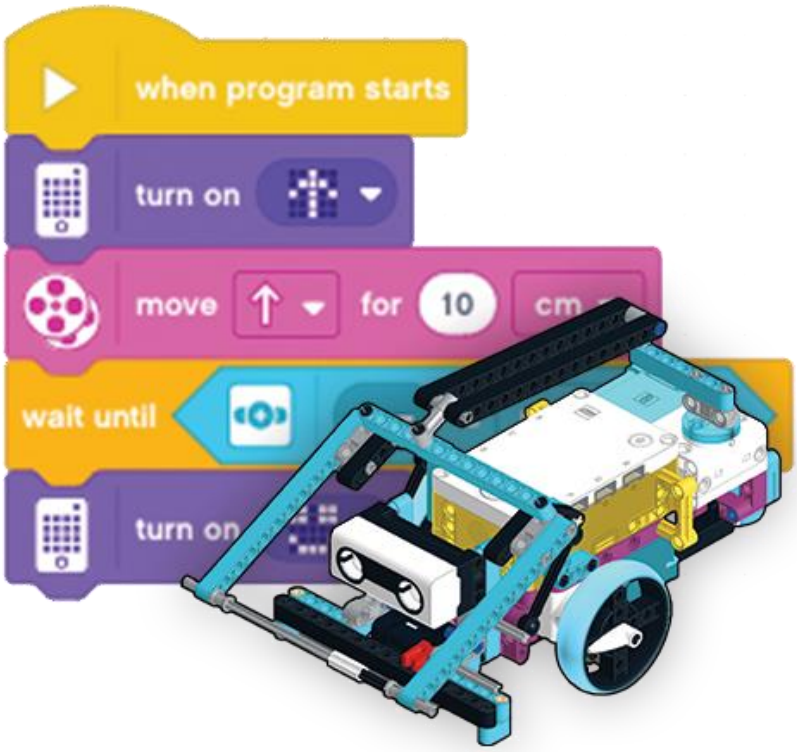
Coding and Computational Thinking with LEGO SPIKE Prime



Lessons and Challenges Setup and Resources
Through Wait Unit & Sensors

Last Updated: 12/15/2021

Carnegie Mellon Robotics Academy

Note to the Educator

This document provides a complete list of all the additional equipment, supplies, and set up to build and complete all the lessons and challenges in the Coding and Computational Thinking with LEGO SPIKE Prime. In this document, you will find a complete list of all the supplies and setups and a per-unit breakdown for the lessons and challenges.

Curriculum Breakdown

This curriculum uses 3 types of supplies: Student Equipment, Robot Props, and Board setup.

Student Equipment: Students will need access to the following supplies semi-regularly throughout the course.

1. CMRA TACObot built using the LEGO® Education SPIKE™ Prime Set (#45678)
2. Rulers (preferably with metric units)
3. Protractors
4. A computer or other compatible device with the LEGO® Education SPIKE™ App
    a. The SPIKE App is compatible with Windows 10, ChromeOS, macOS, iOS, and Android.

Robot Props: Robot Props are objects or LEGO assemblies that the Robot will interact with by pushing, lifting, or grabbing and then moving them.

1. LEGO Utensils – Fork, Knife, and Spoon.
2. These are built using parts left over from building the TACObot
3. "Trash" – Small ball of paper or other small objects that the TACObot's arm can hold.
4. Small pushable boxes – Boxes or objects that the TACObot can push using its front bumper
5. LEGO Ice Crystals
6. These are built using parts left over from building the TACObot
7. Large box/ removable wall – Boxes or binders or other objects that can be placed in front of the Robot and then removed by hand.
8. LEGO Wi-Fi Modules
9. These are built using parts left over from building the TACObot

The latest build instructions for the LEGO Utensils, Ice Crystals, and Wi-Fi Modules can be found as a downloadable PDF in the curriculum

Board Setup: Board setup includes materials and other supplies to build boards or challenge tables to complete the lessons and challenges.

1. Colored Electrical Tape
2. Colored Paper – To create signs or colored floor squares
3. Books, Binders, or Actual walls to use as walls or obstacles for the TACObot

Unit Breakdown

Getting Started with SPIKE Prime

This unit is the introductory and setup unit. Students will need the LEGO® Education SPIKE™ Prime Set (#45678) to build the TACObot and access to download and install the LEGO® Education SPIKE™ App if the software is not already installed on the computer.

The latest TACObot building instructions can be found as a downloadable PDF in the curriculum.

Programming the Hub with SPIKE Prime

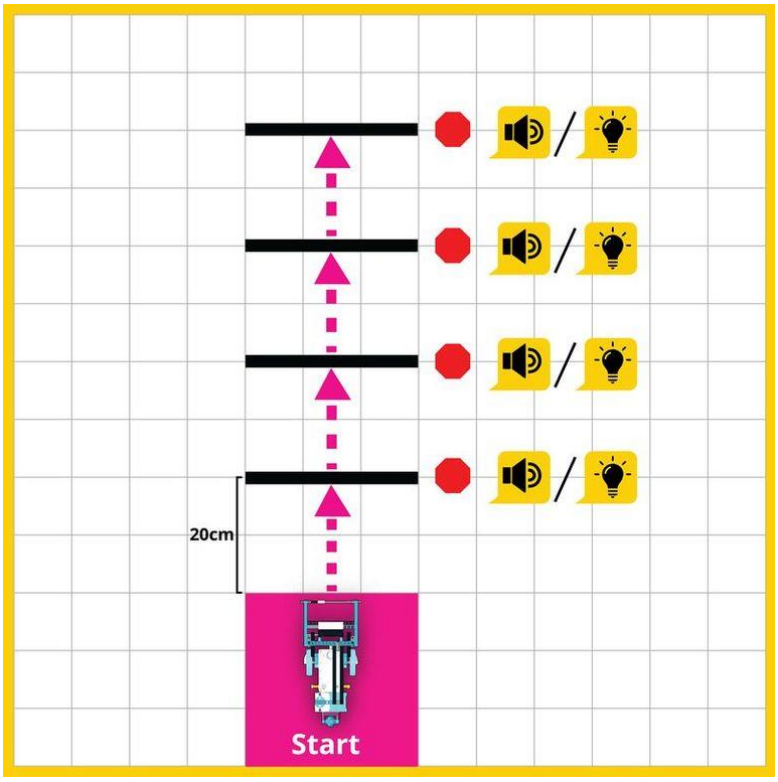
This unit lessons and challenges focus on using the Light Matrix and Speakers on the SPIKE Prime Hub. This unit has no setup for the lesson or challenges.

Robot Movement with SPIKE Prime

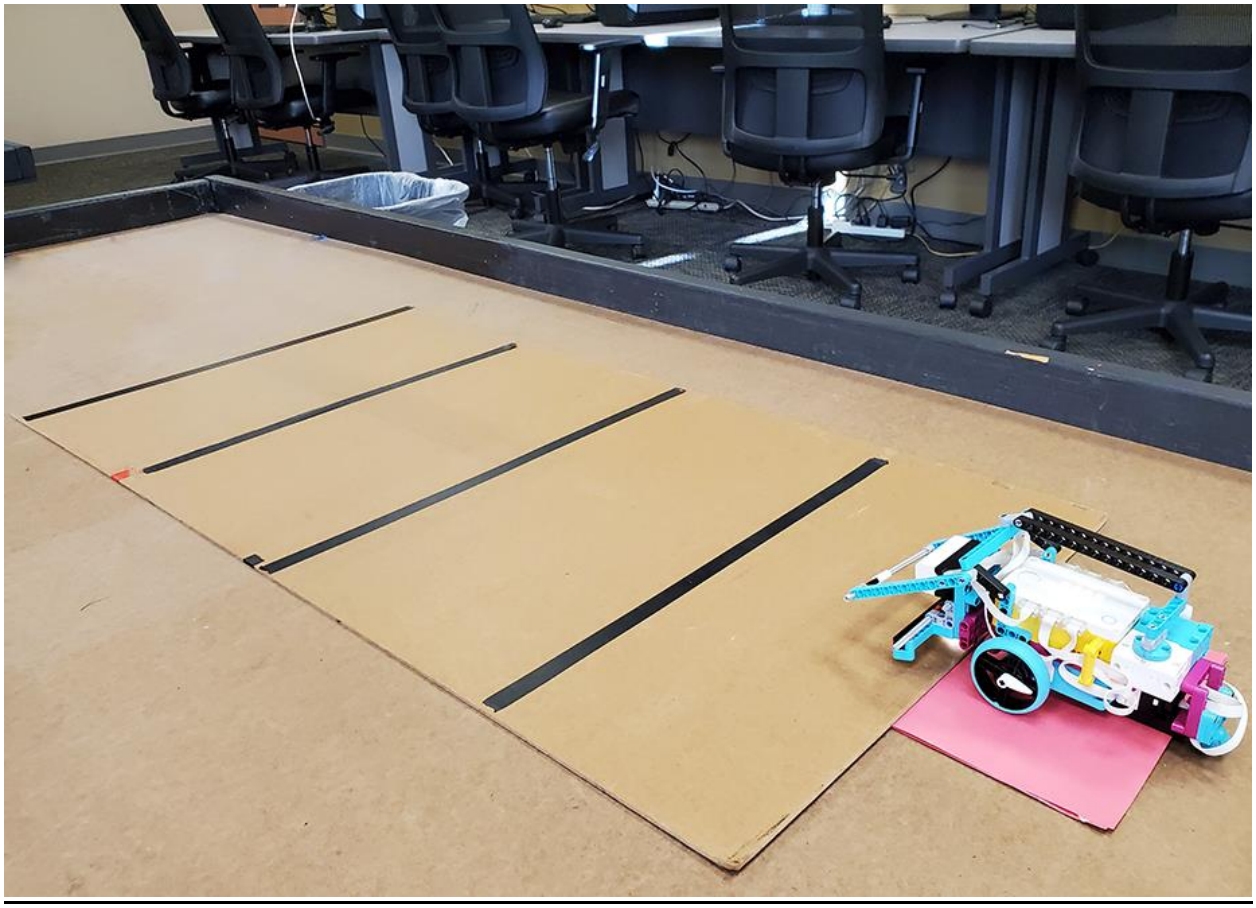
Robot Movement Lessons

The Robot Movement Unit has the students learn how to program the Robot to move specific distances, driving forward and backward, and turning. Students will need access to rulers and protractors to check their Robots' movements.

Mini-Challenge: Sequential Movements

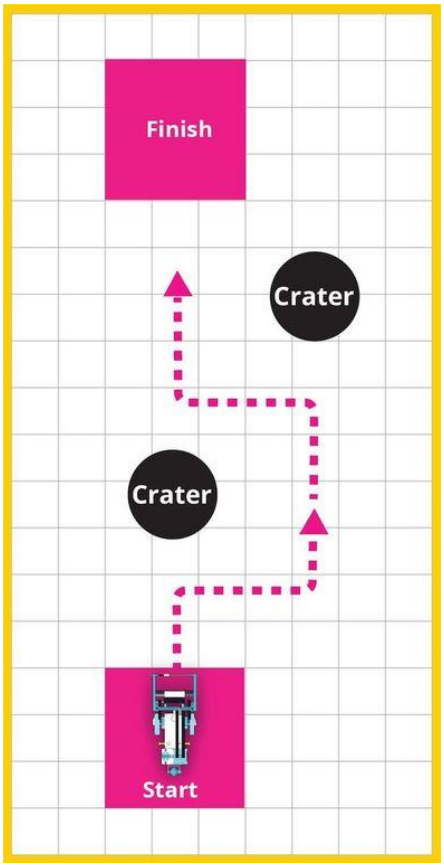


This challenge requires the Robot to drive forward 20cm four times. The Robot stops for 1 second at each line and displays or plays a tone on the hub.



This challenge can be set up by laying out 4 lines of black electrical tape on a table or flat surface. The starting box can be a piece of construction paper taped down or a 5th line.

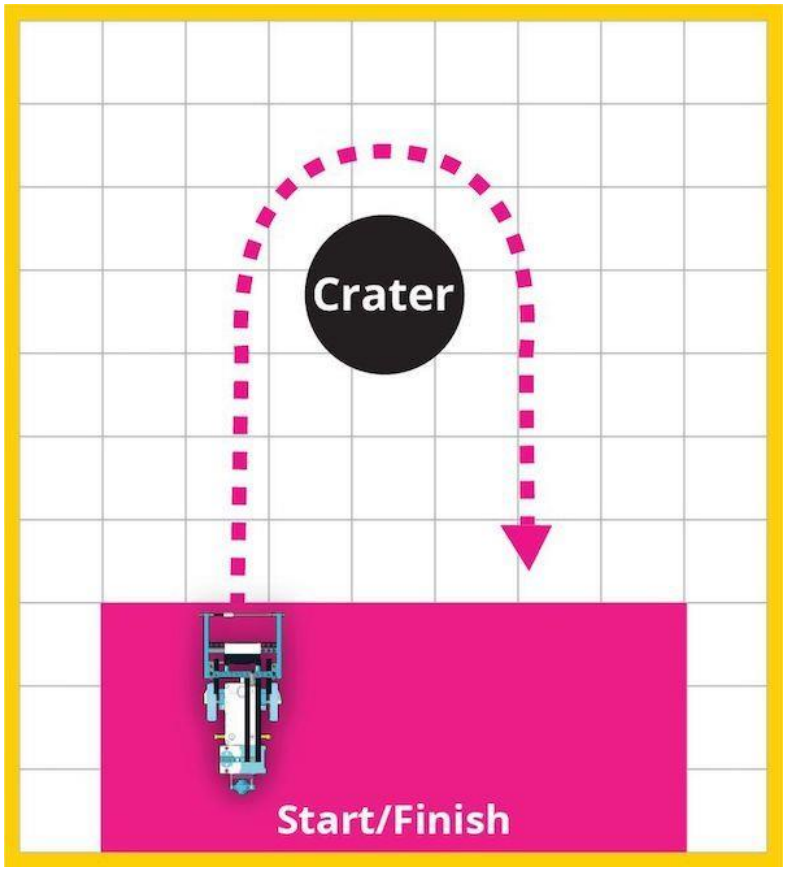
Mini-Challenge: Turn Around the Craters



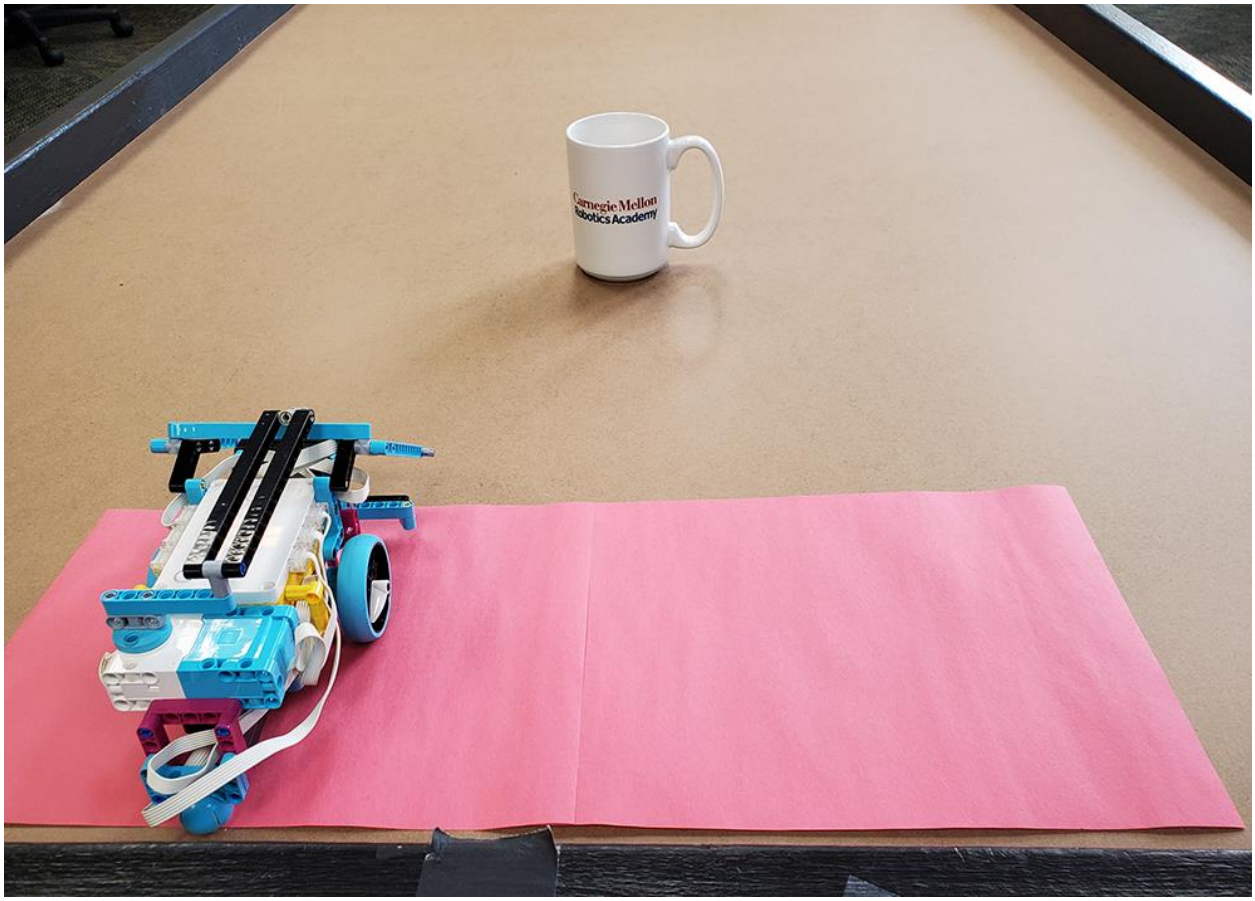
This challenge requires the Robot to drive around 2 craters to reach the finish.

Craters can be a stack of books, a box, or any other object the Robot can drive around. For example, the Start and Finish box can be a piece of construction paper taped down or a line of electrical tape.

Mini-Challenge: Steer Around the Crater

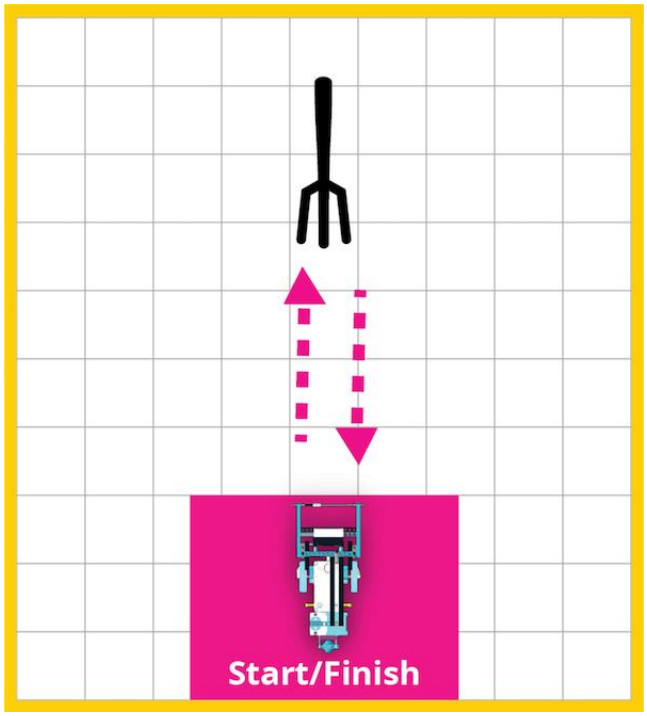


This challenge requires the Robot to drive around 1 crater to reach the finish.



The crater can be a stack of books, a box, or any other object the Robot can drive around. For example, the Start/Finish box can be a piece of construction paper taped down or a line of electrical tape.

Mini-Challenge: Collecting Spilled Silverware



This challenge requires the Robot to drive forward, collect 1 utensil and return to the starting point.

Students can use any of the 3 LEGO utensils to complete the challenge. Each kit has enough pieces to build one of each utensil.

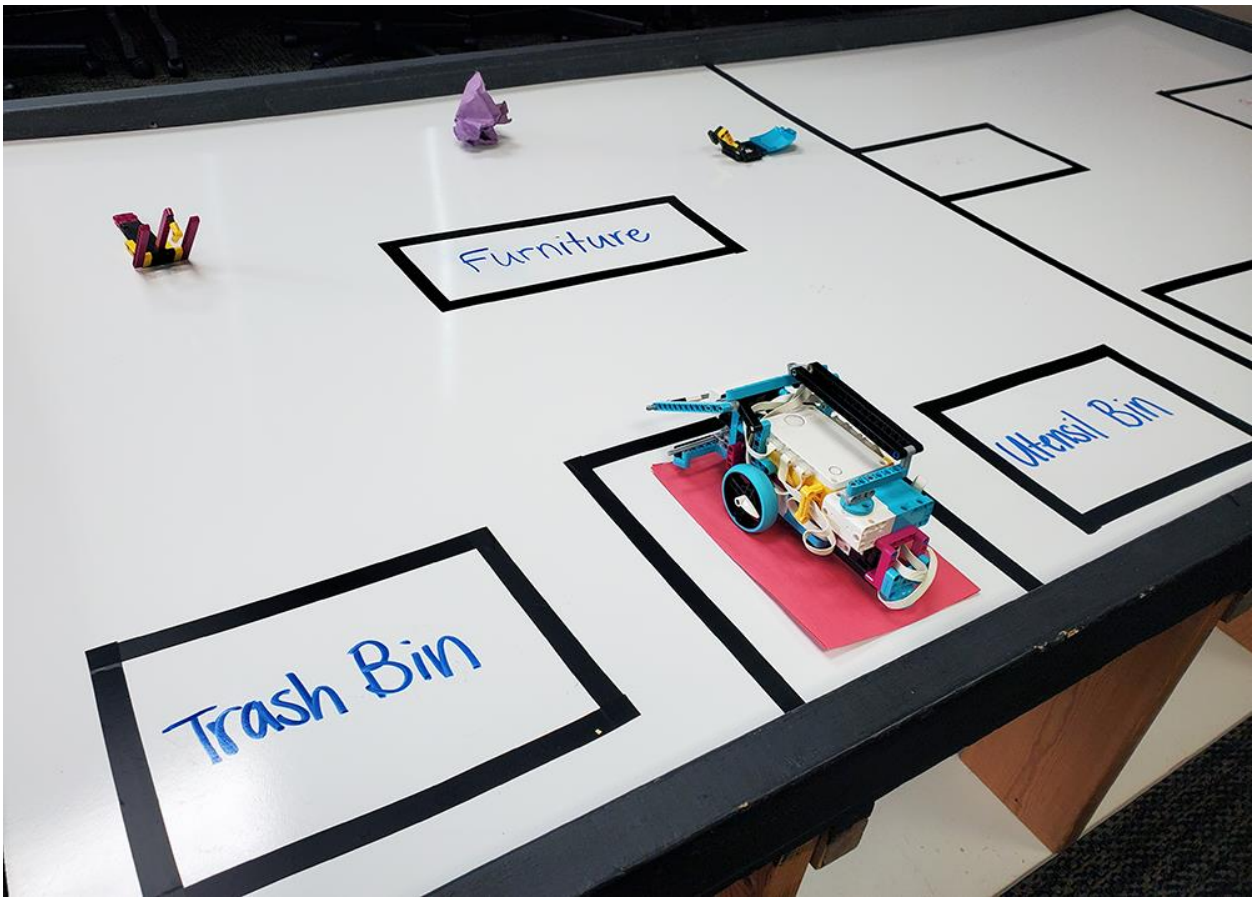
The Start/Finish box can be a piece of construction paper taped down or a line of electrical tape.

Challenge: Clearing the Home

Students will create a program for your Robot to act like LoCoBot by driving around your room and clearing up all the trash so that it is safe for people to walk around.

To set up this challenge, you will need:

1. At least one (1) piece of furniture
2. At least one (1) piece of trash and two (2) utensils.
3. 2 Areas denoting the Trash Bin and Utensil Bin.

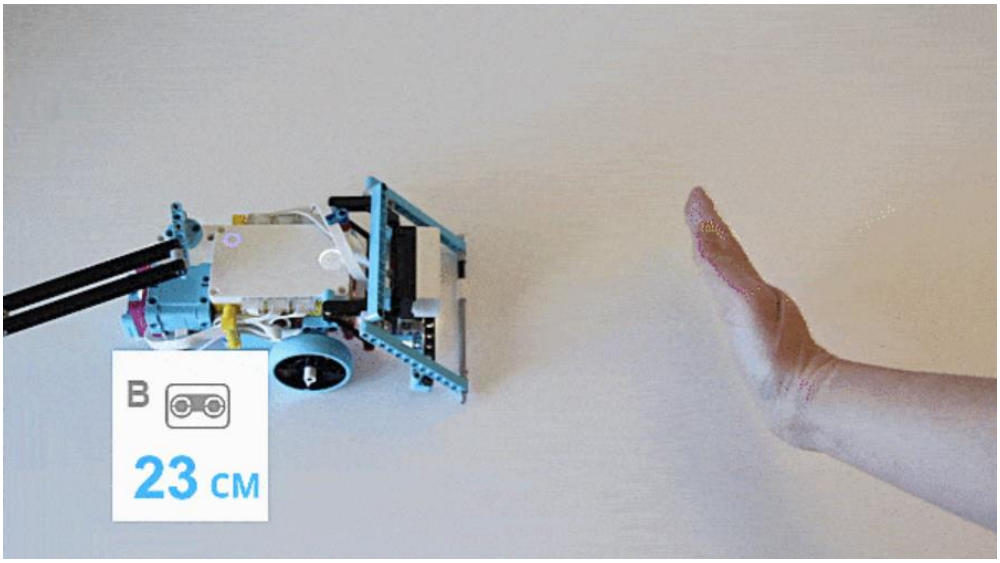


In this challenge, the furniture can be any object or obstacle that blocks the Robot's path. Some examples are boxes, books, red tape, binders, or other classroom material.

Wait Until & Sensors with SPIKE Prime

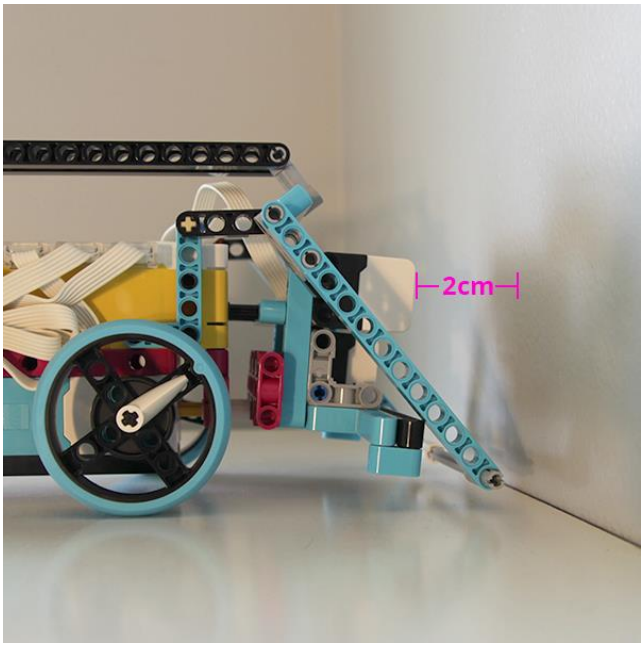
Lesson: Wait Until Near

For this lesson, students will need some object that is detectable by the Ultrasonic Distance sensor. This object will move towards the Robot, so the object can be a box or the flat side of a stack of textbooks or the student's hand.

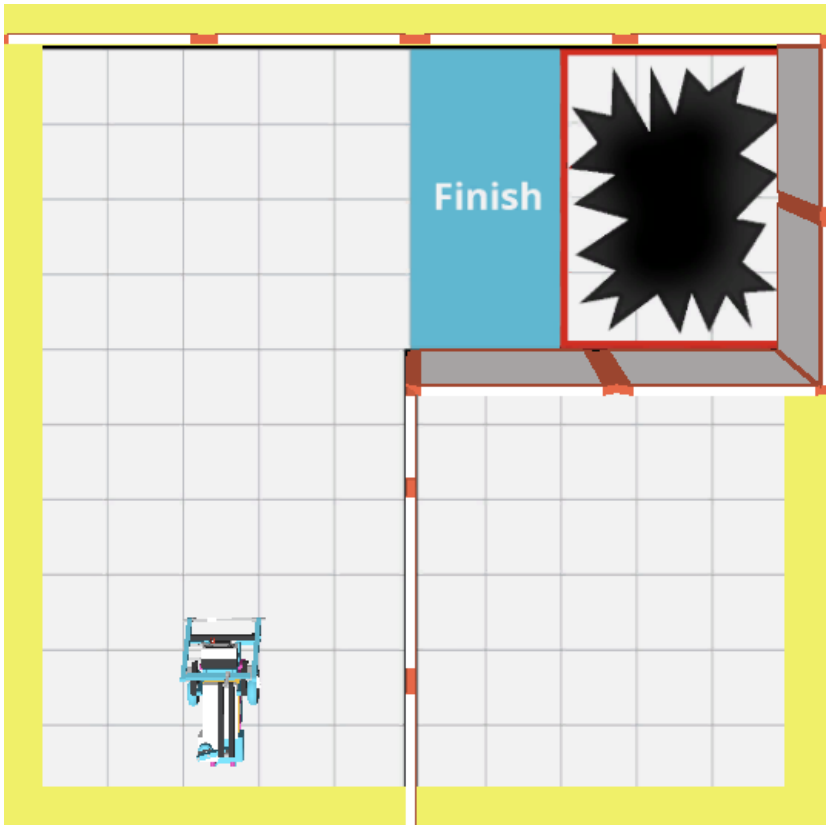


Lesson: Move Until Near

For this lesson, students will need some object that is detectable by the Ultrasonic Distance sensor. This object is stationary, so it can be a wall, a box, or the flat side of a stack of textbooks.



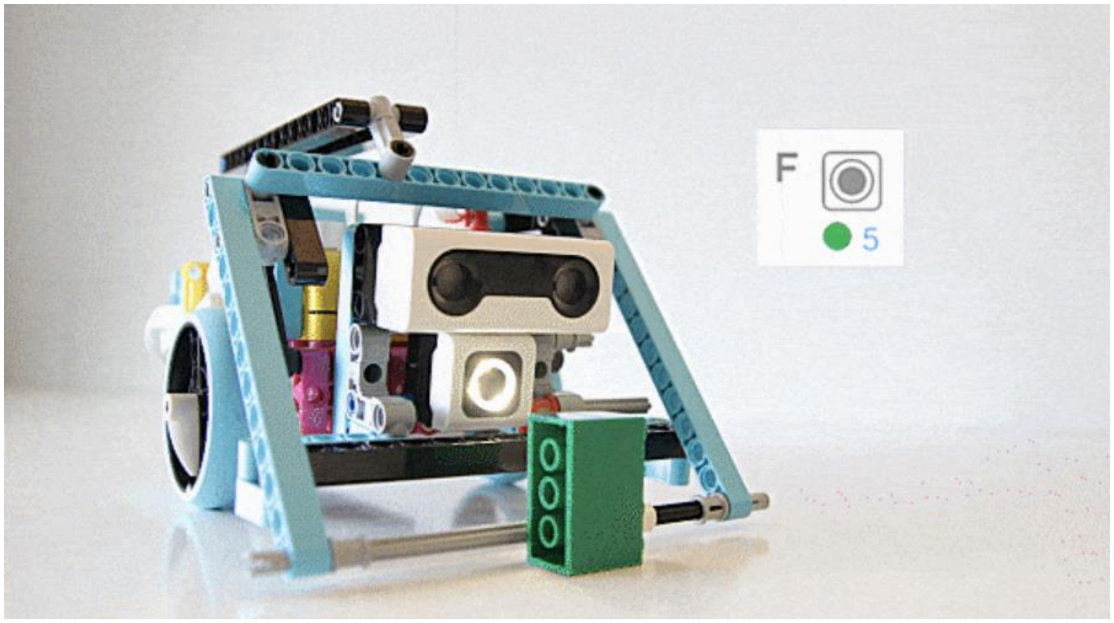
Mini-Challenge: Investigating the Collapsed Building



This challenge requires the Robot to drive in a walled environment with 2 areas denoted on the table. There should be a Finish area, and a Do Not Enter area surrounded by walls. The size of the area can vary as students will measure the area not to enter.

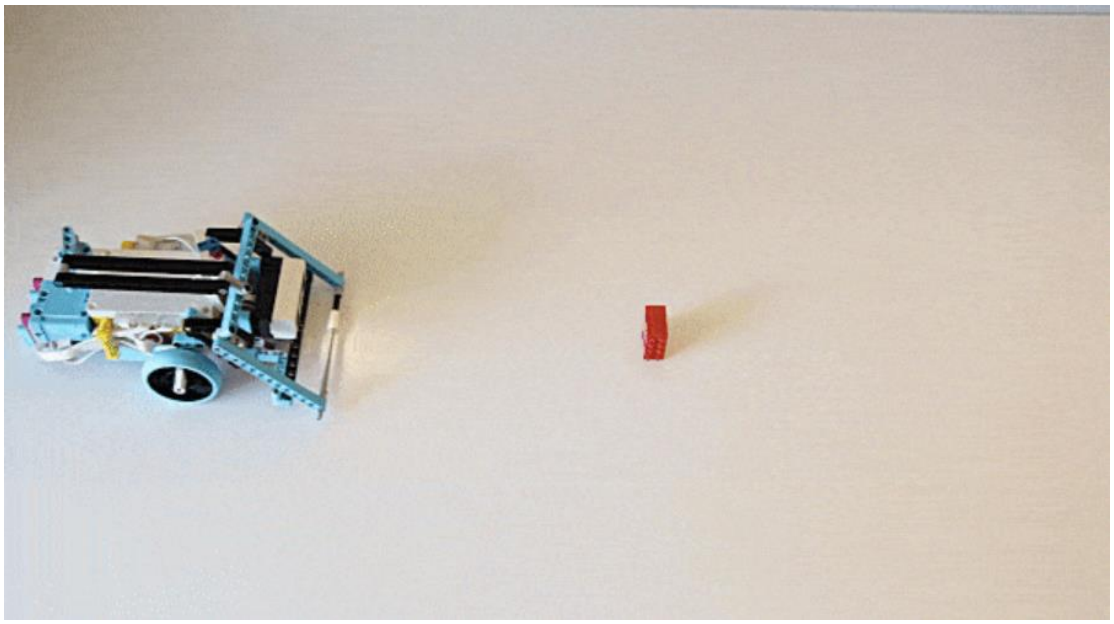
Lesson: Wait For Green

For this lesson, students will need some object that is detectable as **GREEN** by the Color sensor. For example, there are colored LEGO blocks in the LEGO® Education SPIKE™ Prime Set. These blocks are the ideal colors for the Color Sensor. Also, some shades of construction paper are properly detectable by the color sensor; there are shades of color where the color sensor will not detect the correct color.

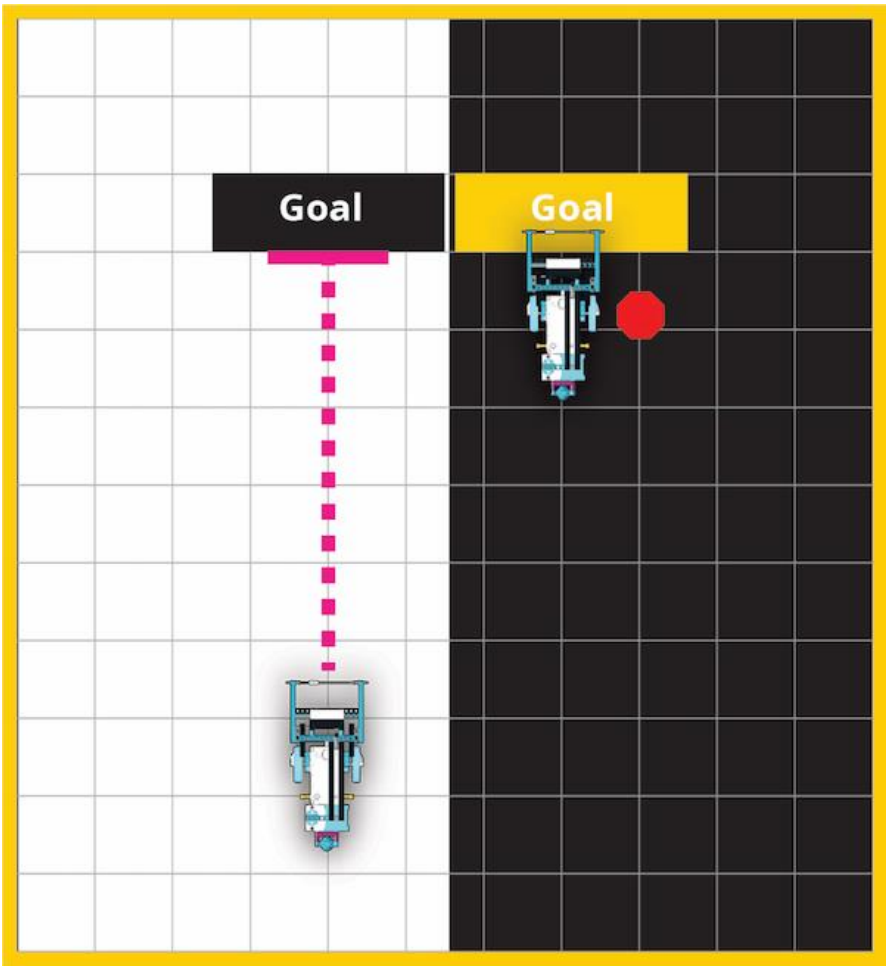


Lesson: Move Until Red

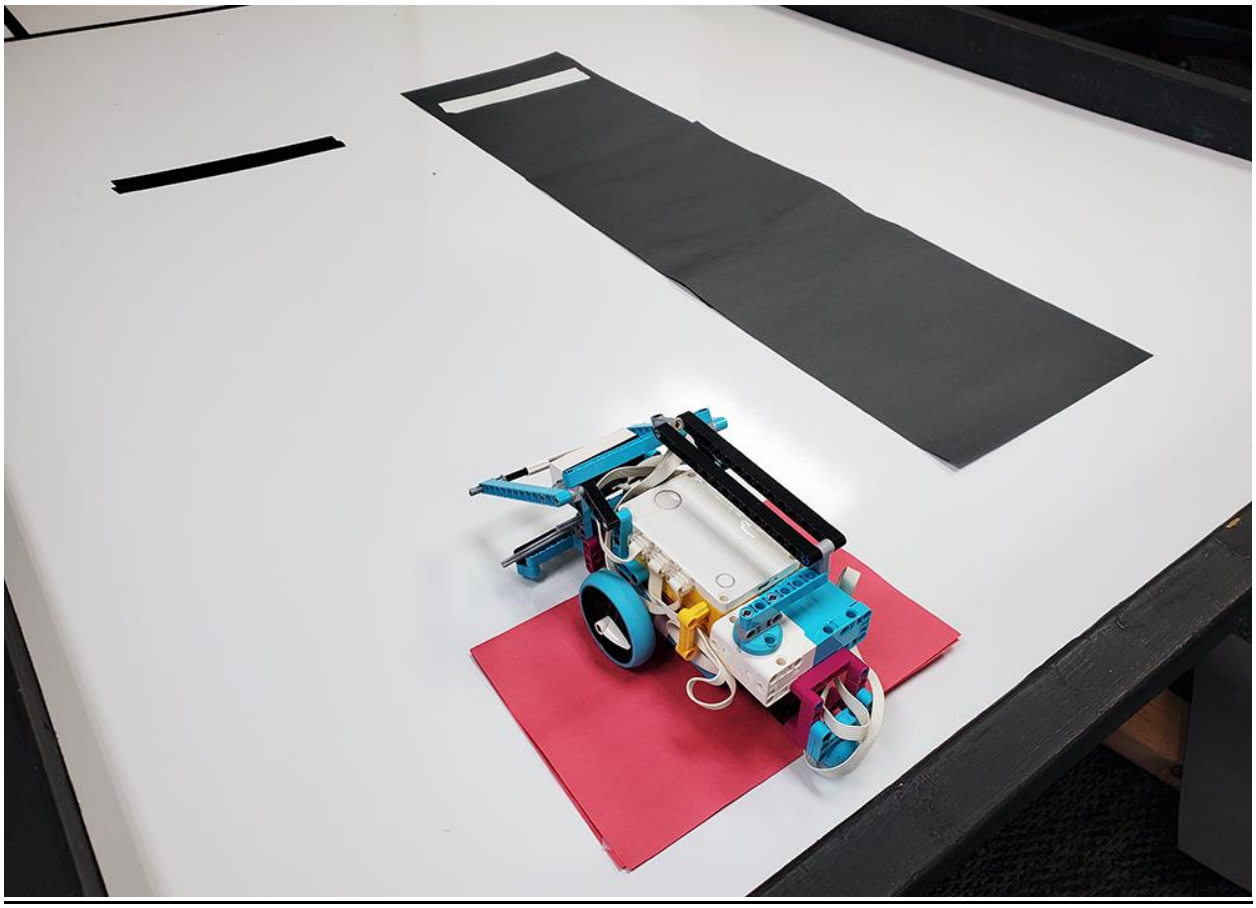
Similar to the challenge above, the students will need some object that is detectable as **RED** by the Color sensor.



Mini-Challenge: Forward Until Stop Line



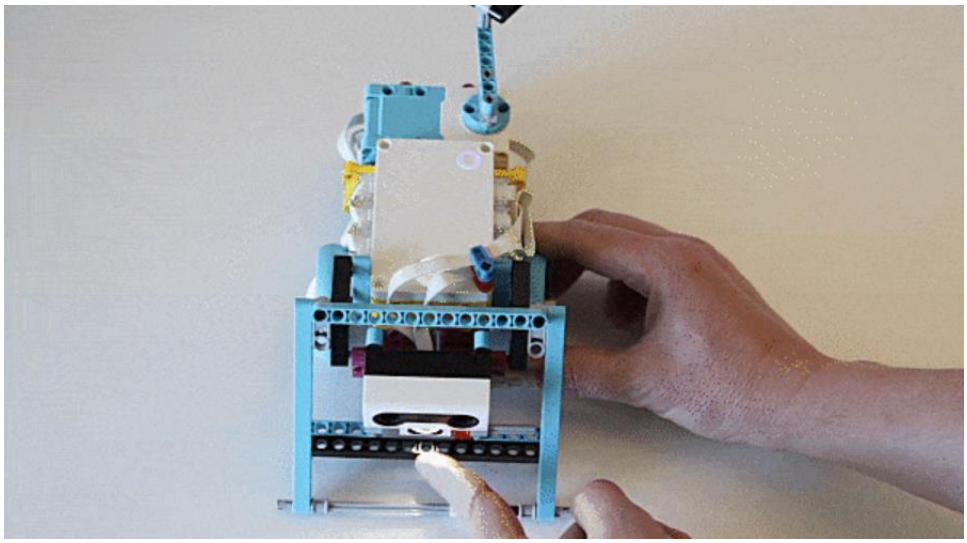
This challenge requires the Robot to drive over 2 different surfaces and detect 2 different colored lines. Black and White vinyl electrical tape can be used to create lines for the Robot to connect.



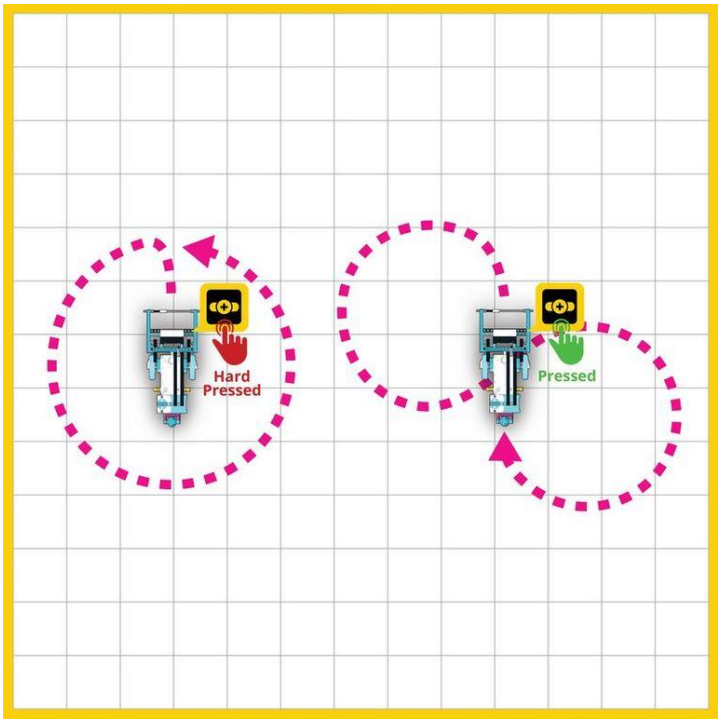
Our table has a light surface, so we used black construction paper to create the dark surface; any table/surface color can be used as long as they are distinct from the dark and light lines.

Lesson: Wait Until Pressed

In this lesson, students will push the Force Sensor; no other setup is needed.



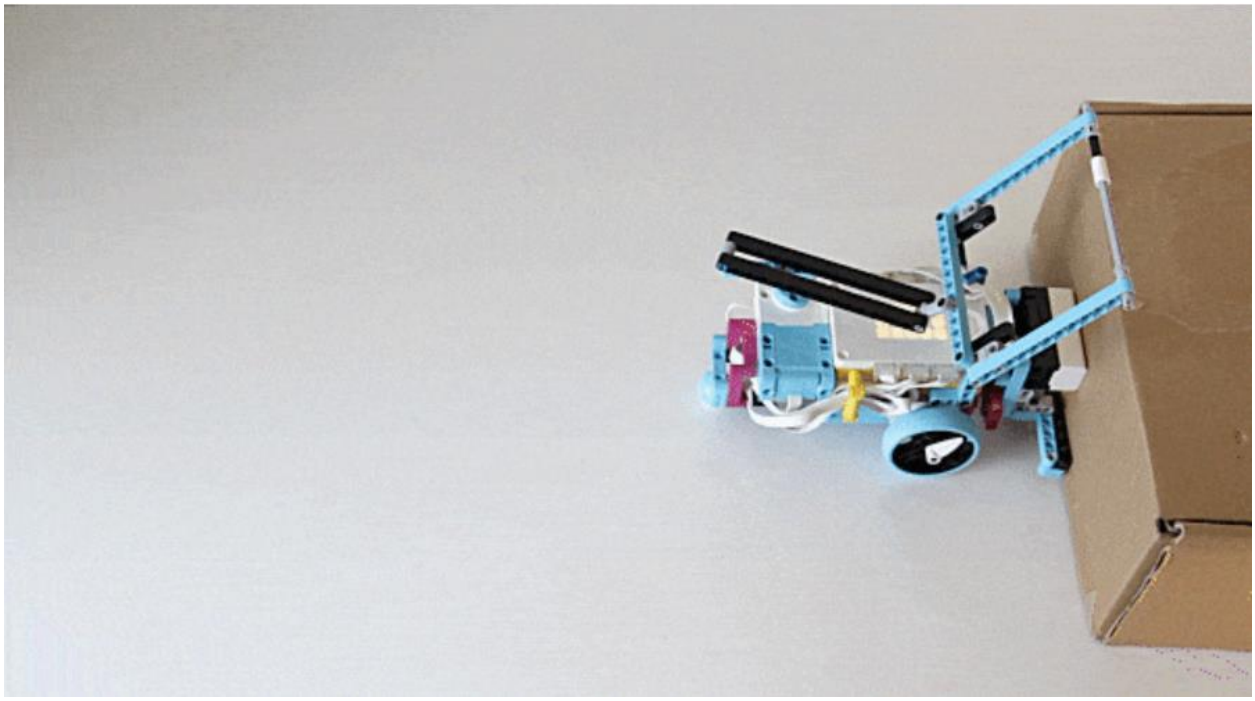
Mini-Challenge: Push Then Dance



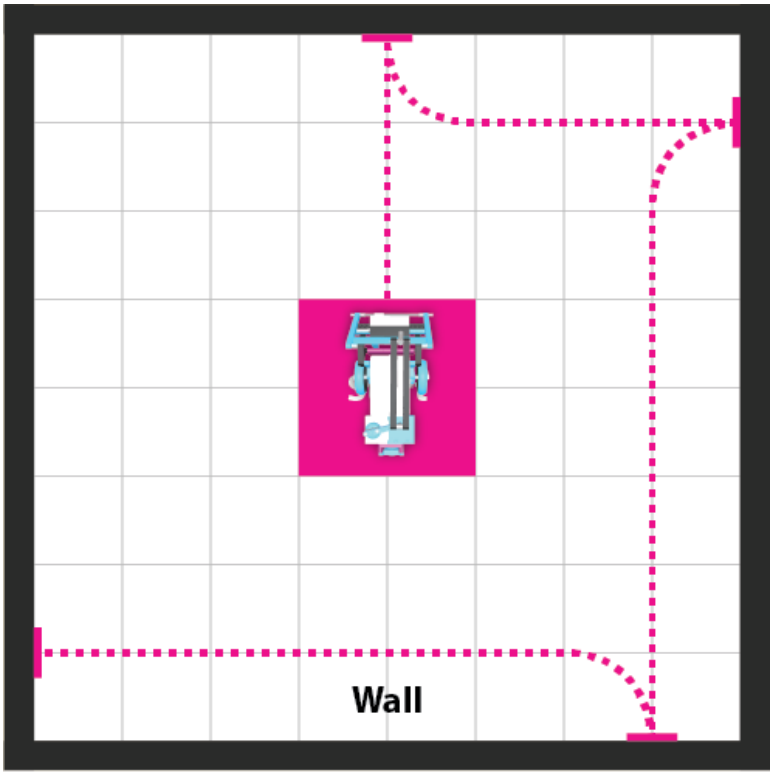
In this challenge, students will press on the Force Sensor with different amounts of force; no other setup is needed.

Lesson: Move Until Pressed

In this lesson, students will program to drive forward until the Force Sensor is pressed. After that, the Robot will need some object to run into; this can be a box, textbooks, a wall, or the student's hands.

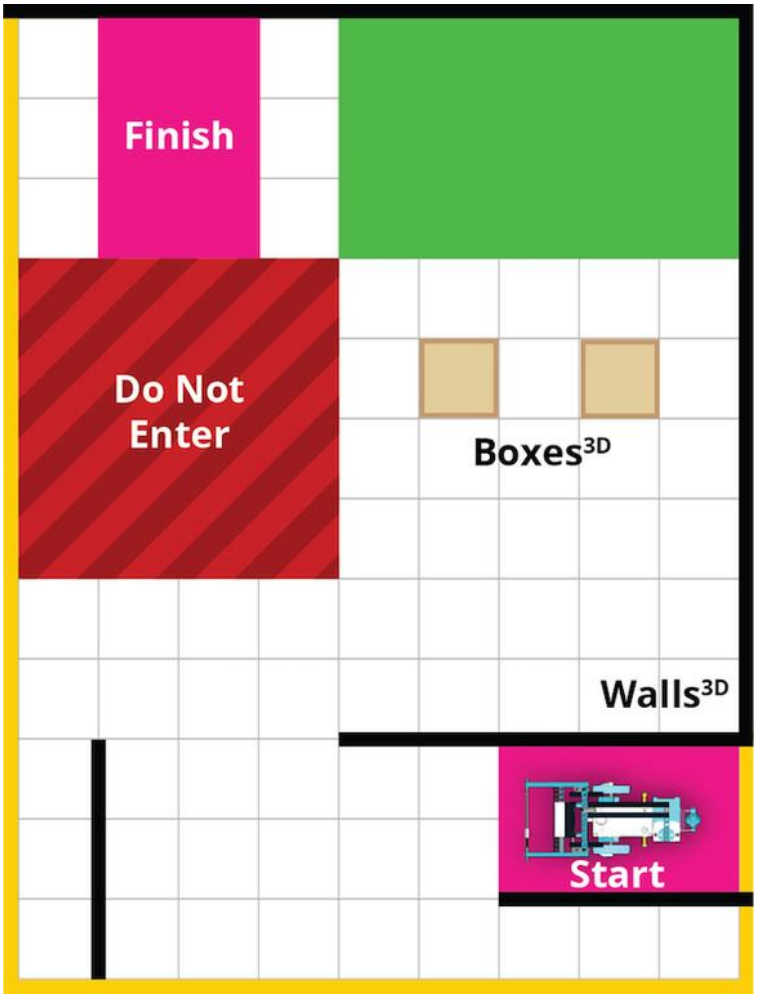


Mini-Challenge: Vacuum Challenge

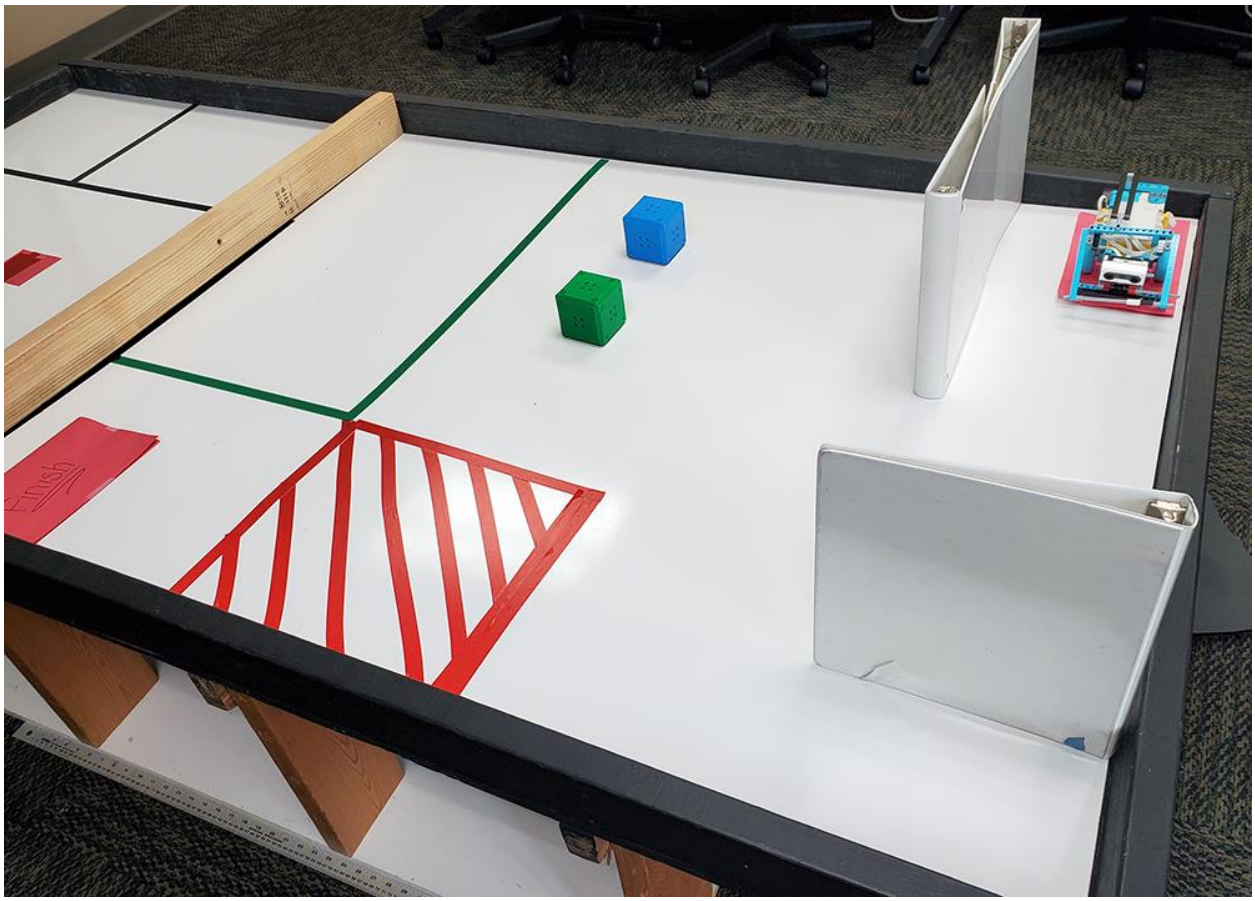


This challenge requires the Robot to drive in a walled-in environment with 4 walls.

Challenge: Exploring a Disaster Site



In this challenge, students will program their Robot to solve multiple obstacles using the different sensors on their Robot.

To set up this challenge, you will need:

1. 'Walls' set up similarly to the challenge using books or binders.
2. A "Do Not Enter" area can be created with red construction paper or red tape. Likewise, the green area can be created with green construction paper or green tape.
3. Objects or boxes that the Robot can push around.