drive back to the

base to return the sample. The LED Bumper Sensor will glow red again for 3 seconds to indicate that the sample is being returned.

In Lab 2, students will build a project in VEXcode GO to drive the Code Base to collect and return three samples. They will develop projects using a sequence so that the Code Base drives to a location, collects a sample, has the LED Bumper Sensor glow red as it collects the sample, returns to the base, drops off the sample, and the LED Bumper Sensor glows red again indicate the sample has been "buried."

Common Core State Standards (CCSS)

CCSS.ELA-LITERACY.L.3.6: Acquire and use accurately grade-appropriate conversational, general academic, and domain-specific words and phrases, including those that signal spatial and temporal relationships.

How Standard is Achieved: In Lab 1, students will describe the intended movement of the Code Base using spatial language as they build their VEXcode GO project. After testing the project, students will explain how the Code Base moved, and compare that to the intended behaviors.

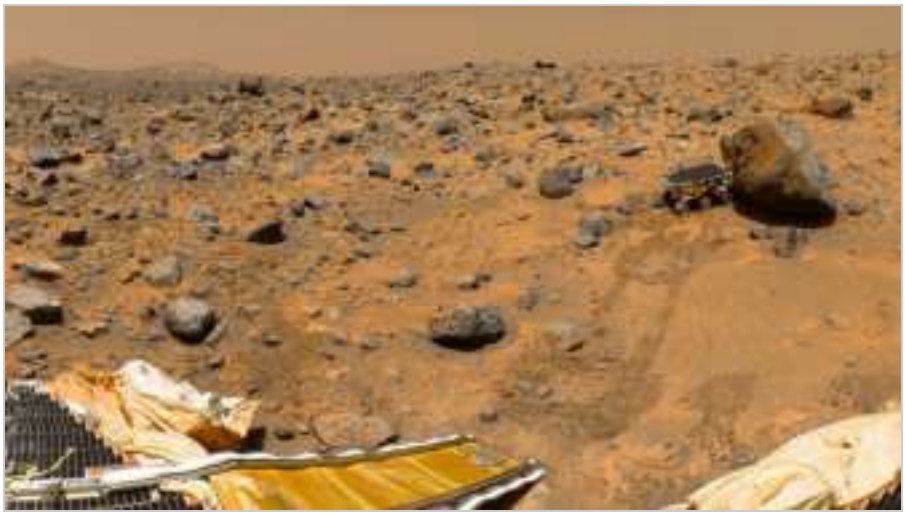
In Lab 2, students will create a VEXcode GO project where the Code Base collects three samples at different locations. As they build their projects, they will be asked to explain, using accurate spatial and sequencing language, how they want the Code Base to move in order to complete the task. After testing the project, students will compare how they intended the Code Base to move and how the robot actually behaved.

Background

The Mars Rover: Surface Operations Unit will familiarize you and your students with building VEXcode GO projects to solve a problem. The actions of the Perseverance rover and the Mars 2020 Mission are used as inspiration for the challenges the students will work through using VEXcode GO and the Code Base. The projects they create will need to be correctly sequenced to collect samples and 'bury' them.

NASA's Mars 2020 Mission

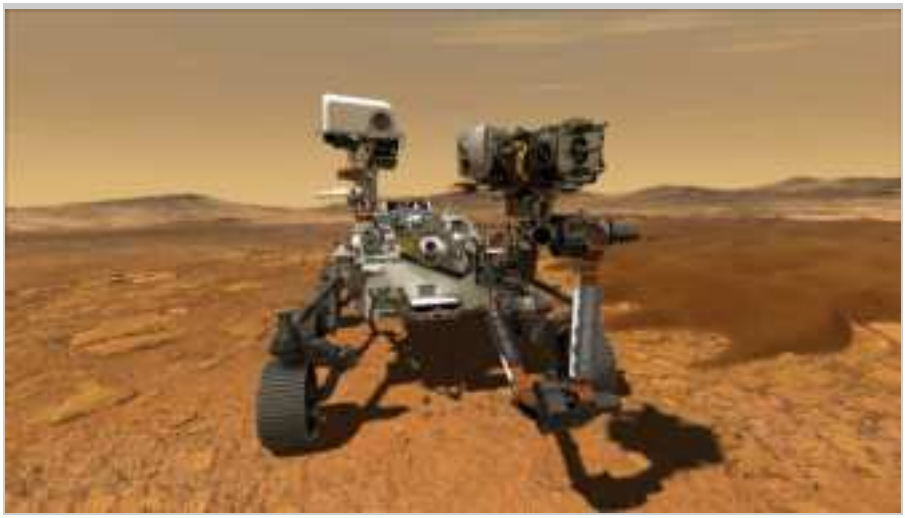
NASA's Mars 2020 Mission addresses high-priority science goals for Mars exploration: life, climate, geology, and humans. The Perseverance rover will be completing surface operations to gather data to help inform the research on the Red Planet.



Credit: NASA/JPL

What is a rover?

A rover is a device designed to move across the solid surface of a planet or other celestial body (like the Moon). Some rovers are designed to transport members of a space crew, while others are partially or fully autonomous robots. These robots are generally tasked with collecting information about the terrain and collecting samples of rocks, dirt, soil, or even liquids.



Credit: NASA/JPL-Caltech

What are surface operations?

Surface operations are the scientific studies that the rover will be completing on Mars. These are all focused on finding, collecting, and caching geological samples. To begin, Perseverance will look for compelling rocks. A rock could be considered compelling if it has the possibility to have preserved chemical traces of ancient life or to have been altered by an environment that supported microbial life.

After identifying the compelling rocks, Perseverance will drill out a sample, place it in a sealed tube, and cache them on the surface. Depot caching, used during this mission, is where multiple samples are left or buried at the same location. A future mission will then be able to retrieve these samples and return them all together to the scientists on Earth.

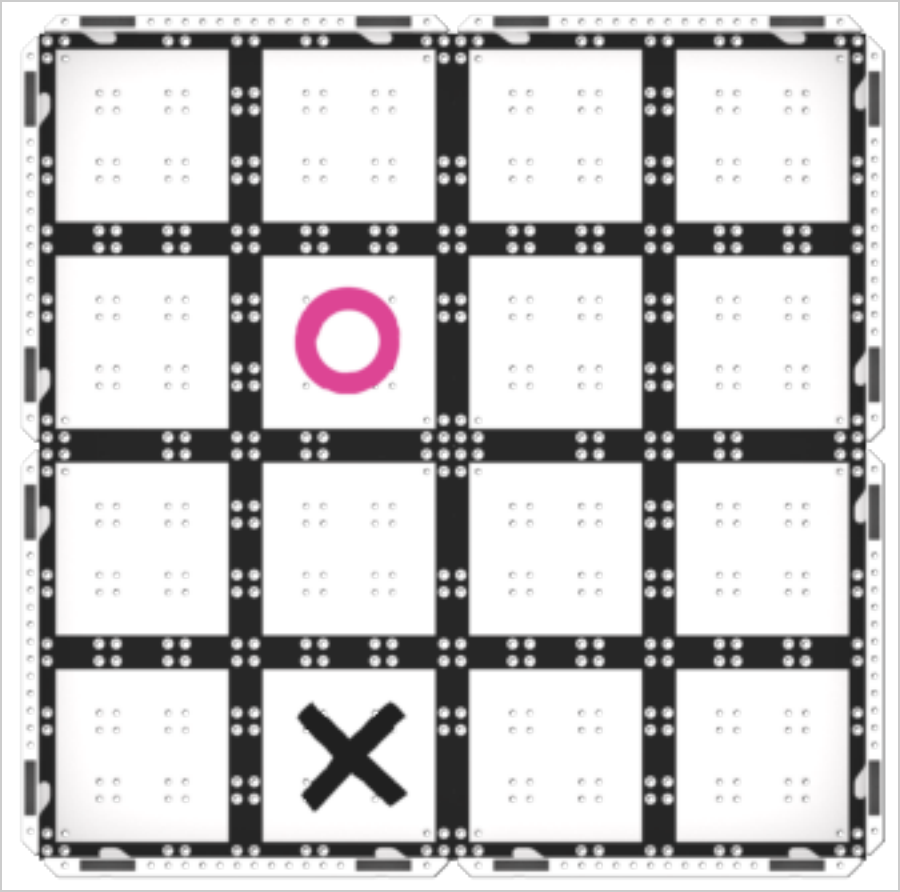
What is a sequence?

A sequence is the specific order in which behaviors are performed. An action or event leads to the next ordered action in a sequence. Sequencing is important for the Code Base, because the robot will only move exactly as the commands tell it to.

In this animation, you can see how the project starts with the {When started} block at the top of the project, then each block is executed in order from top to bottom. The Code Base drives forward for 325 millimeters (mm) on a GO Field, waits 2 seconds, then glows a color on the LED Bumper. The green Highlight Feature around the blocks indicates which individual block is running at that moment. This can provide students with immediate feedback to connect the behaviors of the Code Base with specific VEXcode GO blocks.

Steps to Sequence a Project

1. First, identify the goal —what needs to be done? For example, drive from the start to the first sample.

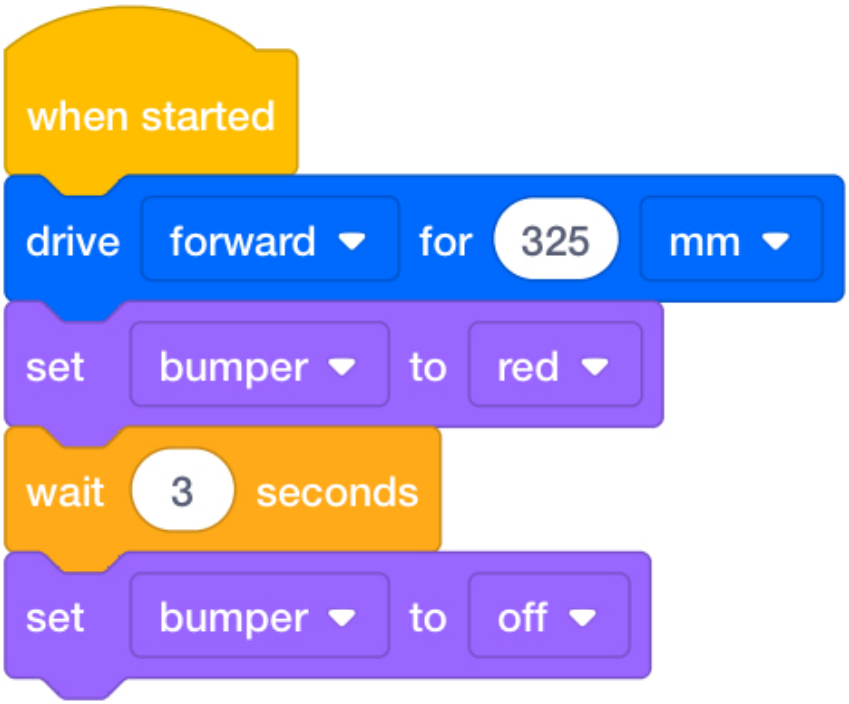


Drive to the object

2. Then, break down the steps needed to accomplish the goal, and identify the blocks needed to accomplish these steps. Here you will need to move forward 325millimeters (mm) to reach the sample, then set the LED Bumper Sensor to glow red to show that it is collecting a sample, wait 3 seconds to collect the sample, then have the LED Bumper Sensor glow stop or turn off to indicate the sample was collected. This can be accomplished with the [Drive for], [Wait], and [Set bumper color] blocks.

[Drive for], [Wait], and [Set bumper color] blocks

3. Next, plan the sequence of the project by dragging the matching blocks into the workspace and attaching them to the {When started} block from top to bottom. As each block is added, change the parameters to match the steps broken down previously.



4. Select “Start” to test the project and see if the Code Base accomplishes the goal identified in the first step.

Select 'Start'

If you want to change your project, simply change parameters, or add and remove blocks from the project before testing again.

What is VEXcode GO?

VEXcode GO is a coding environment that is used to communicate with VEX GO robots. Students use the drag and drop interface to create VEXcode GO projects that control their robots actions. Each block's purpose can be identified using visual cues such as its shape, color, and label. For more information on how to work with VEXcode GO, see the VEXcode GO Section of the VEX Library.

The following VEXcode GO blocks will be used in this Unit:

VEXcode GO blocks	Behaviors
	The {When start} block begins running the attached stack of blocks when the project is started.
	The [Drive for] block moves the Drivetrain forward or in reverse a given distance. Set how far the Drivetrain will move by entering a value into the oval.
	The [Turn for] block turns the Drivetrain for a given distance. Set how far the Drivetrain will turn by entering a value into the oval.
	The [Wait] block waits for a specific amount of time before moving to the next block in a project.
	The [Set bumper color] block sets the color of the LED Bumper.

Spatial Reasoning

Predicts STEM Proficiency

Recent studies have shown that spatial reasoning predicts STEM achievement and proficiency. In many areas of mathematics, a skill required to solve problems effectively is the ability to create an accurate and organized mental representation of the problem that is to be solved. Being able to create that representation requires the ability to visualize mentally. In fact, research shows that spatial reasoning is linked to performance within many strands of mathematics including: basic magnitude and counting skills.

Spatial reasoning is an umbrella term that encompasses many cognitive processes, including understanding the characteristics of a particular object, the similarities and differences between objects, the transformation of an object (e.g. a rotation), and being able to mentally compose/decompose an object based on seeing its pieces or parts (e.g. composing a number with smaller numbers as in an equation, 4+2=6).

Some examples of spatial reasoning skills include the ability to comprehend and recognize imaginary movements in space, describe experiences and observations using spatial language, and explain mental processes using gestures.

Most children have a sense of self-efficacy by the time they reach kindergarten about mathematics. Some students may feel they have a strong understanding, while others may have a sense of despair. Spatial reasoning skills have a strong correlation with mathematical proficiency and can be improved regardless of a child's age. A great way to improve spatial reasoning is to have students participate in constructional tasks that require these skills. This should not come as a surprise, since teachers have known for some time that students often retain concepts better when they have the opportunity to engage those concepts in a hands-on activity.

Beyond the activities contained within this unit, students are also prompted to engage in "spatial talk" throughout their activities. With spatial talk, students are asked, for example, to describe where certain pieces are being placed as an object is built.

Applying VEX GO

Connection to VEX GO

The Mars Rover: Surface Operations Unit is a great way for students to be introduced to VEXcode GO and continue to build on their understanding of sequencing in coding. In Lab 1, students are introduced to the Mars 2020 mission and how scientists can use robots to help them study the planet from here on Earth. Just like robotic rovers used on Mars, students will need to code their Code Base to complete a task. They will build a VEXcode GO project to drive the Code Base to collect and return a sample. Students will need to sequence the project so that the Code Base drives to the location, glows a color while the sample is collected, then drives back to the base and glows again to show that the sample has been successfully returned.

In Lab 2, students are challenged to create a project to where the Code Base collects and buries three different samples. They will develop a VEXcode GO project using a sequence to have the Code Base drive to a location, glows a color to show that it is collecting a sample, return to the base, drop off the sample, and glow again to indicate the sample has been 'buried,' and repeat this process three times. Throughout both of these Labs, students will practice spatial reasoning by describing how the Code Base is moving, and how the behaviors of the robot compare to what students intended. Students will communicate the mental models of how they intend the Code Base to move by acting out or gesturing to help as they verbally explain the movements of the robot.

Making this Unit Come Alive in Your Classroom

This VEX GO STEM Lab Unit does not need to be an isolated activity or disconnected piece of your classroom curriculum. It can be part of a larger theme in your classroom, to immerse students in project-based learning about

Mars, or space in general.

Make this Unit Come Alive in Your Classroom

Some strategies to support this include:

- **Mars Bulletin Boards** - Create a Mars inspired bulletin board to showcase students' learning in this Unit, and more broadly. Use backing paper to make the bulletin board the color of Mars, have students add creative elements using tissue paper, construction paper, or markers, to show what they envision the surface of Mars looks and feels like. Add photos of students working throughout the Lab, along with students' own writings, posters, drawings, or questions about what they are learning about Mars outside of the VEX GO Unit.
    - Add these elements to your VEX GO Learning Center, to carry the Mars theme through this area. Utilize resources like the NASA website to find imagery and information related to the Perseverance rover missions, to make this real world connection more visible for your students.
- **Connect to Language Arts** - Take a trip to the school or neighborhood library, and have students borrow books related to Mars, rovers, NASA, or space. Add these books to your classroom library, and have students go on "fact finding missions" to find the answers to certain questions in these non-fiction texts.
    - Students can also write expository or informational essays or paragraphs to share what they have learned about the NASA 2020 Mission, the Perseverance rover, or Mars more generally. Students can create short videos to share their learning as well, that you can then share with your classroom community.
    - Have students write letters to NASA scientists and engineers to share what they are doing and learning with VEX GO, and ask questions about what they are curious about. Hang these letters in your classroom so students can see what their classmates are more curious about.
- **Get creative -** Make models of planets and spacecraft and hang them from the ceiling, or high up in your classroom. Have students make posters of different rovers from the past or the present, that highlight what

they were designed for, special features they have, and how they work. Students can also design their own rovers, or rover additions, and hang their designs around the room.

Teaching Coding

Throughout this Unit, students will be engaged with different coding concepts such as decomposition and sequencing. The Labs within this unit will follow a similar format:

- **Engage:**
  - Teachers will help students make a personal connection to the concepts that will be taught in the Lab.
  - Students will complete the build.
- **Play:**
  - **Instruct:** Teachers will introduce the coding challenge. Ensure that the students understand the goal of the challenge.
  - **Model:** Teachers will introduce commands that will be used in the creation of their project to complete the challenge. Model the commands by projecting VEXcode (GO/123) or by showing physical (representations of the blocks/Coder cards). For Labs that include pseudocode, model for students how to plan and outline the intention for their projects.
  - **Facilitate:** Teachers will be given prompts to engage students in a discussion about what the goals of their project are, the spatial reasoning involved in the challenge, and how to troubleshoot unexpected outcomes of their projects. This discussion will also verify that the students understand the purpose of the challenge and how to properly use the commands.
  - **Remind:** Teachers will remind students that the first attempt of their solution will not be correct or run properly the first time. Encourage multiple iterations and remind students that trial and error is a part of learning.
  - **Ask:** Teachers will engage students in a discussion that will connect the Lab concepts to real-world applications. Some examples could include, “have you ever wanted to be an engineer?” or “where have you seen robots in your life?”
- **Share:** Students have an opportunity to communicate their learning in multiple ways. Using the Choice Board, students will be given a “voice and choice” for how they best display their learning.

Pacing Guide

This unit should be implemented to supplement student learning on the concepts of coding the Code Base to solve a challenge with VEXcode GO.

STEM Labs can be adapted in various ways to fit into any classroom or learning environment. Each STEM Lab includes the following 3 sections: Engage, Play, and Share (optional).

Each STEM Lab in this unit can be completed in as little as 40 minutes

Section Summary

The Engage and Play sections, which contain the primary learning activities, can be completed within 40 minutes. The Share section, which enables students to express their learning is optional, but estimated at around 3-5 minutes per group.

Engage (20 minutes)

The Engage section is the introductory section designed to capture the student's attention. This section is intended to be a whole-class activity. It includes a hook, a leading question that personalizes the learning for students, and the build that will be utilized to create a hands-on, exploratory learning experience that places STEM into the hands of young learners.

Play (20 minutes)

The Play section is split into 3 parts in order to structure learning while maintaining student interest: Part 1, Mid-Play Break, and Part 2. In Play Part 1, students will run an investigation, test, and/or make predictions about scientific phenomena using their build as it relates to the key concepts of the unit. The Mid-Play Break includes a discussion of Part 1 and transition to Part 2. In Play Part 2, students will continue to explore their builds and deepen their understanding of key concepts by applying their knowledge in new ways.

Share (Optional: 3-5 minutes per group)

The Share section is the closing section of the lab whereby students can think about their learning through discussion of observations made during the activity and make connections about how the concepts could apply to other areas in their lives. Students are also given the opportunity to consider the cooperative learning components of the lesson.

The Pacing Guide

The pacing guide for each Lab provides step-by-step instructions on What, How, and When to teach. The STEM Lab Pacing Guide previews the concepts that are taught in each section (Engage, Play, and Share (optional)), explains how the section is delivered, and identifies all the materials that are needed.

Lab 1 - Collect a Sample

Total Time: 40 minutes

Engage	Play	Share
20 mins	20 mins	Optional 3-5 mins per group

Build
Code Base 2.0 - LED Bumper Top

Engage
Students will discuss what they know about Mars and how scientists can learn more about the red planet. They will build the Code Base 2.0 - LED Bumper Top, to act as the Mars rover.

Play
Students will build a project in VEXcode GO to drive the Code Base to the location of a sample and wait for three seconds so the sample can be collected. After collecting the sample, the LED Bumper on the Code Base will glow a color to indicate the sample was collected! In Play Part 2, students will add to their projects to turn the Code Base around and drive it back to the base.

Share
Students discuss how they worked together to create and test their projects.

Main Focus
How can I drive my Code Base to an object?

Materials Needed

- VEX GO Kit
- Code Base 2.0 Build Instructions
- Code Base 2.0 - LED Bumper Top Build Instructions
- Robotics Roles & Routines
- Pencils
- VEX GO Field Tiles and Walls
- Tablet or Computer
- VEXcode GO
- Lab 1 Image Slideshow
- Dry erase markers
- White board eraser
- Small classroom items (i.e. erasers, pom poms)
- Pin Tool
- Get Ready...Get VEX...GO! PDF Book (optional)
- Get Ready...Get VEX...GO! Teacher's Guide (optional)

Lab 2 - Collect and Bury Mission

Total Time: 40 minutes

Engage	Play	Share
20 mins	20 mins	Optional 3-5 mins per group

Build
Code Base 2.0 - LED Bumper Top

Engage
Students discuss how things change over time (plants grow, pets grow, leaves change color). Scientists can study things as they change in order to learn more about them. The Code Base in the next part of its mission, is going to collect samples, do an initial study, and then bury the samples so they can be brought back to Earth to be studied later.

Play
Students will build and test a VEXcode GO project where the Code Base collects samples and takes them to the base so they can be buried. They will be challenged to collect and bury all three samples in any order they choose.

Share
Students share their projects and discuss how projects differ from group to group. How do the projects differ from one group to another? Why did they choose to pick up the samples in that order?

Main Focus
How can I drive my Code Base to multiple objects?

Materials Needed

- VEX GO Kit
- Code Base 2.0 Build Instructions
- Code Base 2.0 - LED Bumper Top Build Instructions
- Robotics Roles & Routines
- Pencils
- VEX GO Field Tiles and Walls
- Tablet or Computer
- VEXcode GO
- Lab 1 Image Slideshow
- Dry erase markers
- White board eraser
- Small classroom items (i.e. erasers, pom poms)
- Small colored flags or colored paper (optional)

- Pin Tool
- Get Ready...Get VEX...GO! PDF Book (optional)
- Get Ready...Get VEX...GO! Teacher's Guide (optional)

Making This Unit Fit Your Unique Classroom Needs

Not every classroom is the same, and teachers face a variety of implementation challenges throughout the year. While each VEX GO STEM Lab follows a predictable format, there are things that you can do in this Unit to help make it easier to meet those challenges when they arise.

- **Implementing in less time:**
  - For a coding-focused quick implementation of Lab 1, implement Play Part 1 as a whole class activity. Have the class share ideas and follow along with you to plan, create and test a project that drives the Code Base to collect the first sample.
  - In Lab 2, you can combine Play Parts 1 and 2, and have students only retrieve two samples with their code rather than all three samples.
  - To briefly summarize coding instruction in this Unit, have students watch the Driving Your Robot tutorial video to learn about Drivetrain blocks, and the Sequencing tutorial video to explain the importance of the order of blocks in a project.
- **Activities to support reteaching:**
  - If students are struggling to build a successful project in Lab 2, show them the Sequencing tutorial video to reiterate the importance of sequence in building a project that works as intended.
  - For additional practice with planning and sequencing a project, have students complete the Create a Course GO Activity to code the Code Base to follow a path.
- **Extending this Unit:**
  - Once groups have successfully collected their samples, have them try to use the Drive Tab in VEXcode GO, to collect the samples using remote control driving. Then, compare and contrast the movement and accuracy of the Code Base between remote control driving and driving with their coding projects. Which is faster? Which is more precise? Which drives further? What are some advantages and disadvantages to each form of driving the Code Base?
  - Use the Choice Board activities to extend the Unit, while allowing students to express their voice and choice in what activities they want to complete.
  - To extend the Unit, have students experiment with the Astronaut Vault GO Activity, to continue practicing driving the Code Base and exploring how to change the speed of the Code Base. What could be the advantages to driving faster to collect samples? What about the disadvantages? How might that effect the battery life of the rover?
- **If students get done building at different times,** there are a number of meaningful learning activities early finishers can participate in as the rest of the group finishes building. View this article for several suggestions about how to plan for engaging students who finish building earlier than others. From establishing

classroom helper routines to completing short activities, there are many ways to keep all students engaged throughout class building time.

The following **VEXcode GO resources** support the coding concepts that are taught in this STEM Lab Unit. Above are some ways to use these resources to support your implementation needs from catching up for missed class time to remote learning and differentiation. Below is more information about these resources, so you can be confident and prepared for the suggested implementations or when using these resources to best suit your own unique teaching environment.

VEXcode GO Resources

Concept	Resource	Description
Drivetrain Commands	**Driving Your Robot** Tutorial Video	Describes basic movements using the [Drive for] and [Turn for] blocks in a project.
Drivetrain Commands	**Turning Your Robot** Tutorial Video	Describes the difference between the kinds of Drivetrain turn blocks. Use this to expand the coding instruction in Lab 2.
Drivetrain Commands	**Turning Accurately** Example Project	Shows the different kinds of Drivetrain turn blocks used in a project. Use this with the Turning Your Robot tutorial video for an additional challenge.
Sequencing	**Sequencing** Tutorial Video	Defines sequence and explains the importance of ordering blocks in a project so the robot performs as you intent it to.

Using VEXcode GO Help

In this Unit, the VEXcode GO projects are provided for the student either in the form of example projects or images of projects to recreate. You can use the Help feature together with your students as an extension tool to explain how specific blocks are functioning in one of the projects.

After reading the description for, or with your student, you can ask students to describe how the block functions in the project they are working on. If students want more practice with a specific block, have them look at the example provided and ask them what the robot will do in the project shown, then you can help them make connections to how that is similar or different to the project they are working on in the Unit.

Blocks in this Unit include:

- [Drive for]
- [Turn for]
- [Wait]
- [Set bumper color]

Choice Board

Choice Board Examples & Strategies

Use the Choice Board to allow students to display their voice and choice within their learning. The Choice Board can be used in multiple ways by the teacher to:

- Engage students who finish early
- Assess what students have learned at different points throughout the Unit
- Extend the Unit or lesson
- Allow students to display their learning in the Share section

The Choice Board is intended to provide content that can be added to the classroom's existing Choice Board or to any bulletin board in the classroom.

The following is the Choice Board for this Unit:

Choice Board		
Dear NASA Write a letter to a NASA engineer to ask questions about a real Mars Rover project. What are they learning about? What do you hope they will find?	**Collection Device** Design and build an extension onto your Code Base to help collect samples. Can you create something to push, pull, or hold the samples as the Code Base returns them to the base?	**How far?** How far is your Code Base traveling? Add up the distances in all of your projects, to see how far it is going all together.
Change Calendar Think of something that changes during a year (leaves, snow, etc.). Draw or write all of the changes that happen to that object over a year. Can you think of 6 changes?	**Recess Rover** Create a recess game where you move like the Mars Rover. Draw or write the rules and the goal of the game, then share it with your teacher at recess.	**From the Future** Write a journal entry from the future, as the scientist who gets the collected samples from Mars. How did they change? What did you learn?
Remote Control Rover Try driving your Code Base to collect samples using the Drive Tab in VEXcode GO. Compare and contrast the movement of the robot between code and remote control.	**Watch out for the crater!** Imagine that there is a crater between your Code Base and the first sample. Create a project to drive around the obstacle, to collect the sample and return it to base.	**Communication Test** Work with a partner, where one of you is the "sequencer," and the other is the "driver." Reset the Field so that the driver cannot see where the objects are. The sequencer needs to communicate how to navigate the Code Base to the driver, who will build the project in VEXcode GO. Test your communication as you test your project!

Vocabulary

VEXcode GO

A programming language used with VEX GO robots.

{When started} block

A block that begins running the attached stack of blocks when the project is started.

[Drive for] block

A block that moves the Drivetrain forward or in reverse a given distance.

[Turn for] block

A block that turns the Drivetrain for a given distance.

[Wait] block

A block that waits for a specific amount of time before moving to the next block in a project.

[Set bumper color] block

A block that sets the color of the LED Bumper.

Mars

The fourth planet from the Sun, often referred to as the “Red Planet.”

Rover

A vehicle designed and used to explore a surface, like Mars.

Sample

A small piece of a larger object, like soil from the surface of Mars, that can be collected.

Encouraging Vocabulary Usage

The following are additional ways to facilitate vocabulary usage as students are engaged in the activities throughout this Unit.

Students should be encouraged to use the vocabulary terms:

- Throughout all of the activities
- As they are working in groups
- As they are reflecting
- As they are sharing their knowledge and experience

Tips for Encouraging Vocabulary Usage

- **Track the Terms -** Keep track of the number of times students correctly use vocabulary or other terminology from the Unit in their conversations outside of the STEM Labs. Offer a reward for the

students who can use the most terms over the course of the week.

- **What other words have you learned? -** Students are always learning new words through their learning experiences. At the end of each Lab, or the whole Unit, ask students to share all of the new words they've learned - start with the vocabulary terms, but ask students for others and add them to your GO documentation in the classroom as well.

Letter Home

In each VEX GO STEM Lab unit, you will find a letter home. The purpose of this letter is for your classroom guardians to receive a detailed and content-specific guide of what the students are learning and creating when using VEX GO Kits in the classroom.

The letter home is easily accessible in an editable format for you to copy and personalize to best fit the needs of your students. The letter will include an introductory description about the unit, all unit titles, vocabulary and definitions, an explanation on how the content is relevant to daily life, and suggested follow-up questions for at-home discussions.

Altogether the letter home encompasses a go-to resource for guardians to glimpse into the daily life at school and be a part of the day-to-day learning their student is engaging in.

Editable Letter Home (Google / .docx / .pdf)

Mars Rover: Surface Operations Letter Home

Introduction

In the Mars Rover: Surface Operations STEM Lab Unit, students will use the actual explorations of the Mars Rover as inspiration to explore coding the Code Base using VEXcode GO. Students will be introduced to some of the elements of Mars Rover missions that are currently underway, like collecting samples from the surface of Mars for future study. The coding challenges in this Unit will use the Code Base to mimic activities of the real Mars Rover, by creating projects in VEXcode GO to drive, collect, and “bury” samples for study.

Students will explore the question - *How do I solve a challenge with the Code Base and VEXcode GO?* In this Unit, students will use VEXcode GO, a coding platform on a computer or a tablet, that enables students to drag and drop blocks to build a project that can be carried out by the Code Base. Students will first code their robot to act as the rover, and drive from the base, collect a sample, and then back to the base in Lab 1, through guided exploration as a class. In Lab 2, students will apply what they learned in Lab 1, to collect multiple samples, and “bury” them for future study.

Please keep this letter for your reference as your student works through the Mars Rover: Surface Operations Unit. It contains information that you can use to keep up to date on what students are learning and to spark discussions about Computer Science and coding at home.

Look Inside the VEX GO STEM Lab Unit

In **Lab 1: Collect a Sample**, students will discuss what they know about Mars and how scientists can learn more about the “red planet”. They will build their Code Bases to act as Mars rovers and observe a demonstration of how to use VEXcode GO to create a project where the Code Base drives to collect a sample. Students will then build projects in VEXcode GO to drive and collect a sample with the Code Base, and return it to the base.

In **Lab 2: Collect and Bury Mission,** students will start by discussing things they know that change over time, and connect those to testing on Mars. They will walk through

building a VEXcode GO project together as a class to drive the Code Base to collect a sample, return to the base, and “bury” the sample. Students will then be challenged to create a project where the Code Base drives to collect a sample, returns to the base, and ‘buries” a sample three times. Groups will approach this problem in different ways, so students will be invited to share their projects and explain why they chose that path and that code for their robot, at the end of the Lab.

Vocabulary

General notes on encouraging vocabulary usage with children:
The vocabulary words offered are not meant for students to memorize terminology, but to give them language to use to talk about the activities and learning they are doing throughout the Unit. Work these terms into conversations naturally, and positively reinforce this for students as well.

The names of VEXcode GO blocks that are included in the vocabulary are meant to help students learn the names of the blocks they are using so that they are able to refer to those blocks correctly when building future projects. Ask students about how they used these blocks in their projects, and what they say or heard the Code Base do with each block, to help them build their VEXcode GO vocabulary.

- **VEXcode GO -** A programming language used with a GO Robot.
- **{When started} block -** A block that begins running the attached stack of blocks when the project is started.
- **[Drive for] block -** A block that moves the Drivetrain forward or in reverse a given distance.
- **[Turn for] block -** A block that turns the Drivetrain for a given distance.
- **[Wait] block -** A block that waits for a specific amount of time before moving to the next block in a project.
- **[Set bumper color] block -** A block that sets the color of the LED Bumper
- **Mars -** The fourth planet from the Sun, often referred to as the “Red Planet”.
- **Rover -** A vehicle designed and used to explore a surface, like Mars.
- **Sample -** A small piece of a larger object, like soil from the surface of Mars that can be collected.

Connection to Daily Life

Scientists are studying Mars to learn more about how it changes over time, which is something that students can relate to in their own lives. They are exposed to many things that undergo changes over time, from nature to themselves. Thinking about what can be learned by studying those changes can pique students' curiosity about the world around them. Talk with your students about things that have changed in your lifetime, things that change over time outside your window, or ways that your student has changed over time. Ask your student questions about what they can learn from those changes, and how that might change their thinking about a particular topic or idea.

Through the coding explorations in this Unit, students will need to work in sequences, thinking precisely about the order in which they add blocks to their projects. Students will likely have to work through some iteration and find the persistence to keep trying until they find a solution. Both of these things are generalizable to life outside of code — as students are often tasked with doing things that require a series of steps, and that may not go correctly the first time around. Help your student to build this persistence for iteration by sharing stories of things you have done that were "tricky," or required a few tries to learn — like trying a new recipe and having it not turn out right the first time, or learning to drive, and needing to practice. Talking about these things with your student can let them know that they are not alone in their frustration, that making mistakes and trying again is part of learning something new, and that persistence pays off.

Follow-up questions to ask at home

Use these questions to discuss the activities that your student is participating in with their group. Included here are questions that address the trial and error that is an essential part of building and coding. It will likely take several tries for your student to create their VEX GO Builds and create successful coding projects. Asking process-oriented questions and celebrating mistakes can encourage learners to embrace making mistakes and help them build resilience and confidence to persist when confronted with challenges.

1. How did you code the Code Base to act like the Mars Rover?
2. How did you work with your group to build your projects?

3. What part of the challenge took your group a few tries to get right? What did you learn from trying again?
4. What do you think the real scientists are learning about Mars? If you were one of them, what would you want to look for or find out?
5. What is something that made you feel proud of yourself and your group? Was it an easy thing, or a harder thing for you and your group to do?
6. What is something you know about coding that you didn't know before this challenge? What do you want to learn more about?