

- Starting and stopping a project in VEXcode GO.



Students will know

- How to use the [Forever] or [Repeat] block in a project to have the Code Base repeat a behavior, or group of behaviors.
- 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 robot drive until it detects an object.

Objective(s)

Objective

1. Students will identify that the [Forever] block repeats the behaviors inside the block forever.
2. Students will develop a project in VEXcode GO using a loop to solve a challenge.
3. Students will communicate behaviors, through words and gestures, that the Code Base will need to complete in order to solve a challenge.

Activity

1. Students will discuss the [Forever] block in the Engage section, and be introduced to the concept of a loop to repeat behaviors. In the Mid-Play Break, students will identify that the [Forever] block can be used in their projects to have the Code Base detect all the objects in the Mars landing area.
2. In Play Part 1, students will iterate on the project from Lab 1, adding blocks and changing parameters to have the Code Base detect multiple obstacles on the Mars Landing area (GO Field). In the Mid-Play Break, they will identify that a loop can be used to repeat sequences in their projects to have the Code Base continuously check for obstacles in order to solve the challenge.
3. In the Play sections, students will describe how they want the Code Base to move as they create their projects.

Assessment

1. In the Mid-Play Break and Share sections, students will be able to communicate how the blocks inside the [Forever] block are repeated in a forever loop until the Code Base is instructed to stop.
2. In Play Part 2, students will continue to work on their VEXcode GO project using Drivetrain blocks and the [Repeat] or [Forever] block so the Code Base can locate all of the obstacles on the Mars landing area, even if the location of the obstacles change.

3. During Share, students will explain the projects they created, and describe how the Code Base moves after their projects are started. They will use these descriptions to discuss how projects varied between groups.

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: In the Play section, students will build a VEXcode GO project that has the Code Base examine the entire landing area to make sure it is clear of obstacles so that the next Mars rover can land. Students will create a project that uses Eye Sensor with a [Forever] or [Repeat] block to have the Code Base drive to and detect all objects on the landing area. In Play Part 2, students will edit their projects to make have the Code Base drive to and detect all obstacles on the Field, even if the location of the obstacles change.

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: During the Play section, students will create a VEXcode GO project where the Code Base drives until it detects multiple obstacles on the Mars landing area. As they build their project, students will use spatial language and gestures to describe how they want the Code Base to move and turn on the Field in relation to the obstacles. After building and testing their projects, students will reflect in the Mid-Play Break and Share sections on how the [Forever] block, [Repeat] block, and changing the parameters of other blocks affected the movement of the Code Base. They will use spatial language, gestures, and relational words to describe how the movement changed.

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.

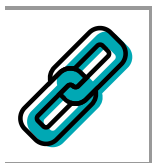
Other editable documents have been included to assist in implementing the Labs in a small group format. Print the worksheets as is or copy and edit those documents to suit the needs of your classroom. Example Data Collection sheet setups have been included for certain experiments as well as the original 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 Build Instructions (3D) or Code Base 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
VEXcode GO	For students to build projects for the Code Base.	1 per group
Lab 2 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
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
Scrap white or light-colored paper	To ball up and use as obstacles on the Field.	3 per group
Pin Tool	To help remove pins or pry beams apart.	1 per group
Dry erase marker	To make the starting location and the location of the obstacles on the Field.	1 per group
White board eraser	To erase the marker from the Field at the end of the Lab.	1 per group

Materials	Purpose	Recommendation
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) Google Doc / .pptx / .pdf	For additional prompts when introducing students to VEX GO with the PDF Book.	1 for teacher use

Engage

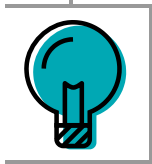
Begin the lab by engaging with the students.



Hook

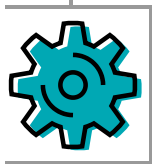
In Lab 1, the Code Base drove and detected one obstacle on the landing site so the Mars rover can land safely. What if there were multiple obstacles on the landing site?

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 you use a loop in your projects to detect multiple obstacles on the landing site?



Build

Code Base 2.0 - Eye Forward

Play

Allow students to explore the concepts introduced.

Part 1

Students will be challenged to create a project where the Code Base drives around the entire landing site and detects all of the obstacles the Mars rover might encounter during landing. They will use the project from Lab 1 as a starting point to help solve the challenge. This Lab is an open-ended exploration that will ask your students to use what they have learned previously to solve the challenge.

Mid-Play Break

This will be a chance to check in on students' progress and troubleshoot. Students can show their projects and describe what the Code Base is doing. Is it driving to and detecting all the obstacles on the Mars landing area (the Field)? Do they think their project will work if the location of the obstacles is changed? Why or why not?

Part 2

The location of the obstacles has changed on the landing site! Students will be challenged to edit their project so that the Code Base drives to all of the obstacles on the landing site when the locations have changed.

Share

Allow students to discuss and display their learning.

Discussion Prompts

- How would you describe what the loop does in your project?
- What was one challenge your group faced while creating and testing your VEXcode GO project? How did you solve the problem together?
- What other behaviors might you want to code with a loop? Why are loops useful when building VEXcode GO projects?

Engage

Launch the Engage Section

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

ACTS	ASKS
<ol style="list-style-type: none"> 1. Have students share their ideas, and guide them to the Code Base needing to repeat the project. 2. Let students share their ideas about possible coding additions, like adding more blocks to the project, etc. 3. Help students to picture the landing site using either the demonstration setup, or a drawing on the board. Trace the paths of the Code Base with your finger or a dry erase marker, to help students visualize the idea of repeating the project. 4. Draw or write two blocks on the board, then draw an arrow starting beneath the blocks, and looping around to the top, to give students a visual introduction to how a loop functions. 5. Have students get ready to join their groups. 	<ol style="list-style-type: none"> 1. In Lab 1, our Code Base robots detected an obstacle to make it safe for the Mars rover to land. What if there was more than one obstacle in the way? What would our Code Base need to do? 2. How do you think we would code our Code Base to do that? 3. What if we didn't know where the obstacles were going to be? What is a way that we could make the Code Base keep looking for obstacles all over the landing site? 4. There is a special kind of block that will let us repeat our project over and over again. It's called a "loop," and it can go around our project. How do you think a loop works? 5. Let's find out how we can use loops in our projects to help us detect multiple obstacles on the landing site.

Getting the Students Ready to Build

First, we need to get our Code Base robots and VEXcode GO ready. (If students do not have a pre-built Code Base 2.0 - Eye Forward from the previous Lab, allow 10 - 15 minutes for students to build it prior to the Lab activities.)

Facilitate the Build

1

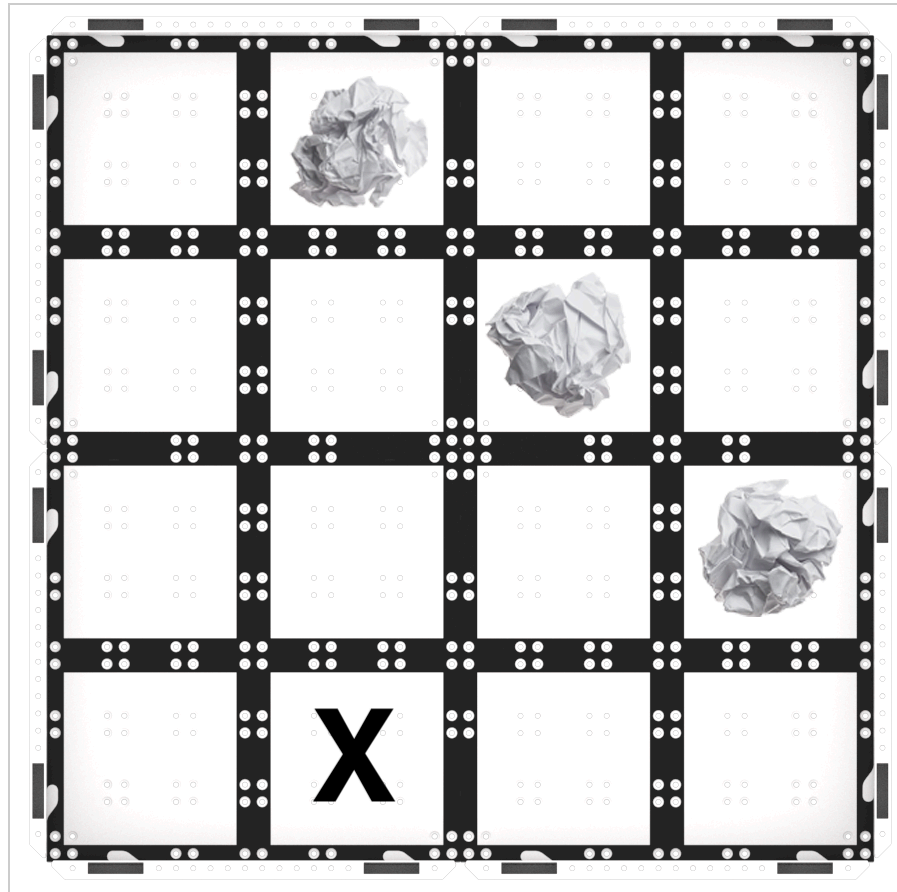
Instruct

Instruct students that they are going to prepare to clear the landing site, by turning on the Brain on their Code Base robots, connecting and configuring them in VEXcode GO, and getting their projects ready.

2

Distribute

Distribute a Code Base 2.0 - Eye Forward robot and a computer or tablet to access VEXcode GO to each group. Groups can share access to the Field for testing their projects. It can be set up with a starting location marked, and obstacles in place, as pictured below, to be ready for the Play activity.



GO Field setup

3

Facilitate

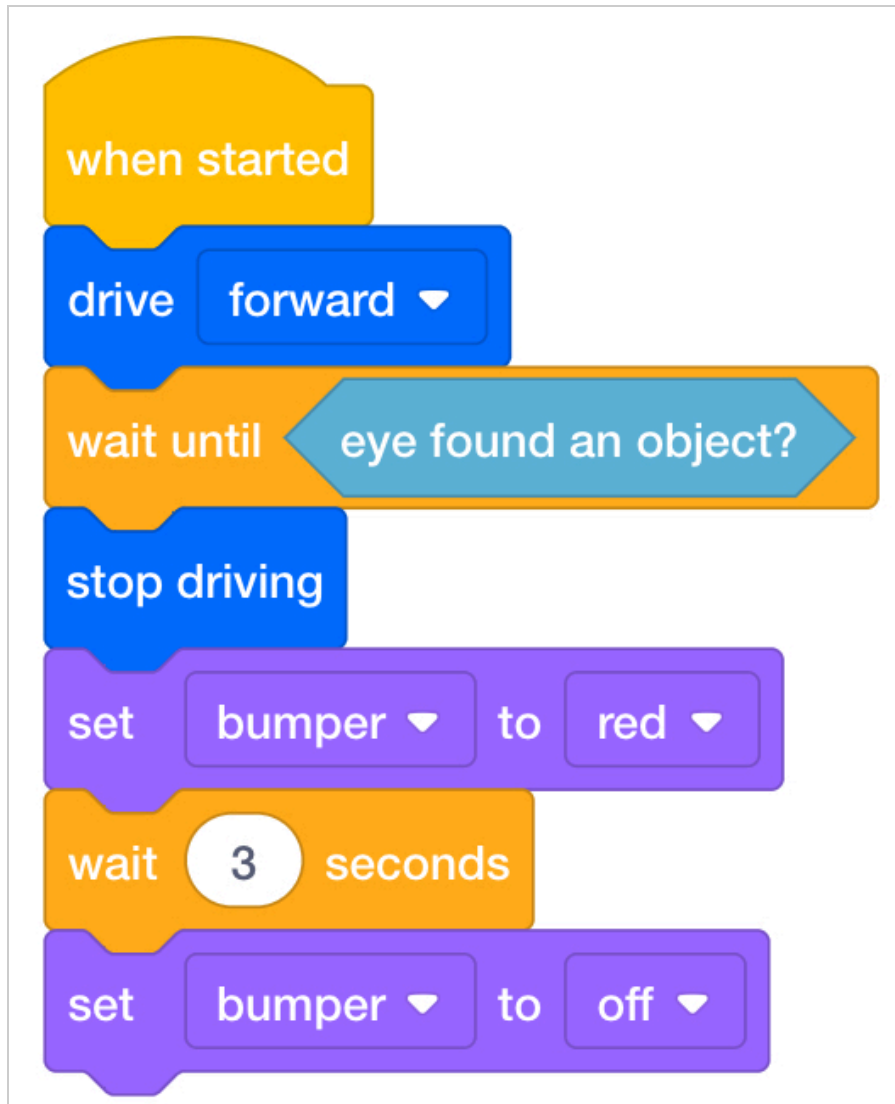
Facilitate student groups to get their Code Base and VEXcode GO ready.

- Make sure that the LED Bumper is still attached to the Code Base, and connected to Port 2 on the Brain. Use the image below for reference, if students need to add the LED Bumper again.



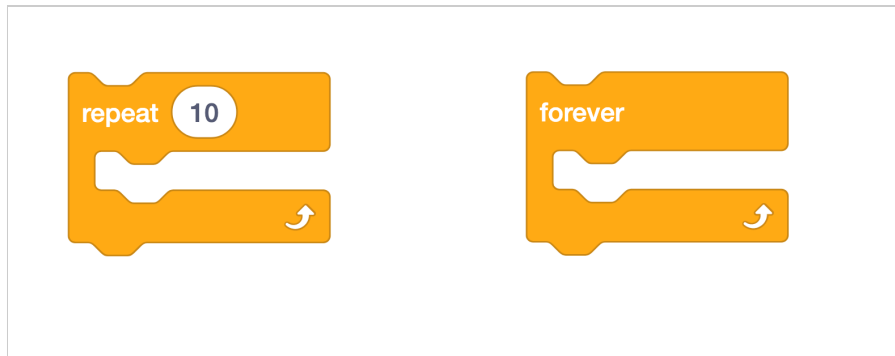
Attach LED Bumper to the Code Base, and connect to Port 2 on the Brain

- Turn on the Brain, then connect the Brain on the Code Base to your 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.](#)
- Next, 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.
- Next, students can open their *Drive until 2* project from Lab 1, or recreate that project, as seen here. If students need to open their *Drive Until 2* project, model the device-specific steps, [as shown in the VEX Library articles in the Open and Save section.](#)



Drive Until 2 Project

- As students have their Code Base robots connected, configured, and their projects ready, you may want to show them the [Forever] block and the [Repeat] block that they may use to create a loop during the Lab.



[Repeat] block and [Forever] block

4

Offer

Offer positive reinforcement for students turn taking and following directions in their groups.

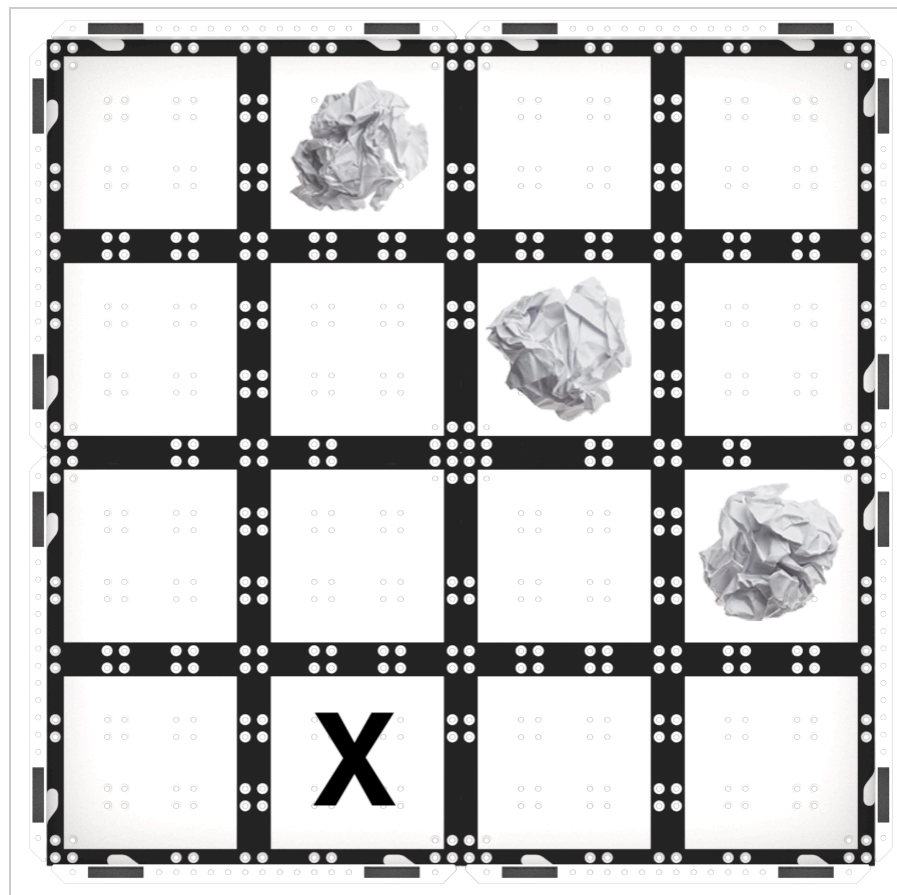
Teacher Troubleshooting

- **Check what blocks are inside the loop** — When students add the [Forever] or [Repeat] block to their projects, only the blocks located inside the loop will be repeated. You can guide students to pay attention to where they are placing blocks (inside or outside of the loop) and how that affects the behavior of their Code Base when they test the project.
- **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.
- **Make sure that students reset the obstacles each time** — After each group tests their project on the Field, make sure that they put the obstacles back in place for the next group. You can mark the locations of the obstacles with a dry erase marker on the Field, to make this process easier.

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 will need a GO Kit, Build Instructions, a computer or tablet to access VEXcode GO, and balled up pieces of white or light-colored scrap paper to act as obstacles 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. 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

- **Prepare for the Open-Ended Challenge** — Clear the Landing Area is designed to be an open-ended exploration that will ask your students to persevere to solve a challenge. Students will be asked to use loops in their projects, and it may take several iterations before they have success. Use suggestions outlined in the ["Preparing for Open-Ended Challenges in this Unit" section in the Background](#) to guide students through the trial and error process, and to help them troubleshoot their projects to achieve the goal of the challenge. The Facilitation section in Play Part 1 and 2 contain additional instructional supports for guiding students through the Lab 2 challenge.

- **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 be challenged to create a project to have the Code Base detect all the obstacles in the Mars Landing area. They will be encouraged to build onto their project from Lab 1.

The following animation shows one possible way that the Code Base could be coded for the Clear the Landing Area Challenge.

2

Model

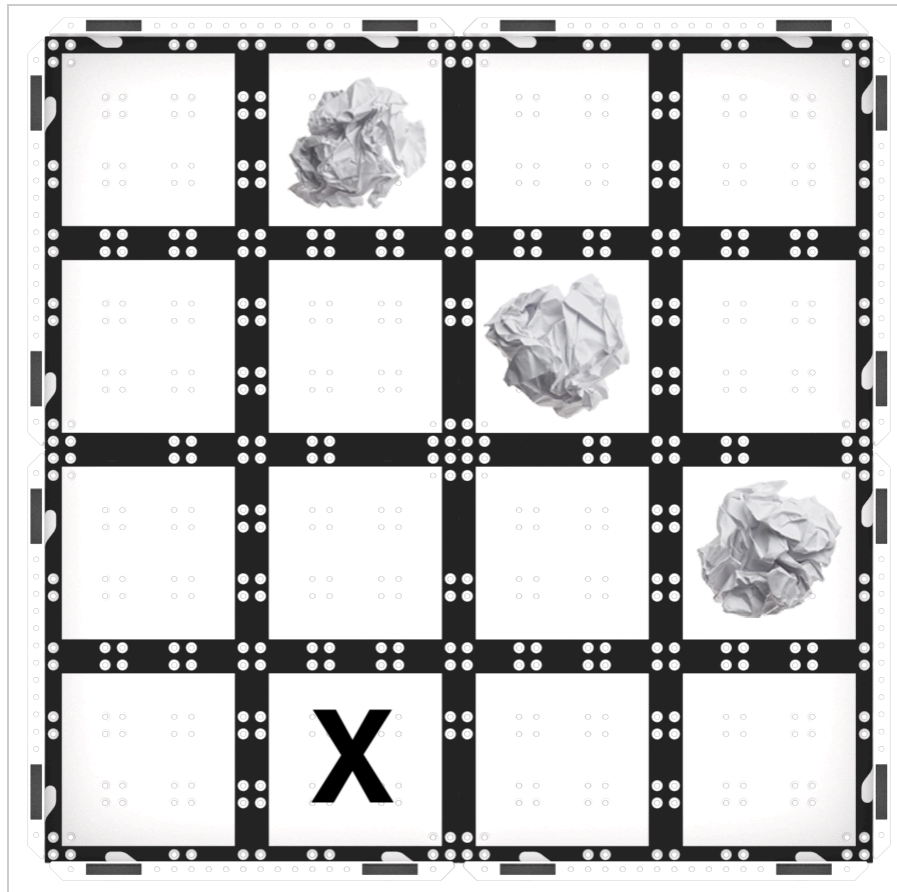
Model for students how to get started with their projects in VEXcode GO.

- If necessary, show 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.
- Have students name their project as *Clear Area* 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 apply what they have learned in other Labs to build a project to have the Code Base clear all the obstacles in the Field. They will need to add blocks and change parameters, then test their projects on the Field.

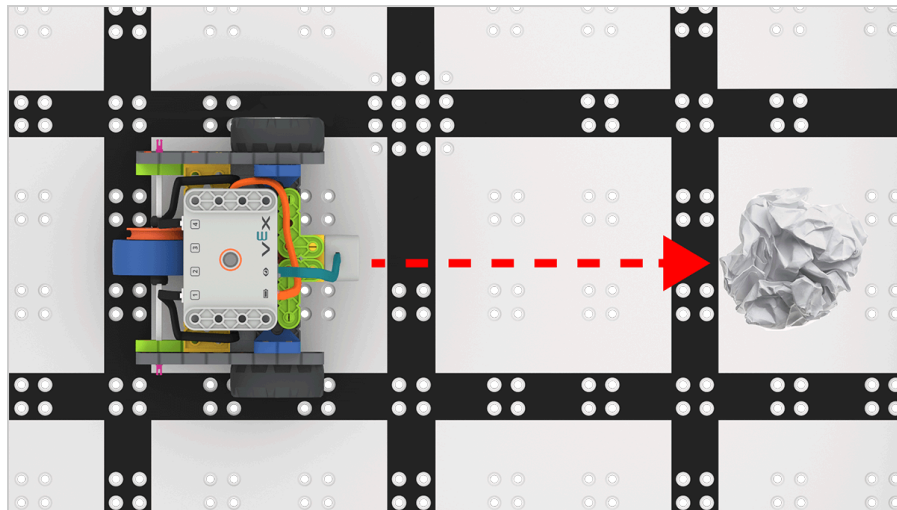
If necessary, model for students how to test their project on the Field.

- Show them how to place the Code Base on the starting point marked with the "X."



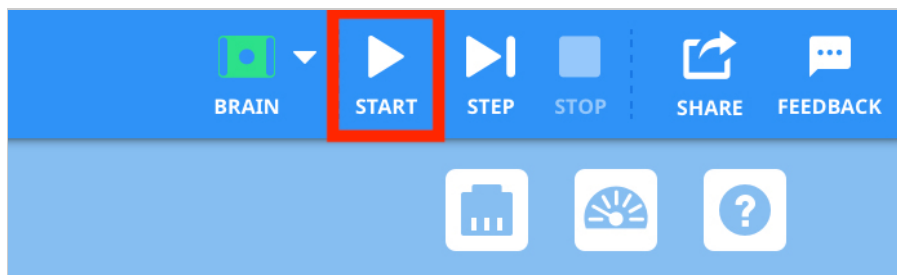
Play Part 1 Field Setup

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



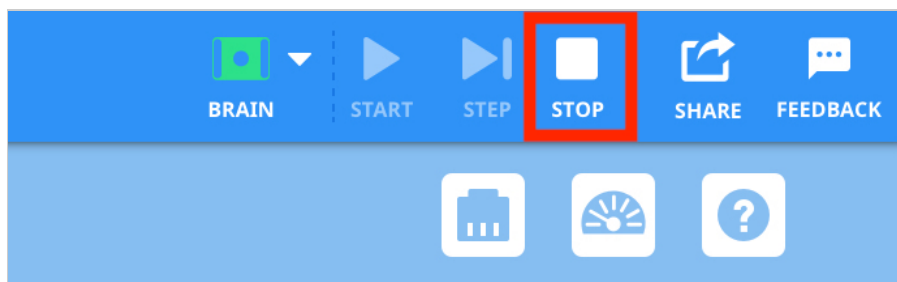
Eye Sensor faces the obstacle

- Place the Code Base on the Field and select 'Start' in VEXcode GO to test their projects.



Select 'Start' to test the project

- Students should remove the obstacles after they are detected by the Code Base.
- Students will need to select the 'Stop' button in the VEXcode GO Toolbar to stop the project.



Select 'Stop'

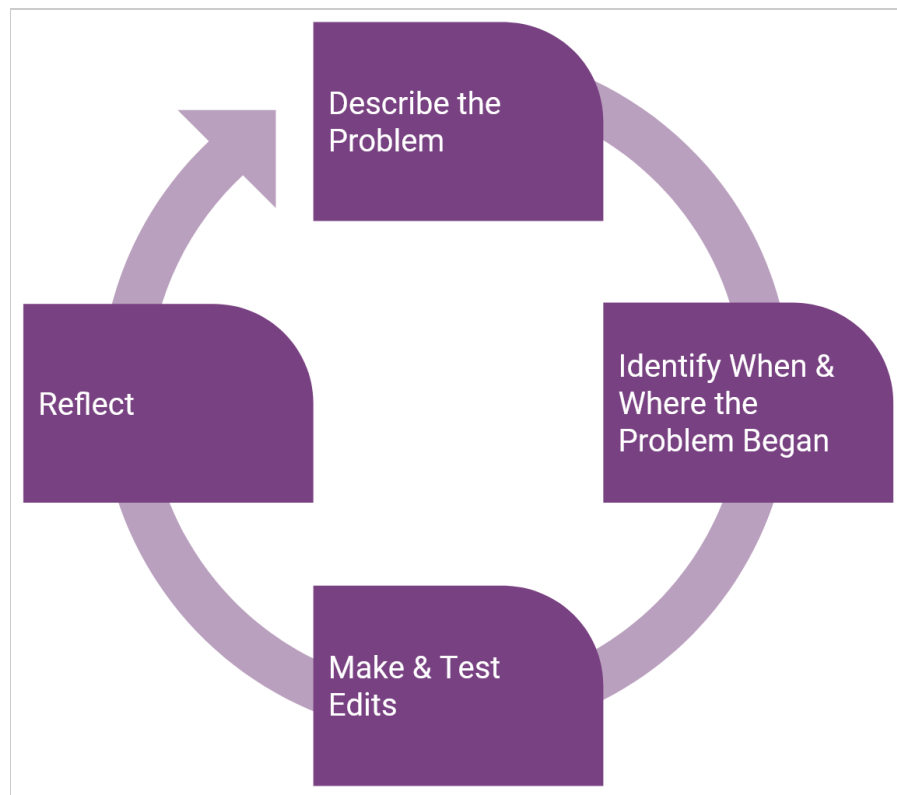
- **Note:** If students are using a forever loop, the Code Base will not stop until the Stop button is selected. In this scenario, have students stop their project when the Code Base has detected all the obstacles, has repeated a loop four times without detecting an obstacle, or if it gets stuck at the edge of the Field.
- For groups who finish early and need additional challenges, have them experiment with different starting points. Does their project still work?

3

Facilitate

Facilitate a conversation with students as they experiment with their projects.

- Prepare students for the trial and error that is an intrinsic part of the experimentation that they will engage in with this challenge. You may want to use the Problem Solving Cycle graphic from the Background page as a visual aide to establish a structure for the problem-solving process with your students.

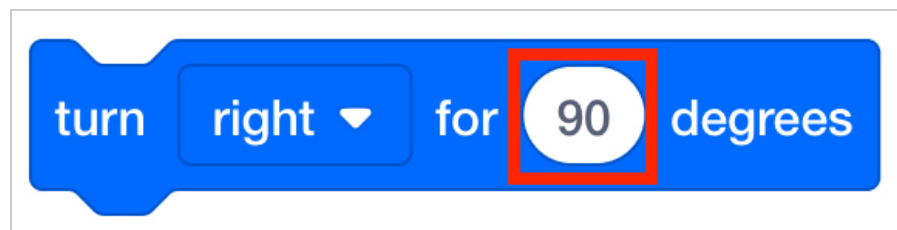


Student Problem-Solving Cycle

- If students are using a loop in their project with a [Forever] block or [Repeat] block, but the Code Base is not moving as intended, they may not have all the necessary blocks inside the

loop, or they may sequence the blocks inside the loop in a way that causes the Code Base to move in an unintended way.

- Use the Project Stepping feature to help students go through their project one block at a time to see how each block is being executed in their project. This will allow students to see how the loop functions in their project and will give them visual feedback to show which blocks may be causing the error, so debugging can become a more targeted and efficient process. For more information on how to use the Project Stepping feature, [see the Stepping Through a Project in VEXcode GO VEX Library Article](#).
- Remind students that they can also use the Highlight feature to see which blocks are being executed and when as they run their projects. The following questions can be used to encourage students to identify how a loop affects the project flow with the Highlight feature.
 - How does the highlight move when there is a loop in our project?
 - Which VEXcode GO block creates the loop?
 - Which blocks are repeated in your project?
- If the Code Base is not turning, students may not have added the [Turn for] block. Show students how to add the [Turn for] block so that the robot changes direction after it detects an obstacle, otherwise, the Code Base will just drive forward and stop. Since students may not be familiar with angles, you may want to provide several angles for them to experiment with such as 60, 90, 120 degrees.
 - Remind them that they can change the turn angles in the input oval in the [Turn for] block. If experimenting with turn angles, ask students how changing this parameter affects the movement of the Code Base. What would happen if we increase the turn angle? How does it change the movements of the Code Base? Does this change have the Code Base detect more obstacles? If not, try a different turn angle.



Change Turn Angle in the [Turn for] block

4

Remind

Remind students that this challenge requires playful exploration and there will be cycles of trial and error. They will make mistakes in their projects as they experiment, and each time they make a mistake in their code, they have a chance to learn something new! Help students to identify where in the code there was a problem and tease out ideas for addressing the problem.

- Did something go wrong? Great! Where in the code is the problem? How can you change that block?
- Do you need a different block or do you need to change the parameters in this one?
- What is your favorite mistake so far? What did you learn from it?

5

Ask

Ask students how they think the real Mars rover could use a loop and eye sensor to detect obstacles on the ground before it lands.

Mid-Play Break & Group Discussion

As soon as every group has experimented with their projects to solve the challenge, come together for a brief conversation.

Ask students to show their projects and describe what the Code Base is doing. This is a chance to check in on the students' progress and troubleshoot.

- What was working well in your project?
- What challenges have you faced in your project?

Ensure that students understand that they can use a loop to have the Code Base repeatedly check for obstacles on the Field.

- Have they used a loop to have the Code Base detect multiple objects? If not, remind students about the [Forever] and [Repeat] blocks you talked about in the Engage section.
- If they are using a loop, how are they using it? What blocks are they using to create the loop in their project?
- How does the sequence of the blocks in the loop affect the behaviors of the Code Base?
- What happens if some of the blocks are not in the [Forever] or [Repeat] loop? Will those blocks be repeated?

Prepare for the challenge variation in Play Part 2:

- What if we change the location of the obstacles? Will this project still work? Why or Why not?

1

Instruct

Instruct students that they are going to move the obstacles on the Mars landing area and continue to experiment with their projects. The goal is to have the Code Base detect all the obstacles on the Field, even if their location changes! Encourage them to use what they have learned about loops and the [Repeat] or [Forever] block to update their projects. View the animation below for one example of how a Code Base might complete this challenge.

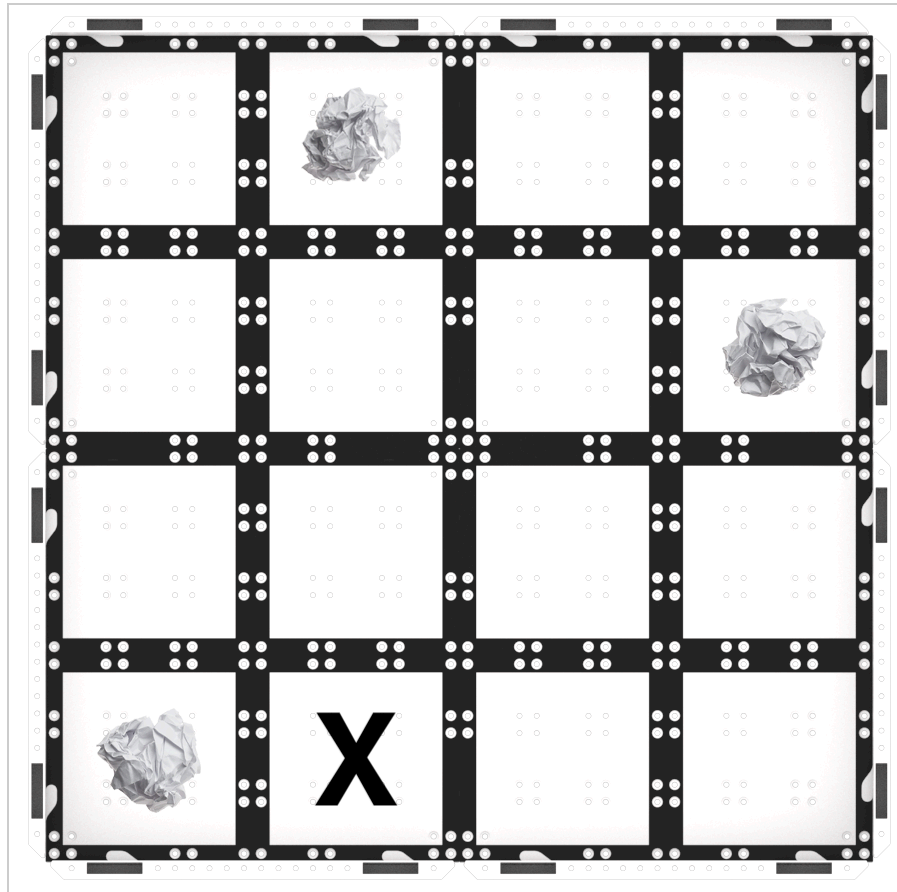
- Note that the animation stops after all of the objects are detected and removed, but a [Forever] loop would make the Code Base run forever in that loop until the project is stopped.

2

Model

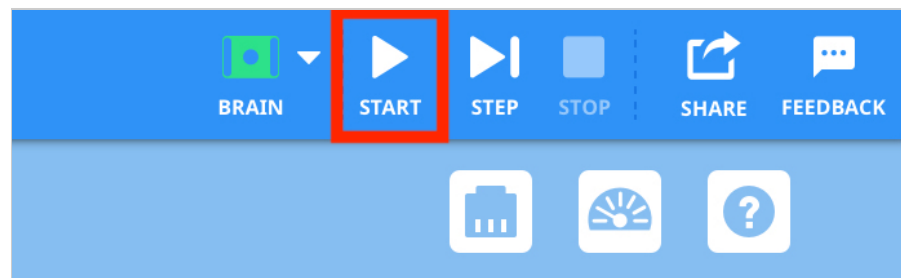
Model for students how set up the Field and test their project.

- First, show them how to place the obstacles in new locations on the Field, and choose a starting point and mark it with an "X." The following is one possible way to set up the Field.



Play Part 2 Field Setup Example

- Once the obstacles and Code Base are in place, they can select 'Start' in VEXcode GO to test their projects.



Select 'Start' to test the project

- Students will need to select the "Stop" button in the Toolbar to stop the Code Base.
- There are many possible solutions for this challenge. The following is one example for reference.

```
when started
forever
  drive forward
  wait until eye found an object?
  stop driving
  set bumper to red
  wait 3 seconds
  set bumper to off
  turn right for 120 degrees
```

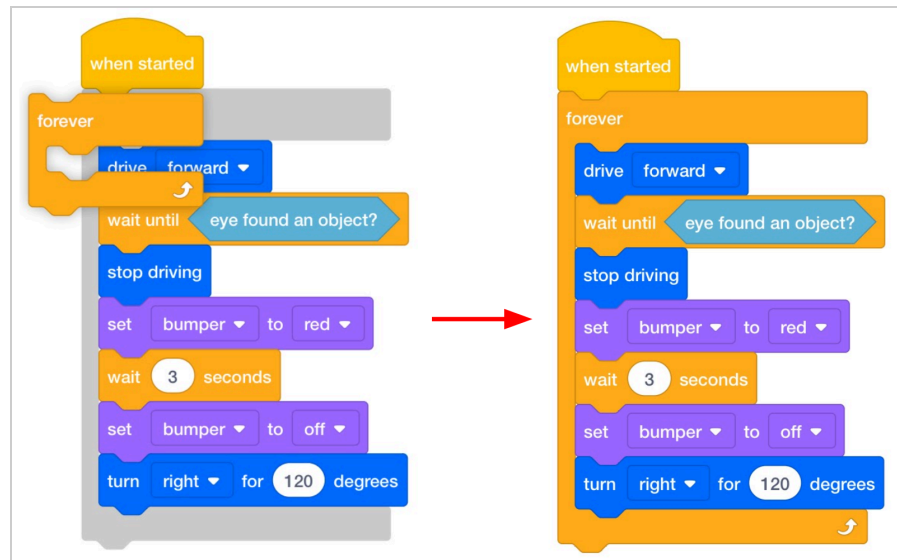
Possible Solution

3

Facilitate

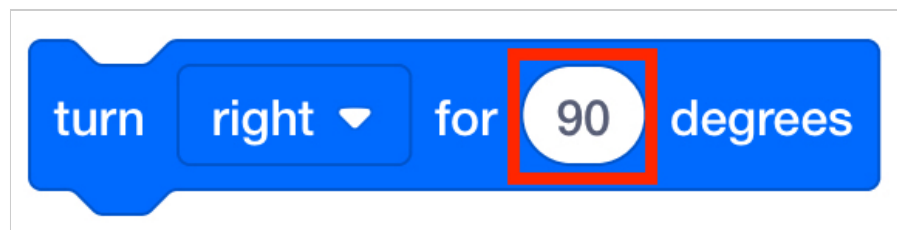
Facilitate a conversation with students as they test their projects.

- If students need help making the Code Base repeat sections of code to detect all the obstacles on the field, suggest that they use a [Repeat] block or a [Forever] block as you talked about during the Engage section, and show them how to use it in their projects. Encourage them to check to make sure the entire project is inside the C-block, as shown below.



Add a [Forever] Block

- If students have built a project, but it isn't detecting all of the objects, encourage them to experiment with turn angles, give them the following turn angles to experiment with such as 60, 90, and 120 degrees. How do the turn angles affect the movement of the Code Base?



Changing the Turn Angle

Engage students in further discussion as they build their projects to have them share their thinking as they iterate on and test their projects.

- Which obstacle does the Code Base detect first in your project?
- What does the Code Base do after it detects an obstacle? What blocks have you used to make it do this?
- What blocks have you used to have the Code Base move to the next obstacle after one is cleared?

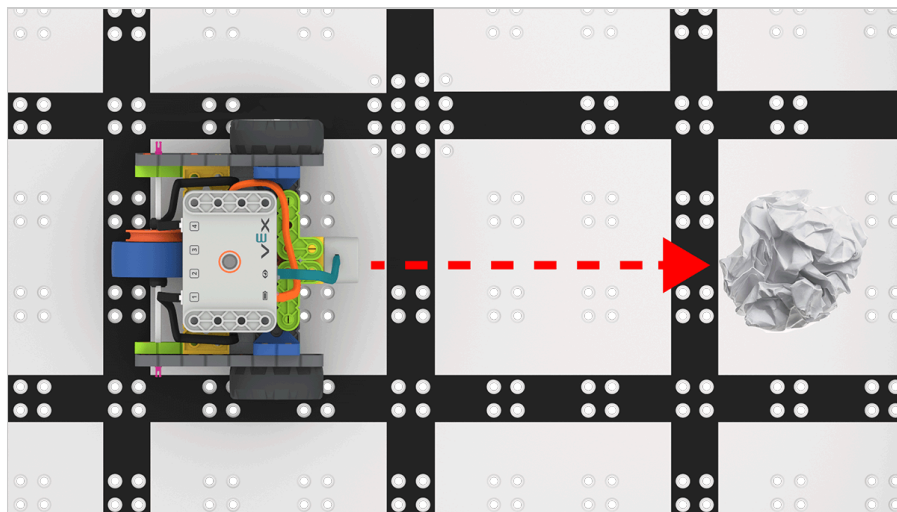
- How does your project have the Code Base clear the entire landing area?

4

Remind

Remind students to start from the same point for the tests. They just want to change one variable — the location of the obstacles.

- Also, remind students to start with the Eye Sensor on the Code Base facing the first obstacle, this will have the Code Base travel to the first obstacle quickly and will enable students to have immediate success with their projects.



Eye Sensor faces the obstacle

Remind students of troubleshooting strategies as needed.

- If the Code Base does not respond, try disconnecting and reconnecting the Brain and try again. This may happen if too much time passes between turns driving the Code Base.
- If students are having trouble connecting their Code Base to their computer or tablet, view the [Connecting articles in the VEXcode GO VEX Library](#), to see details on how to connect the Code Base to the device being used.
- If groups are having trouble starting their project in VEXcode GO, refer to the [Starting a Project in VEXcode GO VEX Library article](#), to see the steps necessary to successfully start a project.
- Review the [Using the VEX GO Sensors](#) and the [Coding with the VEX GO LED Bumper](#) articles for additional information on the Eye Sensor and the LED Bumper.

5

Ask

Ask students to think about how their project has changed throughout the challenge.

- How has your project changed from the start of the lab until now?
- What did you change in your project to make it work better?
- What change did you make that made it less successful? How did you fix it?

Share

Show Your Learning

Discussion Prompts

Observing

- How does your project have the Code Base rover clear the entire landing area?
- Did you use a loop in your project? Which VEXcode GO block creates the loop? How would you describe what the loop does in your project?
- What does the Code Base rover do after it detects an obstacle? What blocks have you used to make it do this?

Predicting

- What other behaviors might you want to code with a loop? Why are loops useful when building VEXcode GO projects?
- What would happen if you changed the order of the blocks in your project? Would it still work?
- What would happen if you added more obstacles to the Mars landing area? Would your project still work?
- If you were going to do this challenge again, how would you change your project?

Collaborating

- What was one challenge your group faced while creating and testing your VEXcode GO project? How did you solve the problem together?
- How has your group's project changed from the start of the Lab until now? How did you work together to make your project more successful in the challenge?
- What changes did your group make that made your project work less successfully? How did you work together to fix it?

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