Goals and Standards

Implementing VEX GO STEM Labs

STEM Labs are designed to be the online teacher's manual for VEX GO. Like a printed teacher's manual, the teacher-facing content of the STEM Labs provides all of the resources, materials, and information needed to be able to plan, teach, and assess with VEX GO. The Lab Image Slideshows are the student-facing companion to this material. For more detailed information about how to implement a STEM Lab in your classroom, see the Implementing VEX GO STEM Labs article.

Goals

Students will apply

- Using the [Wait until] block with the <Found object> block together in a VEXcode GO project that will continually check a condition and will not move to the next block until the condition is met.

Students will make meaning of

- How to code the Code Base robot to solve a challenge, such as driving until an object is detected.

Students will be skilled at

- Using build instructions to build the Code Base 2.0 - Eye Forward.
- Connecting a Brain to a tablet or computer in VEXcode GO.
- Saving and naming projects in VEXcode GO.
- Adding VEXcode GO blocks to a project.
- Sequencing blocks in a project.
- Using Drivetrain blocks in a project to have the Code Base drive to a specific location.

- Changing parameters in VEXcode blocks.
- Starting and stopping a project in VEXcode GO.

Students will know

- How the Eye Sensor on the Code Base can be used to detect objects.
- That the <Found object> block in VEXcode GO works with the Eye Sensor to detect an object in its field of view.
- How to use the [Wait until] block with the <Found object> block in a project to have the Code Base drive until it detects an object.

Objective(s)

Objective

1. Students will develop a VEXcode GO project using the [Wait until] and <Found object> blocks together with Drivetrain blocks to complete a challenge.
2. Students will identify that the Eye Sensor on the front of the Code Base 2.0 - Eye Forward can detect objects in its field of view.
3. Students will communicate behaviors, through words and gestures, that the Code Base will need to complete in order to accomplish a task.

Activity

1. In Play Part 1, students will create a project using the [Wait until] and <Found object> block together to have the Code Base drive until the Eye Sensor detects an object.
2. In Engage, students will build the Code Base 2.0 - Eye Forward and identify the Eye Sensor on the front of the Code Base. In Play Part 1, students will see how this sensor is used to detect when an object is present by using the <Found object> block in a project and testing it on a Field.
3. In Play Part 1, students will describe how the Code Base moves when the [Wait until] and <Found object> blocks are used with Drivetrain blocks in a project.

Assessment

1. In Play Part 2, students will add an LED Bumper to their build and add to their projects so the LED glows a color after an object is detected by the Eye Sensor. Students build and test a project that successfully has the Code Base drive until an object is detected, then it will stop and the LED Bumper will glow for 3 seconds.
2. In the Play section, the students will identify the location of the Eye Sensor on the front of the Code Base and place the robot so the obstacle is in the field of view of the Eye Sensor.
3. In Play Part 2, students will describe how the additional blocks added affect the behaviors of the Code Base.

Connections to Standards

Showcase Standards

Computer Science Teaching Association (CSTA)

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

How Standard is Achieved: Students will build a VEXcode GO project to drive the Code Base until the Eye Sensor detects an object during Play Part 1. During the Mid-Play Break, students will observe the highlight feature in VEXcode GO and describe the project flow with the [Wait until] and <Found object> blocks. Students will then add onto their projects in Play Part 2 to have the Code Base signal after it has detected an obstacle by having the LED Bumper on the Code Base glow green for 3 seconds. They will need to sequence the project so that the Code Base first drives until it detects an object, then glows to represent that the Eye Sensor has detected something. The LED Bumper will glow for 3 seconds, then turn off.

Showcase Standards

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: Students will describe the movement of the Code Base using words and gestures as they build and test their project during the Play sections. After building and testing a project during Play, students will recount how the Code Base moved in relation to the “obstacle” on the Mars landing area (the GO Field) in the Mid-Play Break and Share sections.

Summary

Materials Needed

The following is a list of all the materials that are needed to complete the VEX GO Lab. These materials include student facing materials as well as teacher facilitation materials. It is recommended that you assign two students to each VEX GO Kit.

In some Labs, links to teaching resources in a slideshow format have been included. These slides can help provide context and inspiration for your students. Teachers will be guided in how to implement the slides with suggestions throughout the lab. All slides are editable, and can be projected for students or used as a teacher resource. To edit the Google Slides, make a copy into your personal Drive and edit as needed.

Other editable documents have been included to assist in implementing the Labs in a small group format. Print the worksheets as is or copy and edit those documents to suit the needs of your classroom. Example Data Collection sheet setups have been included for certain experiments as well as the original blank copy. While they offer suggestions for setup, these documents are all editable to best suit your classroom and the needs of your students.

Materials	Purpose	Recommendation
Pre-Built Code Base 2.0 - Eye Forward	For demonstration purposes.	1 for demonstration
VEX GO Kit	For students to build the Code Base 2.0 - Eye Forward robot.	1 per group
Code Base 2.0 Build Instructions (3D) or Code Base 2.0 Build Instructions (PDF)	For students to follow to build the Code Base 2.0.	1 per group
Code Base 2.0 - Eye Forward Build Instructions (3D) or Code Base 2.0 - Eye Forward Build Instructions (PDF)	To add the Eye Sensor to the Code Base 2.0 Build.	1 per group
Tablet or Computer	For students to use VEXcode GO.	1 per group
Lab 1 Image Slideshow Google Doc / .pptx / .pdf	For visual aids while teaching.	1 for class to view
Robotics Roles & Routines Google Doc / .docx / .pdf	Editable Google Doc for organizing group work and best practices for using the VEX GO Kit.	1 per group
Pencils	For students to fill out the Robotics Roles & Routines Checklist.	1 per group
Scrap white or light-colored paper	To ball up and use as obstacles on the Field.	1-2 per group
VEX GO Field Tiles and Walls	To use as a testing area for the Code Base.	4 Tiles and 8 Walls per Field for testing
Pin Tool	To help remove pins or pry beams apart.	1 per group
VEXcode GO	For students to build projects for the Code Base.	1 per group
Get Ready...Get VEX...GO! PDF Book (optional)	To read with students to introduce them to VEX GO through a story and introductory build.	1 for demonstration purposes
Get Ready...Get VEX...GO! Teacher's Guide (optional)	For additional prompts when introducing students to VEX GO	1 for teacher use

Materials	Purpose	Recommendation
Google Doc / .pptx / .pdf	with the PDF Book.	

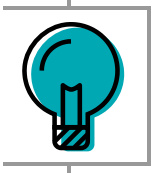
Engage

Begin the lab by engaging with the students.

Hook

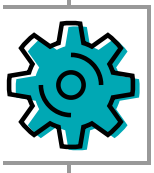
What senses do you have? How do you use your senses? The Code Base 2.0 - Eye Forward robot has an Eye Sensor on the front that will detect when an object is near.

Note: If students are new to VEX GO, use the Get Ready...Get VEX...GO! PDF book and Teacher's Guide (Google Doc/.pptx /.pdf)
to introduce them to learning and building with VEX GO. Add an additional 10-15 minutes to your lesson time to accommodate this additional activity.



Leading Question

How can we use the Eye Sensor on the Code Base - Eye Forward robot to detect an obstacle in the Mars landing area?



Build

Code Base 2.0 - Eye Forward

Play

Allow students to explore the concepts introduced.

Part 1

Students will pretend the Code Base is a Mars rover that is tasked with detecting and clearing obstacles from the Mars landing area (GO Field). They will build a project in VEXcode GO together with their teacher, to drive the Code

Base until an obstacle is detected on the Mars landing area.

Mid-Play Break

Students will observe how the green highlight feature moves as their VEXcode GO project is started. They will compare the movement with the highlight to the behaviors of the Code Base.

Part 2

Students will add a LED Bumper Sensor to the top of their Code Base. Then, they will add a [Wait] and two [Set bumper color] blocks to their project to make the LED Bumper on the Code Base glow after an object is detected by the Eye Sensor.

Share

Allow students to discuss and display their learning.

Discussion Prompts

- If someone came to our class, who did not know about the Eye Sensor on the Code Base, how would you explain what it does to them?
- How did you work together to build and test your project?
- What else do you think the Eye Sensor could detect in our classroom? How could you test your theory?

Engage

Launch the Engage Section

ACTS is what the teacher will do and ASKS is how the teacher will facilitate.

ACTS	ASKS
1. Hold up a marker for the class, and demonstrate each sense as you ask the class. Take the cap off to smell it, hold it to your ear to listen to it, look at it up close and far away, etc. 2. Guide students to the idea of using their five senses. 3. Have students share their ideas about whether or not they think the robot can “sense” and why they feel that way. 4. Hold up the Code Base 2.0 - Eye Forward robot and show students the Eye Sensor on the front. You may want to pass the robot around so students can see the Eye Sensor for themselves. 5. Have students share their ideas about what might be an obstacle on the surface of Mars. Make a list of “Obstacles” on the board, as students name things. 6. Show students the Lab setup —the Field will be the Mars landing area, and the balled up paper will be an obstacle. (See the Lab 1 Image Slideshow (Google Doc / .pptx / .pdf) for the suggested setup for this Lab.)	1. If we didn’t know what this thing was, how could we figure it out? What do we see? What does it smell like? What does it feel like? Does it make a sound? 2. What are we using to figure this out? What do see, hear, touch, taste, and smell all have in common? 3. We use our senses to learn about the things around us. Do you think our Code Base can sense things too? Why or why not? 4. Guess what, robots CAN sense things - using sensors. This Code Base build has an Eye Sensor. What do you think that Eye Sensor might do to help the robot learn about what is around it? If our robot was in a new place, like Mars, could the Eye Sensor help it there? 5. Imagine a rover is trying to land on Mars. What would the Eye Sensor on the Code Base need to look for, or detect, to help the rover land safely? What obstacles might be in the way? 6. How do you think we can code our Code Base to detect obstacles, so it can help the rover land safely on Mars? Let’s find out together!

Getting the Students Ready to Build

Before we can start coding our Code Base to detect obstacles on the Mars landing area, we need to build the Code Base 2.0 - Eye Forward!

Facilitate the Build

1

Instruct

Instruct students to join their group, and have them complete the Robotics Roles & Routines sheet. Use the Suggested Role Responsibilities slide in the Lab 1 Image Slideshow as a guide for students to complete this sheet.

Distribute

2

Distribute build instructions to each team. Journalists should gather the materials on the checklist.

Code Base 2.0 - Eye Forward build

3

Facilitate

Facilitate the building process.

- Builders and Journalists should begin building based on their roles and responsibilities, like those shown in the Lab 1 Image Slideshow.
- Circulate around the room to help students with building or reading instructions where needed. Ask questions about how the build is being constructed to keep all students engaged in the buildings process, and remind students to follow their Role Responsibilities if they need help taking turns.

Offer

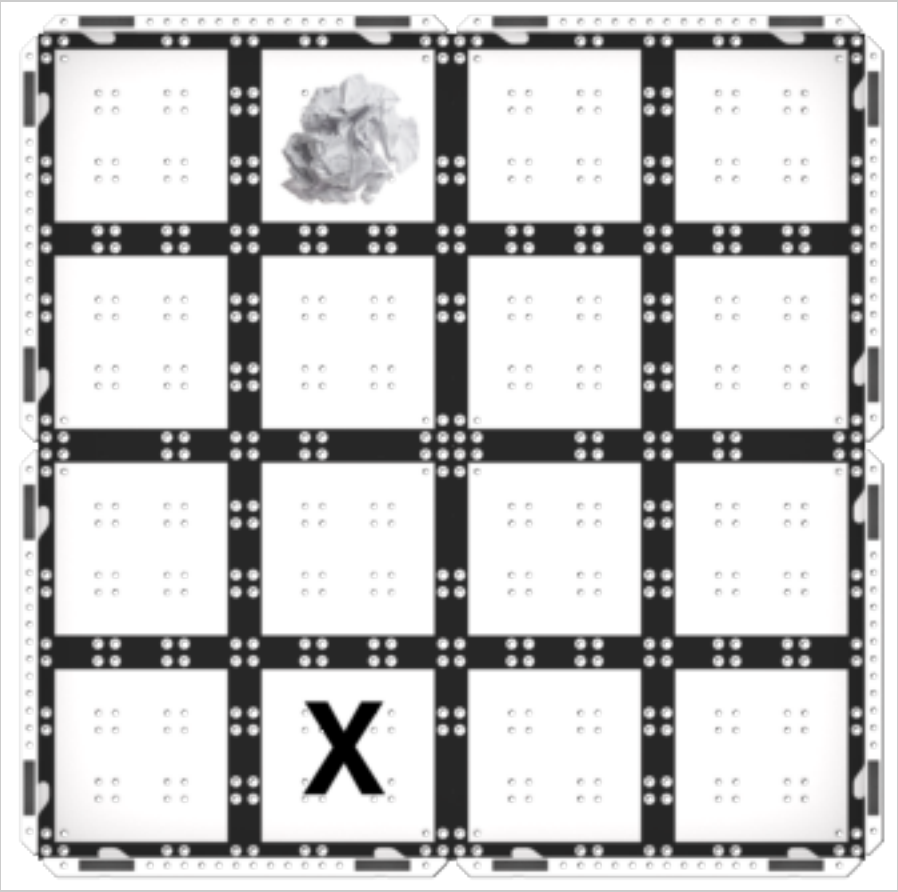
4 Offer suggestions and note positive team building and problem solving strategies as groups build together.

Teacher Troubleshooting

- **Remember to use white or light-colored paper or objects as the obstacles —** The Eye Sensor uses infrared light to detect objects, and since dark-colored objects absorb infrared light, it makes it very difficult for the Eye Sensor to detect them.
- If the wires seem to be getting in the way for students, use a rubber band to pull them together, and you can tuck the bundle into the build if needed, to keep the wires from impeding the movement of the Code Base during the Lab.

Facilitation Strategies

- **Think about how your students will access VEXcode GO.** Ensure that the computers or tablets that students will use have access to VEXcode GO. For more information about setting up VEXcode GO, see this VEX Library article.
- **Gather the materials each group needs before class.** For this Lab, each group of two students will need a GO Kit, Build instructions, a computer or tablet to access VEXcode GO, a balled up piece of white or light-colored scrap paper to act as an obstacle on the landing area. Students will also need access to a Field for testing.
- **The Eye Sensor uses infrared light to detect objects.** Light-colored objects reflect infrared light and are detected more easily by the Eye Sensor. Dark-colored objects absorb infrared light and the Eye Sensor does not detect them as well. During the Unit, use white or light-colored paper for the obstacles to ensure that the Eye Sensor will be able to detect these objects.
- **Set up your Fields ahead of time**, as shown in the image below, to serve as a testing area for the Code Base. Have these spread out around the classroom to allow students ample space to test their projects. Both Labs in this Unit will use the same Field setup, so you can leave your fields together from Lab 1 to Lab 2. The balled up paper is the obstacle to be detected, and the 'X' is the starting point for the Code Base in the Lab activities.



Field Setup

- **Try a new starting position** - If students detect the obstacle right away in Play Part 1, have them move the Code Base to a new starting location and try again, to experiment with object detection more. Does the Eye Sensor still detect the same obstacle? Does it detect something different? Why do they think that is?
- **Use the Get Ready...Get VEX...GO! PDF Book and Teacher's Guide -** If students are new to VEX GO, read the PDF book and use the prompts in the Teacher's Guide (Google Doc / .pptx / .pdf) to facilitate an introduction to building and using VEX GO before beginning the Lab activities. Students can join their groups and gather their VEX GO Kits, and follow along with the building activity within the book as you read.
    - Use the Teacher's Guide to facilitate student engagement. To focus on VEX GO connections in a more concrete or tangible way, use the Share, Show, or Find prompts on each page to give students an opportunity to get to know their kits in more depth.
    - To focus on the habits of mind that support building and learning with VEX GO, like persistence, patience, and teamwork, use the Think prompts on each page to engage students in conversations about mindset and strategies to support successful group work and creative thinking.
    - To learn more about using the PDF book and accompanying Teacher's Guide as a teaching tool any time you are using VEX GO in your classroom, see this VEX Library article.

Play

Part 1 - Step by Step

1

Instruct

Instruct students that they are going to build a project in VEXcode GO to drive the Code Base until it detects an object on the Mars landing area (the Field). This animation below shows how the Code Base will move when this project is started.

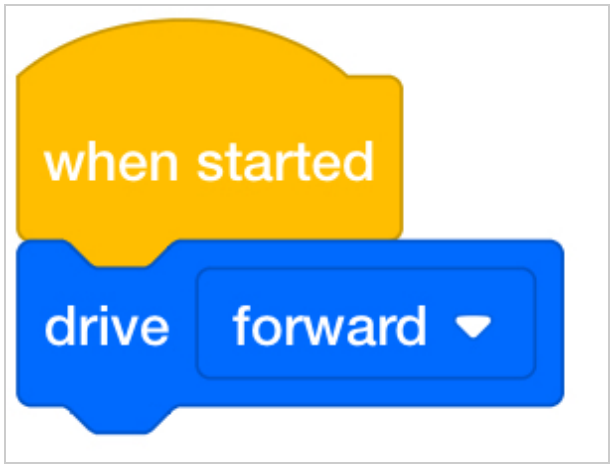
Be sure to use light or white-colored objects to represent the "obstacle" on the landing area to ensure the Eye Sensor will detect this object. Students can remove the obstacle once the Code Base drives up to it and stops.

2

Model

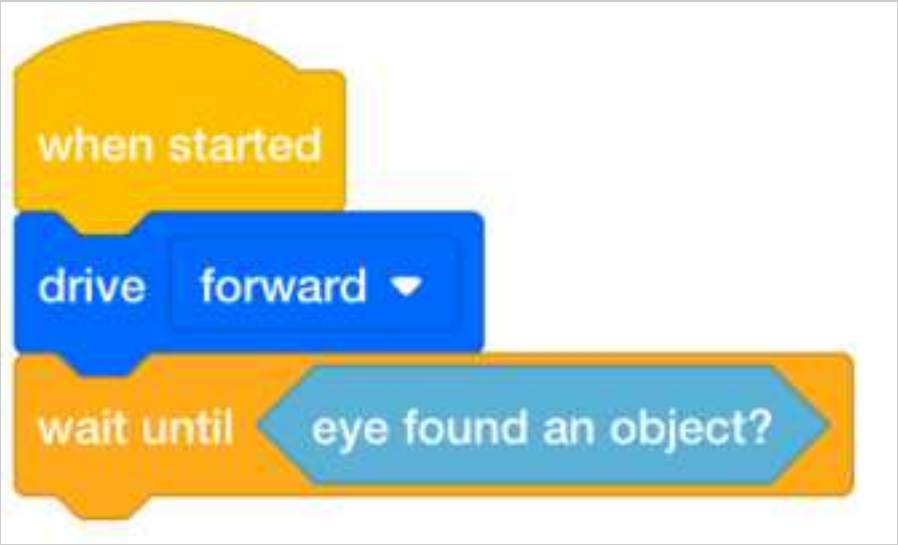
Model for students how to build the project in VEXcode GO and test their projects on the Field.

- Begin by showing students how to connect the Brain on their Code Base to their device in VEXcode GO. Because connection steps vary between devices, see the Connecting articles of the VEXcode GO VEX Library for specific steps to connect the VEX GO Brain to your computer or tablet.
- They will also need to configure VEXCode GO for the Code Base. If necessary, model the steps from the Configure a Code Base VEX Library article and ensure students can see the Drivetrain blocks in the Toolbox.
- Drag a [Drive] block into the workspace and attach it to the {When started} block.



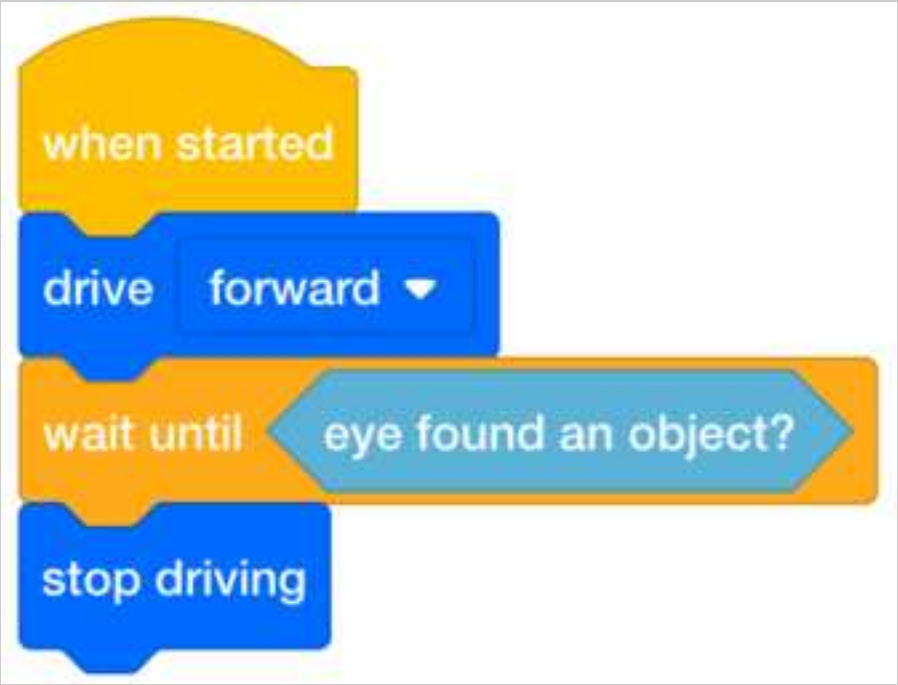
Add [Drive] block

- Then have students add a [Wait until] block. Next, drag a <Found object> block inside the hexagonal space within the [Wait until] block.



Add [Wait until] with <Found object>

- Have students add a [Stop driving] block to have the Code Base stop driving when an object is detected.

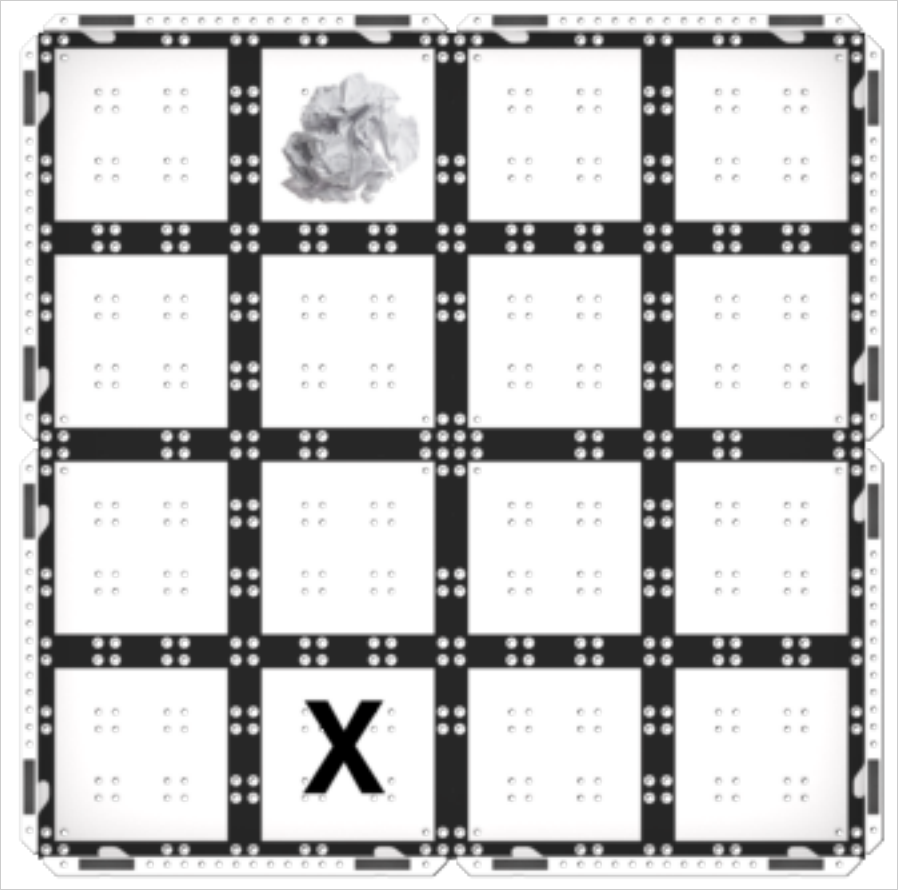


Add [Stop driving]

- Once students have built their project, have them name their project as *Drive Until 1* and save it to their device. See the Open and Save section of the VEXcode GO VEX Library for device-specific steps to save a VEXcode GO project.

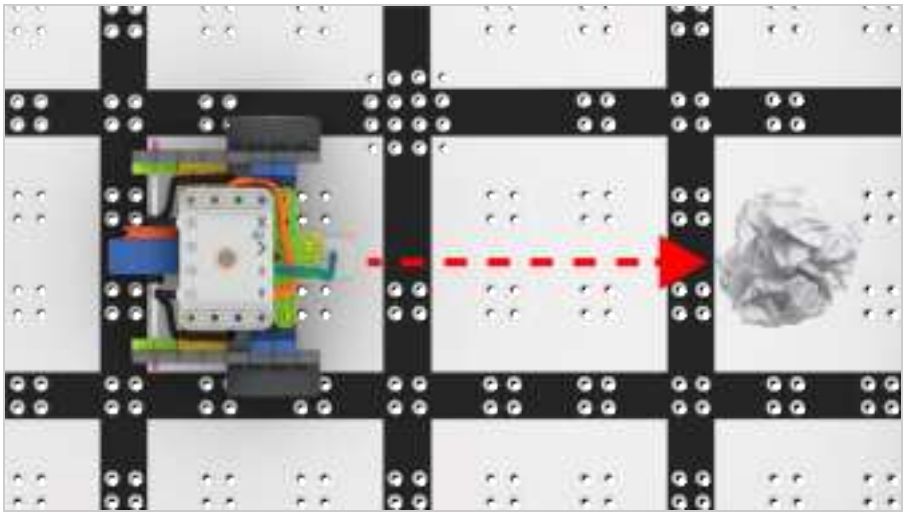
Model for students how to test their project on the Field.

- First, show them how to place the obstacle and the Code Base on the square with the"X."



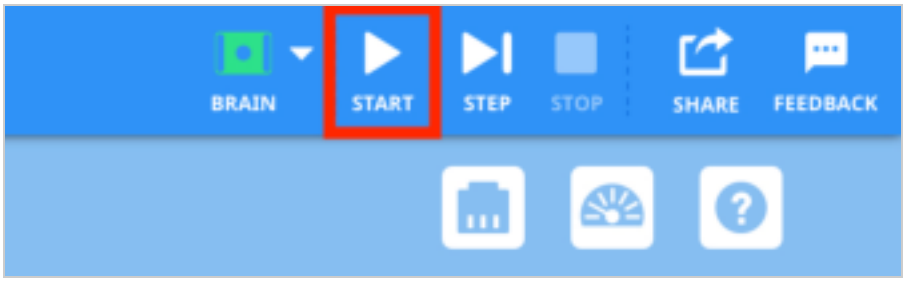
Place the Obstacle on the Field and the Code Base on the "X"

- Ensure that the Eye Sensor, located on the front of the robot, is facing the obstacle.



Eye Sensor faces obstacle

- Once the Code Base is placed on the Field, have students select ‘Start’ in VEXcode GO to test their projects.



Select Start to test project

- After the project is finished running, students will need to select the “Stop” button in the Toolbar.

Select Stop

- For groups who finish early and need additional challenges, have them move the obstacle to a new location and test their project again.

3

Facilitate

Facilitate a conversation with students as they test their projects.

- How does the Code Base robot move in this project? Can you show me with your hands?
- How did the Code Base know when to stop?
- How do you know when there is something in front of you?
- If you were the Code Base, which of your senses would help you drive until an object?

4

Remind

Remind students that even though this is a small project, they may make mistakes and it may take more than one try to have their project work successfully. In order to encourage students to embrace the mistakes along the way, ask questions such as:

- What mistake did you make that taught you something?
- What part of the Lab made you think hard?
- Was it difficult to line up the Code Base so that the Eye Sensor faced the object? What strategy did you use to line it up?

5

Ask

Ask students to name or describe a device or object that they think uses an eye sensor. Ask them if they have heard of a robot vacuum cleaner? Can they describe how the [Drive], [Wait until], and <Found object> commands might work with this device?

Mid-Play Break & Group Discussion

As soon as every group has finished testing their projects, come together for a brief conversation.

- Project your screen so all students can see the code, or bring students to a central area where they can all see the code on your tablet or computer.

- Start the *Drive Until 1* project and ask students to watch the code as the project runs and describe what they see. Direct students to describe what happens with the highlight feature, and identify that it stays on the [Wait until] block until the Eye Sensor detects an object.
    - How does the green highlight move when we start our project?
    - Why do you think the green highlight pauses on the [Wait until] block?
    - What do you think the highlight tells us?

Part 2 - Step by Step

1

Instruct

Instruct students that they will be adding onto their project so the Code Base signals when the Eye Sensor has detected an obstacle in the Mars landing area. Students will add an LED Bumper Sensor to their robot, then add [Set bumper color] and [Wait] blocks to their project to create a signal effect.

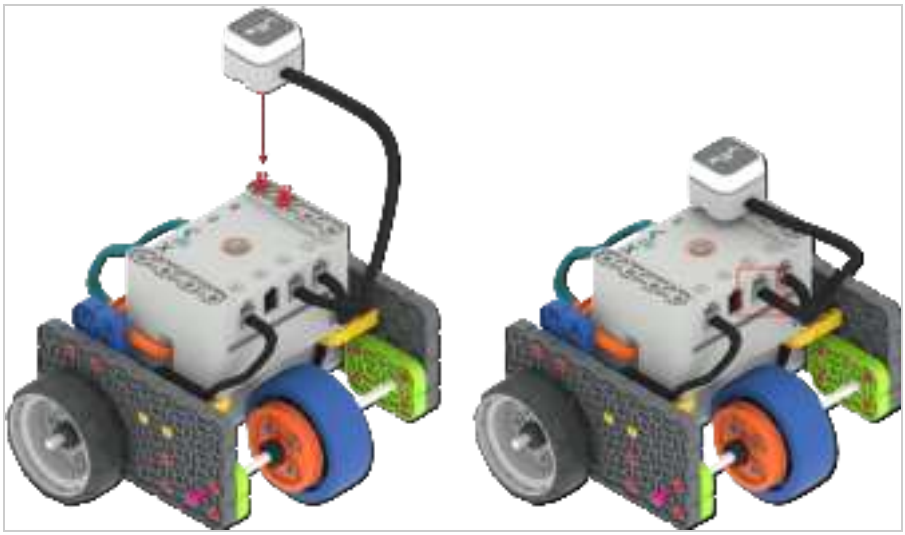
As they test their projects, they will remove the obstacle when the robot glows. The animation below shows how the Code Base will move when the project is started. Once the LED Bumper on the Code Base glows, students will need to remove the obstacle from the Field. This is also shown in the animation.

2

Model

Model for students how to add the LED Bumper sensor to their Code Base.

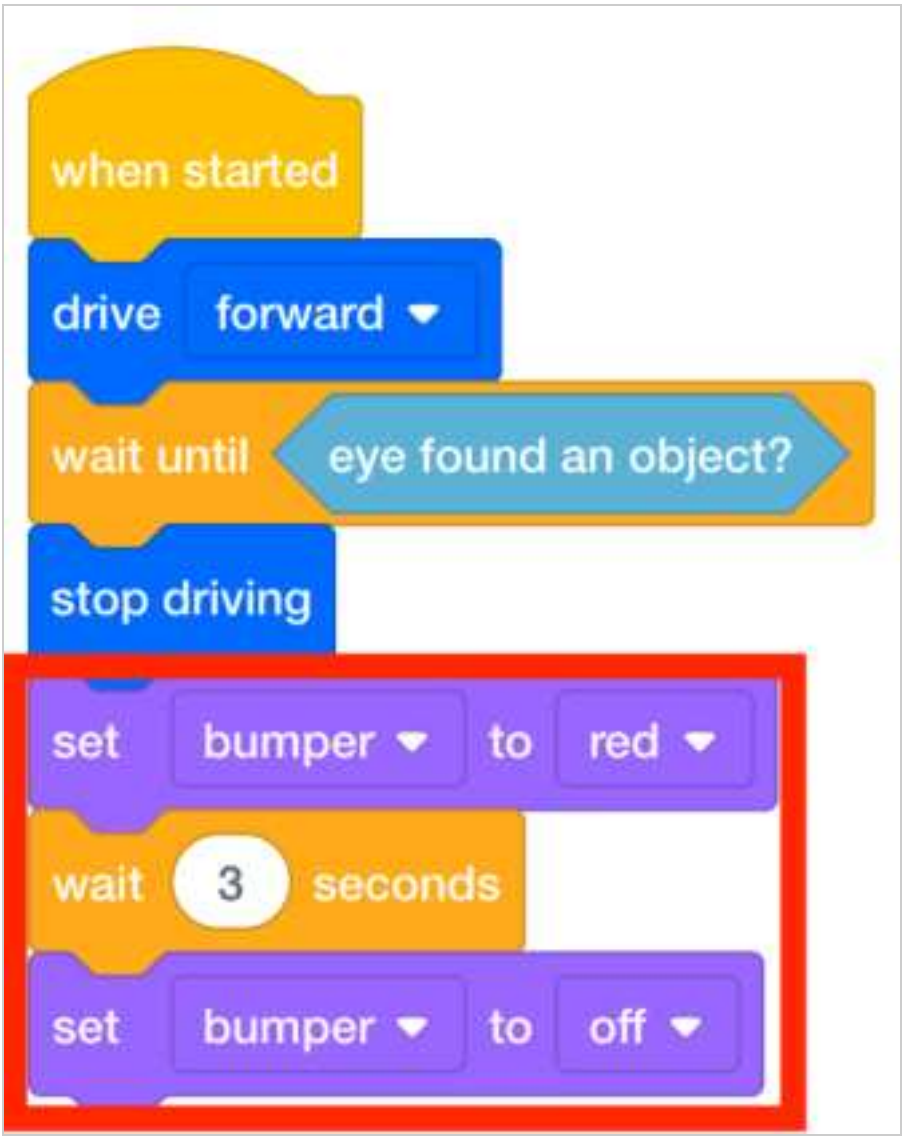
- There are many ways that students can add the LED Bumper to the Code Base. Below is one quick and easy way to add it to the top of the Code Base using only 2 Red Pins and the sensor. The LED Bumper Sensor will need to be connected to Port 2 on the GO Brain.



Add LED Bumper Sensor and Connect to Port 2

Model how to build onto their existing VEXcode GO project and test it on the Field.

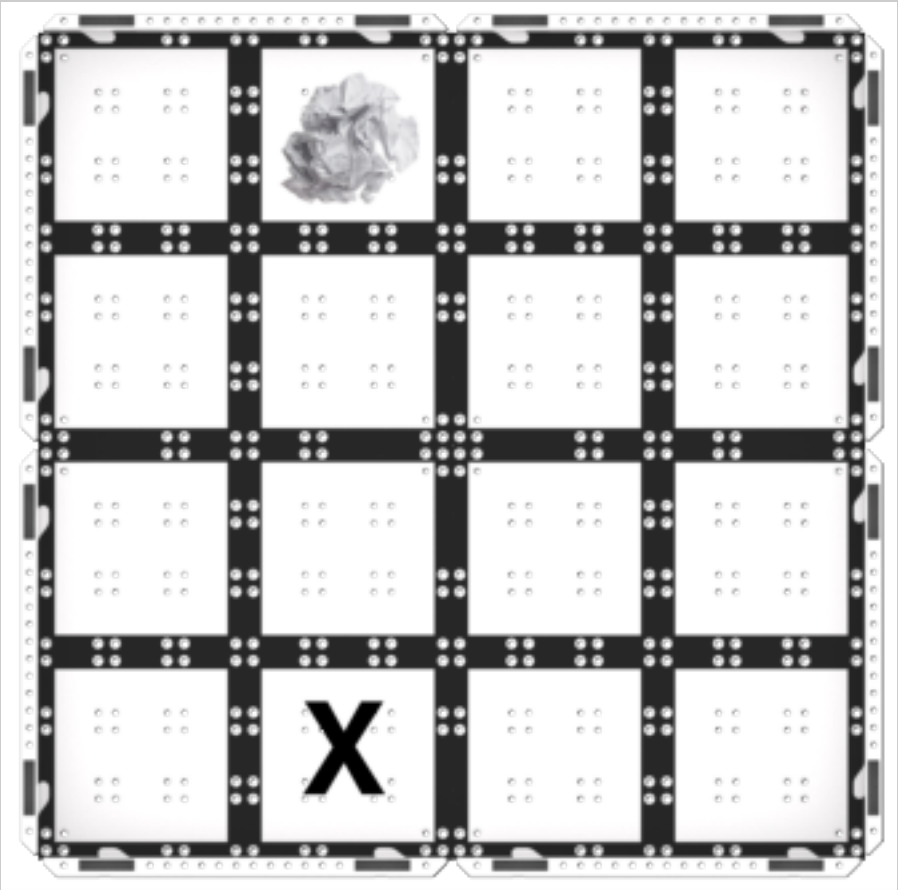
- If students need to open their *Drive Until 1* project, model the device-specific steps, as shown in the VEX Library articles in the Open and Save section.
- Have students add blocks to their VEXcode GO projects to recreate the code in the image below. The new blocks will have the LED Bumper glow red for 3 seconds to signal that it detects an object. The red box indicates the new blocks that need to be added to the project.



Add blocks to have the LED Bumper glow

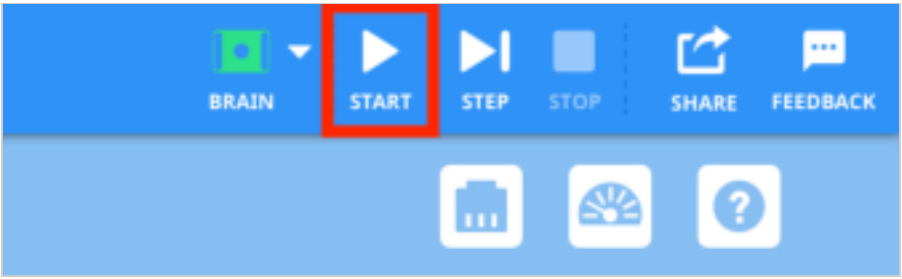
- The [Set bumper color] block set to red will make the LED Bumper glow red.
- The [Wait] block waits for a specific amount of time before moving on to the next block.
- The [Set bumper color] block set to off will stop the glow effect.

- Once students have built their project, have them name their project as *Drive Until 2* and save it to their device. See the Open and Save section of the VEXcode GO VEX Library for device-specific steps to save a VEXcode GO project.
- Have students place their Code Base on the field to test their project.



Place the Obstacle on the Field and the Code Base on the "X"

- Once the Code Base is placed on the Field, have students select 'Start' in VEXcode GO to test their projects.



Select Start to test the project

- After the Code Base drives until it detects the obstacle, the LED Bumper should glow red for 3 seconds to signal that it detects an object. Students should remove the object when the LED Bumper glows green.

- Tell students that they will need to select the “Stop” button in the Toolbar after they remove the object.

Select Stop

- If students finish building and testing their projects quickly, have them add additional Drivetrain blocks to their project to have the Code Base return to the start position. Encourage them to experiment with the different paths that the Code Base can take to get back to the starting point.

3

Facilitate

Facilitate students testing their projects and taking turns on the Field. As students are testing, ask them questions about the Eye Sensor, and how the Code Base will move based on the blocks in their project.

- How is your Code Base going to signal that it has detected an object? What blocks are you using to accomplish this?
- How far away from the obstacle is the Code Base when it stops driving? Can you show me with your hands?
- What blocks in our project tell the Code Base to stop driving?

Review the Using the VEX GO Sensors and the Coding with the VEX GO LED Bumper articles for information on the LED Bumper to help students who need additional support to understand how the sensors work in their project.

4

Remind

Remind students that they should check their project and compare it to the image of the project, before testing. If one student built the project in VEXcode GO, their partner can check the code, before placing the Code Base on the Field and starting the project.

5

Ask

Ask students, how do scientists explore faraway places?

Scientists and engineers design different kinds of robots to explore areas that are too far away or too dangerous for humans to investigate. Scientists design rovers to explore Mars, unmanned submarines to investigate the ocean, and even fly drones into active volcanoes to gather data!

- How could scientists code a submarine to use eye sensors to explore the ocean?
- How could scientists use eye sensors on a drone to help explore a volcano? What command would they use to have the drone fly until it is near the volcano walls?
- What other tasks could scientists code a Mars rover to do with an eye sensor?

Share

Show Your Learning

Discussion Prompts

Observing

- If someone came to our class, who did not know about the Eye Sensor on the Code Base, how would you explain what it does to them?
- How did the [Wait until] block work with the Eye Sensor in your project, to make your Code Base drive and detect an obstacle?
- If the [Wait until] block was before the [Drive] block, would your project have worked the same way? Why not?

Predicting

- What else do you think the Eye Sensor could detect in our classroom? How could you test your theory?
- What else do you think we could use the [Wait until] block to do in a project? Could you use it with the LED Bumper? How might that work?
- What if there were more obstacles in the landing area? Do you think your project would work? What might you have to add or change to detect more than one obstacle?

Collaborating

- How did you work together to build and test your project?
- What is one challenge your group had to work to figure out? How can you use what you learned in the next Lab?
- What is something that you, or your group, has gotten better at doing since we first began with VEX GO? What helped you improve?