

# **FIRST<sup>®</sup> LEGO League Challenge Camp Kit**

*Our Future:*  
**Built Better Together**



Created by  
FRC 8027 and Share & Learn

[www.droidsrobotics.org](http://www.droidsrobotics.org)

<https://www.facebook.com/groups/FLLShareandLearn/>



# Welcome to Camp

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- This week we will be exploring **FIRST**<sup>®</sup>
- You will learn all about the three parts of the program:
  - **Core Values:** You will learn to work as a team
  - **Innovation Project:** You will create a solution to a problem
  - **Robot Design:** You will program your robot to complete specific missions
- You will have lots of fun along the way

# Day 1

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# FIRST<sup>®</sup> Core Values

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- What are the *FIRST*<sup>®</sup> Core Values?
- How are they relevant to us?
- To work well together, we need to learn to respect each other.
- Let's start by getting to know each other.

- We express the *FIRST*<sup>®</sup> philosophies of *Gracious Professionalism and Coopertition through our Core Values:*
- **Discovery:** *We explore new skills and ideas.*
- **Innovation:** *We use creativity and persistence to solve problems.*
- **Impact:** *We apply what we learn to improve our world.*
- **Inclusion:** *We respect each other and embrace our differences.*
- **Teamwork:** *We are stronger when we work together.*
- **Fun:** *We enjoy and celebrate what we do!*

# Core Values Activity: Photo Sharing

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- Share one photograph of yourself doing something you enjoy
- Tell every what you are doing and why this photograph is important to you
- Are there other students in the group who like the same activity as you?



# Innovation Project

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**FIRST®** City needs our help. Due to a pandemic, everyone is under quarantine.

Pick a topic in your city related to the quarantine from the following main areas:

***Staying healthy*** – How can citizens get medical care if they are sick or groceries during a quarantine?

***Isolation*** – how can people stay busy and prevent loneliness?

***Education*** – How can students continue to learn during a quarantine?



## ***What is an Innovation Project?***

A research project to identify and solve a real-world problem.

# Innovation Project

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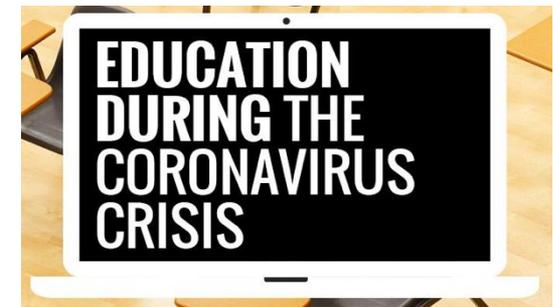
Let's discuss different problems people may face within these broad topics.

What did your family have to do during the quarantine? What problems did your family face? Which of these topics interests you the most?

***Staying healthy*** – getting healthcare and food

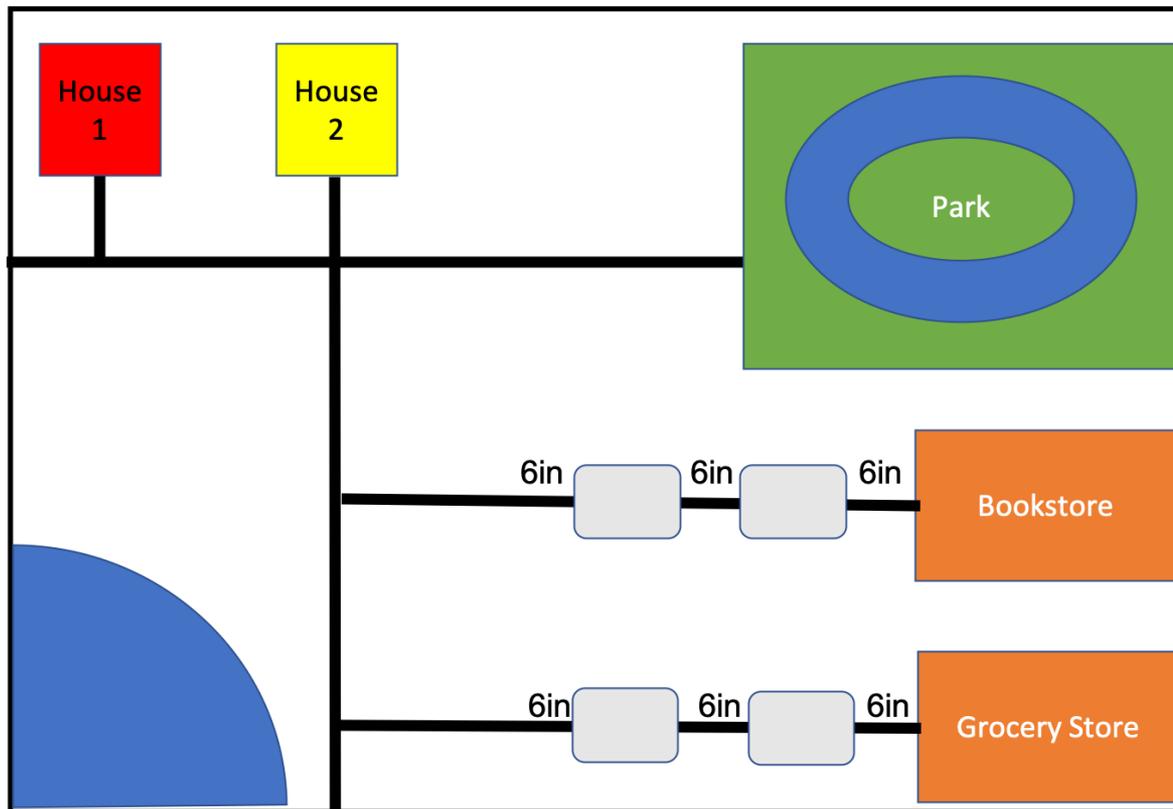
***Isolation*** – feeling lonely and disconnected

***Education*** – having to learn from home



# Robot Design: Strategy

Let's look at our challenge for the week.



**M01:** The family in House 2 is bored and also want an extra resource to help the child with schoolwork. Go to bookstore. Pick up book (Model with Hoop) and deliver to House 2. Stay 6in away from people in line. (5pts per book delivered)

**M02:** The family in House 1 is running low on food. To stay healthy, they need milk, bread and eggs. Go to Grocery store. Pick up groceries (Models with hoop) and deliver to house 1. Stay 6in away from people in line. (5pts per grocery item delivered.)

**M03:** Go to Park to meet your friend and go for a walk together. You must be completely inside the park area and do 3 right turns and 3 left turns.

# Rules

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**R01:** Maintain social distancing at all times at the store. There is a line of people in front of the each store. Your robot must stay 6 inches away and move forward only when robot (box) in front is removed.

**R02:** You must use a sensor to accomplish all missions above

# Thinking About Sensors

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## LINES

Follow lines → Need a color sensor facing down in front of drive wheels

Square up on Lines → Need two color sensors facing down

## WALLS (If you build walls)

Ride along wall → Need riding wheels or flat surface on the sides

Align on Walls → Needs a flat surface on the front and back

## MISSION MODELS

Align on Mission Models → Need the model and robot be flat

# Thinking About The Missions

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## Pick Up

Need an arm to lift up a hooped object

You might be able to push the object

## Drop Off

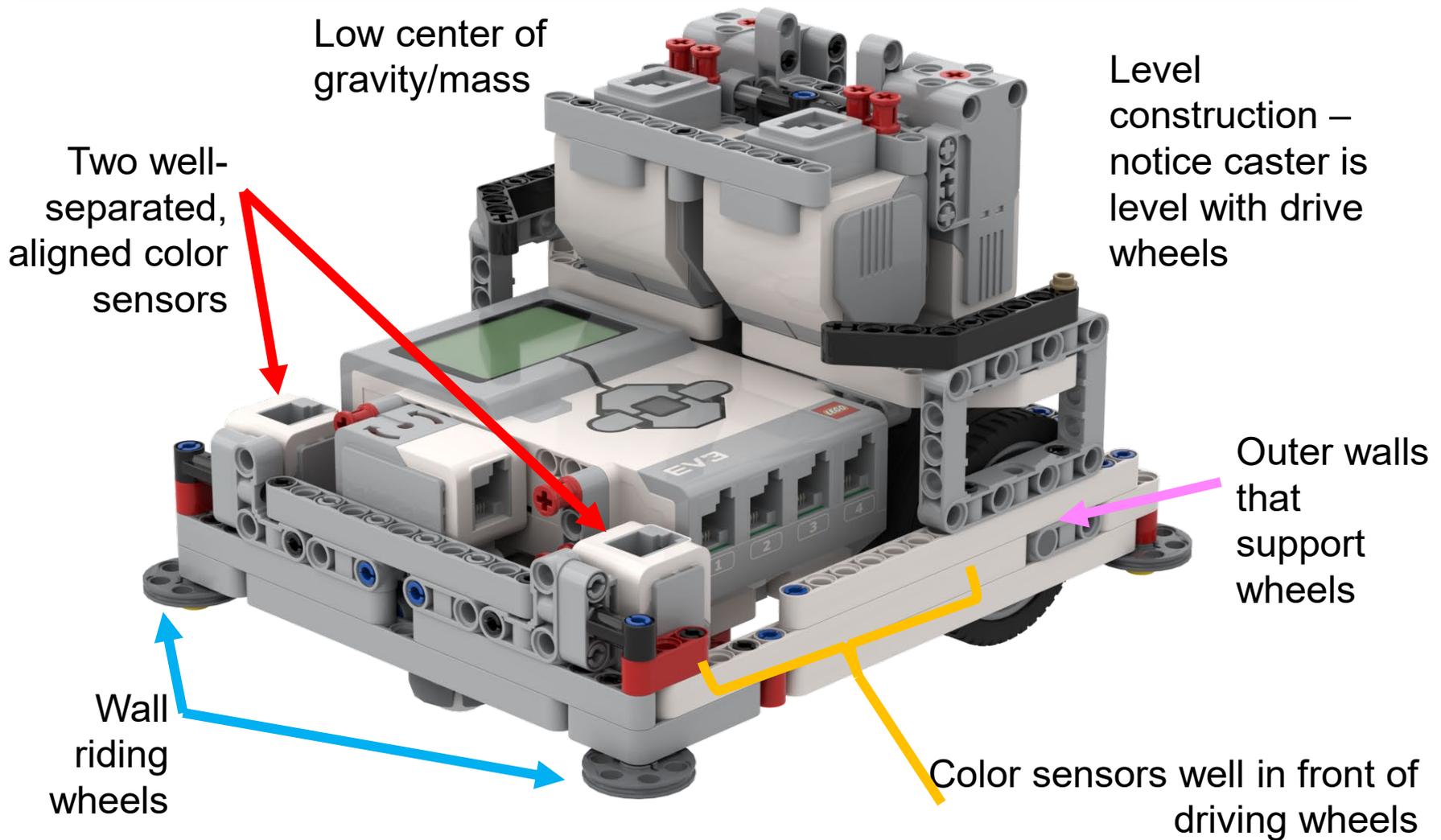
Need an arm to drop off the hooped object

You need to be able to release the object

## Stay Away

What sensor will help us stay a particular distance away from an object?

# Features of a Robot



# Robot Design: Decide on Your Robot

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How many motors will we use?	What sensors should we have?	How will we grab the mission model?	How will we release the mission model?

# Day 2

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# Core Values: Public Service Announcement

- Today's core value goal is to work together.
- Create a Public Service Announcement related to the topic you picked yesterday.
- How can you clearly communicate a message? What words should be on the poster? What images? What colors should you use? Decide together and create a poster.



# Innovation Project: Pick a Problem

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*Now that you have identified a broad topic, let's look at specific problems?*

Identify a specific problem you want to address with regards to staying healthy, isolation or education. For example, you may pick the problem of how to get groceries if you cannot go inside the store.

What Problems Interest us	What experts can we talk to?	Can we go on some virtual field trips?

Identify a Problem

Do Research

Develop a Solution

Test and Share

# Innovation Project: Existing Solutions

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*What solutions exist for your problem?*

*What are limitations in these solutions? Can we make them better?*

*e.g. Instacart will deliver groceries to your house, Giant Eagle grocery store does curbside pickup*

	Pros	Cons	Implementation
Solution 1			
Solution 2			

Identify a Problem

Do Research

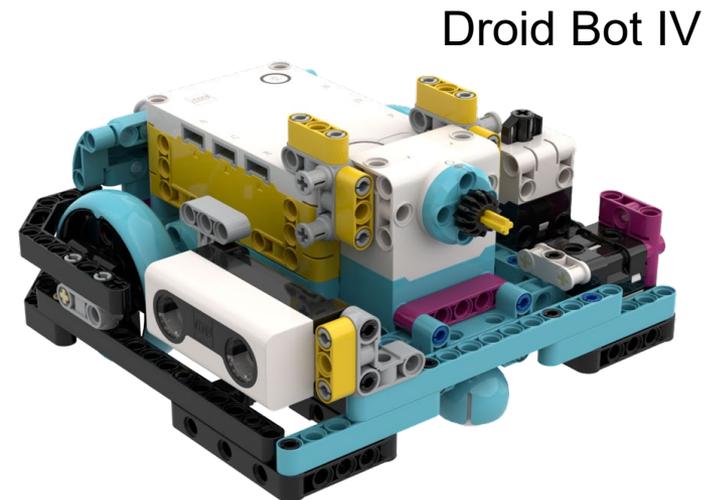
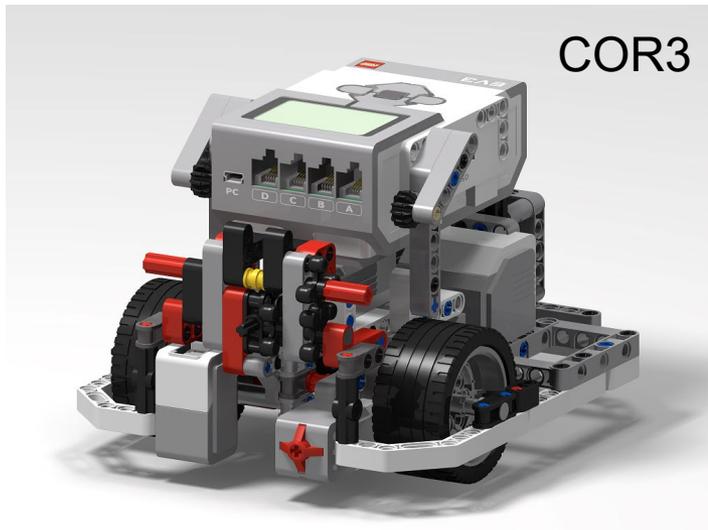
Develop a Solution

Test and Share

# Robot Design: Build a Robot

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- Build a robot based on the criteria you determined yesterday
- You can design it in Studio 2.0 or with your MINDSTORMS or SPIKE Prime sets
- Or you can start with these two designs and modify them (built with one set)



COR3: <http://flttutorials.com/en/robotgame/building/one%20kit%20build/2018/06/12/COR3.html>

Droid Bot IV: <http://primelessons.org/translations/en/lessons/DroidBotIVBuildInstructions.pdf>

# Day 3

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# Core Values: Create a City Emblem

- For today's activity, the team will continue to learn to work together
- Design a city emblem together that represents your team and incorporates elements of the problem you have chosen to study
- What do you want to include in it?
- What colors will you use?
- What images should be on it?
- How do the images or symbols reflect the local culture?

- What elements are in this emblem for the City of Los Angeles?
- Name
- Founding Date
- Symbols



# Innovation Project: Create a Solution

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- Brainstorm all possible solutions to the problem you selected yesterday
- What are the pros and cons of each idea?
- Decide as a team on one solution to the problem
- Think about makes your solution different from what already exists
- What would it take to implement your solution?

Identify a  
Problem

Do  
Research

Develop a  
Solution

Test and  
Share

# Innovation Project: Meeting Experts

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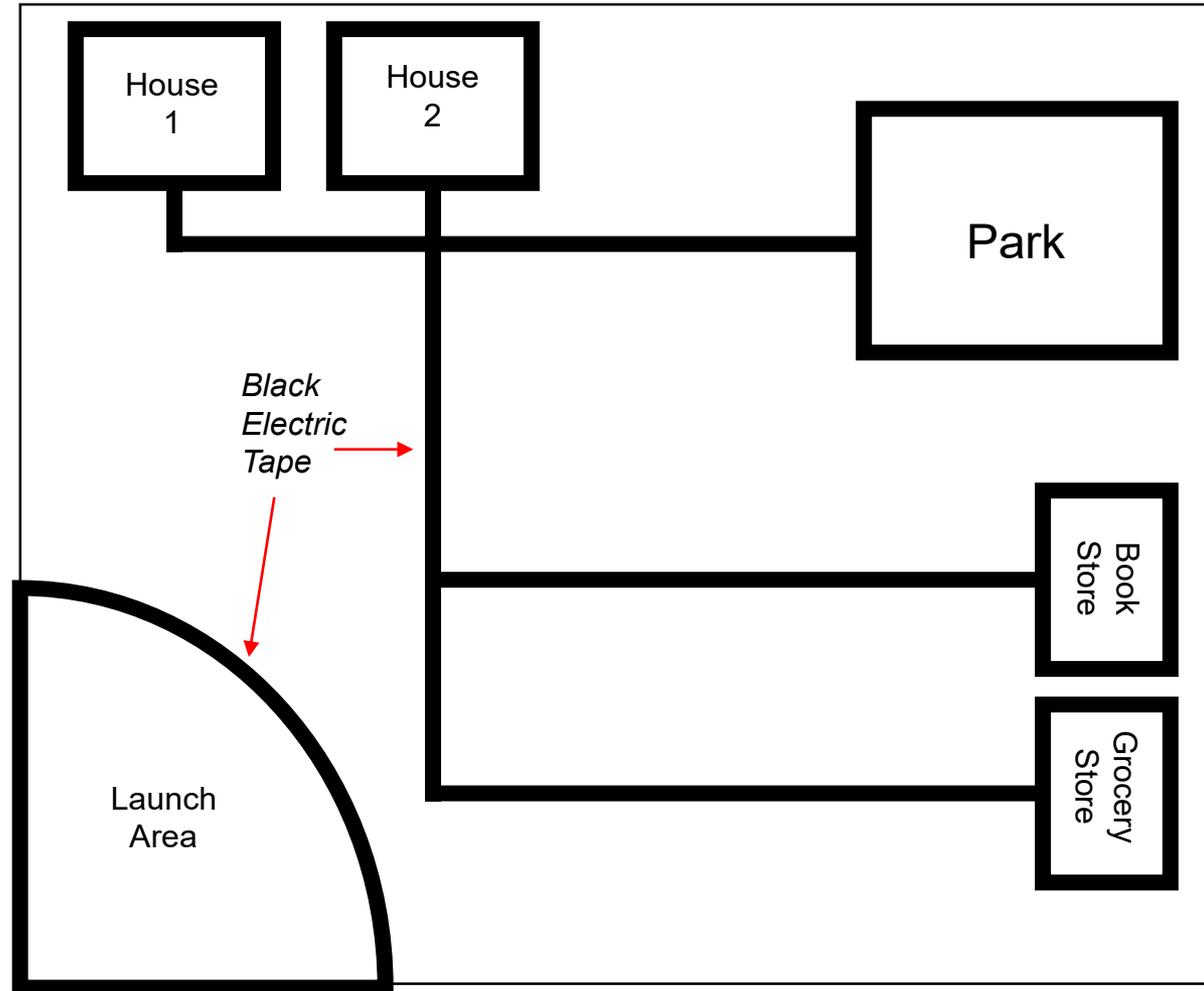
- Pick some experts to talk to and decide what questions you want to ask them
- Make sure that you do a little research about where they work and their role so you can ask good questions
- The sample questions on the right provide some examples
- If you have your solution idea, you should consider sharing it to get some additional feedback

## Sample Questions

Expert	Instacart Deliver Person
<b>Question 1</b>	Our team is trying to solve the problem of getting groceries during Covid-19.  In your experience, how many of your orders were because of Covid-19?
<b>Question 2</b>	How do you ensure that you are not contaminating the groceries you are delivering?
<b>Question 3</b>	What is one problem you see with delivering groceries during Covid-19?
<b>Question 4</b>	We have come up with a way to sanitize all the groceries before you deliver them. What do you think of our idea?

# Robot Game: Build the Challenge/Models

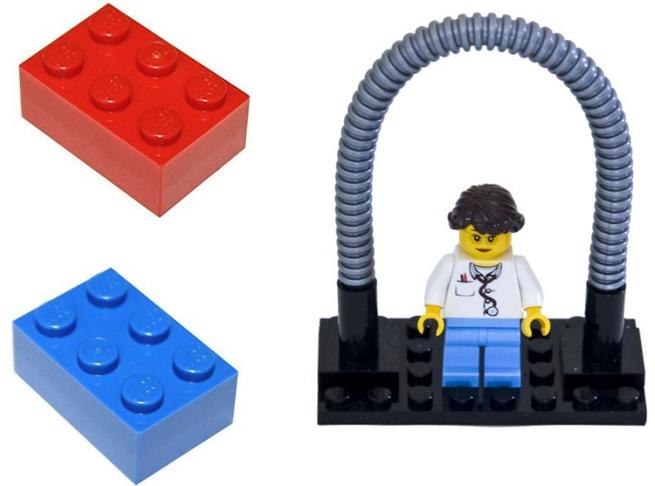
- Use white paper and black electric tape to create the lines and zones on this page
- You can use boxes 6in apart to create the line outside the stores
- Areas such as homes, the park and stores just need to be identified with tape on the ground
- Use the building instructions to build the mission models that represent books, groceries



# Mission Model Build Instructions

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- Create simple mission models with hoops to represent books and groceries
- The example on this page has a minifigure, but you can replace it with different colored 2X3/2X4 LEGO brick to represent different books and food items
- Create 6 such models – three groceries and three books
- If you not have a hoop, you can still use any LEGO brick as your mission model
- If you do not have spare LEGO brick, use pipe cleaners and any recyclable materials to fashion similar mission models.
- Place three items in each store.



# Robot Game: Programming Lessons

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## Beginner:

Move Forward/Backward

Turn

## Advanced: (Download the lessons from [EV3Lessons.com](http://EV3Lessons.com))

My Blocks

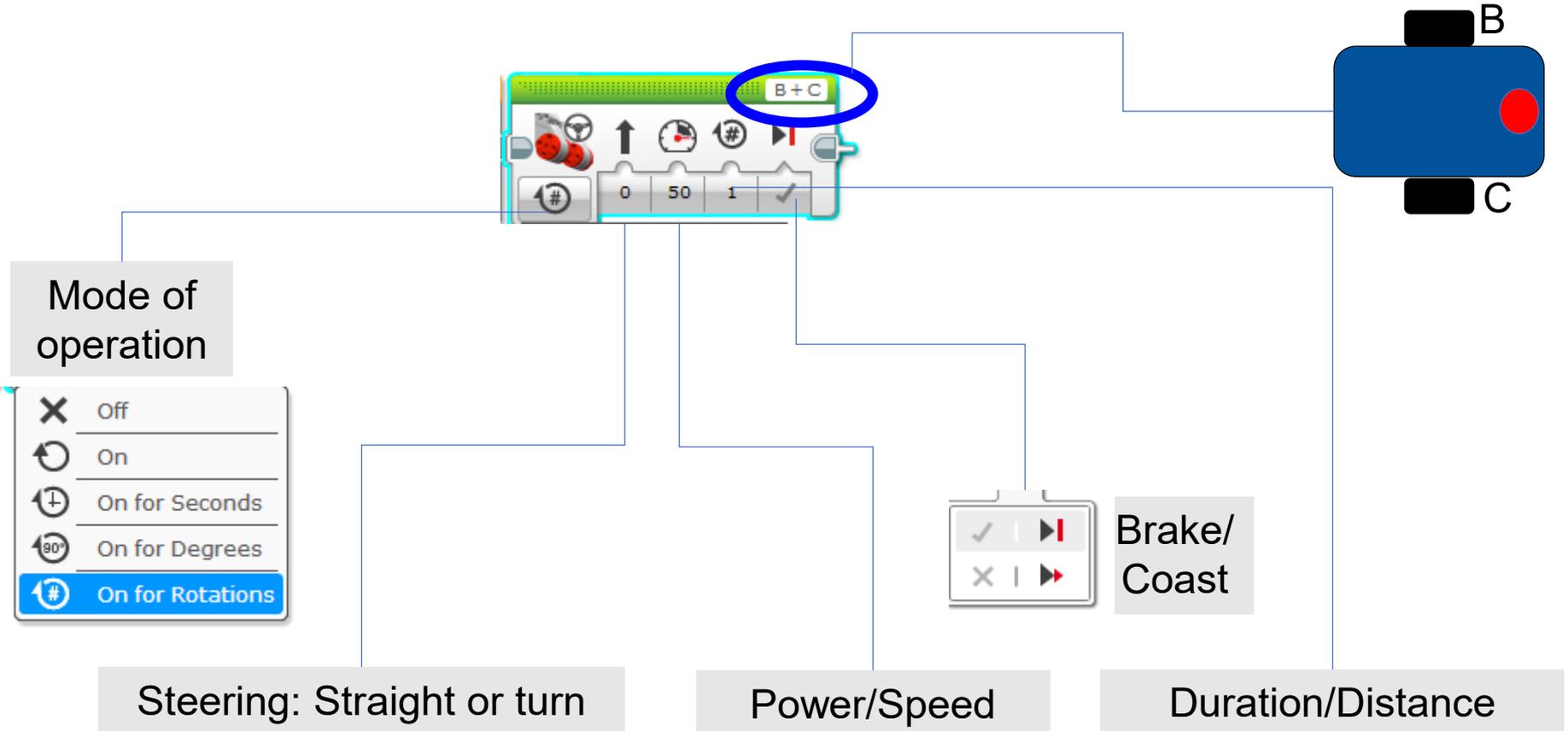
Move\_CM My Block

# Moving Forward/Backward

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To access a SPIKE Prime version, download from  
[PrimeLessons.org](https://PrimeLessons.org)

# Move Steering Block



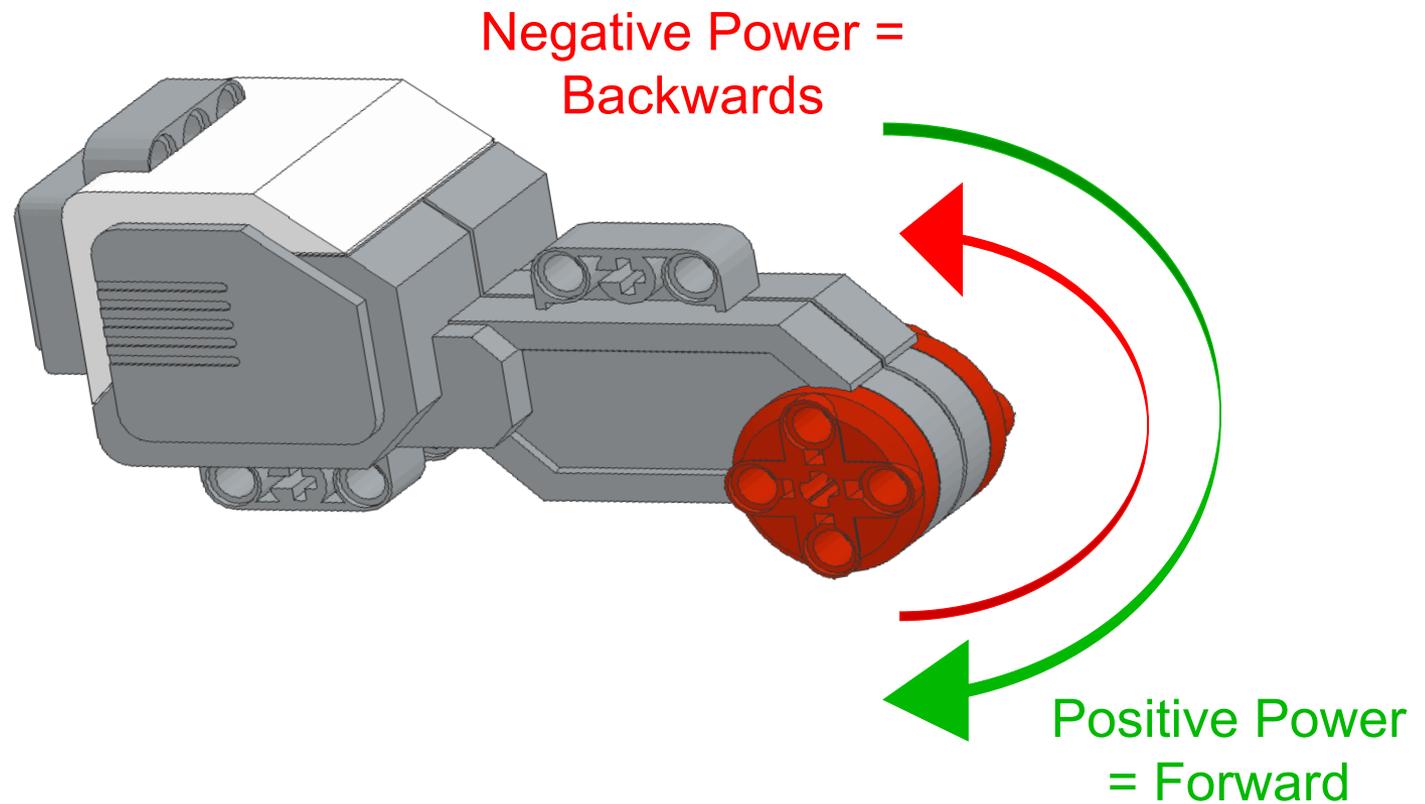
# Moving Forward/Backward

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To access a SPIKE Prime version, download from  
[PrimeLessons.org](https://PrimeLessons.org)

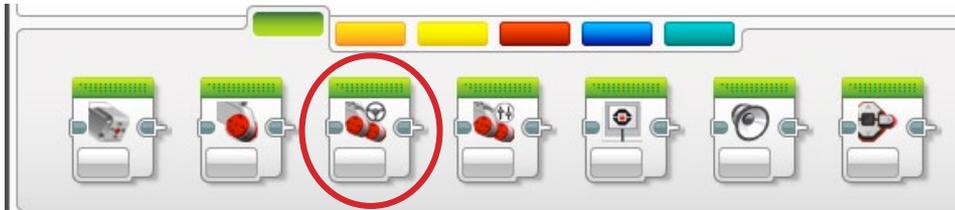
# NEGATIVE & POSITIVE POWER: BACKWARD & FORWARD

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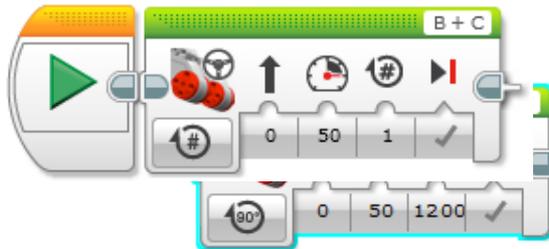


# How do you Move Straight?

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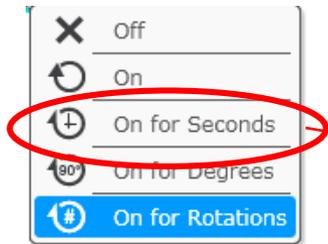


STEP 1: Green Block Tab, Click and hold Move Steering and drag to programming area

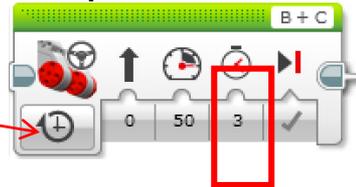


STEP 2: Drop next to the Start Block (green arrow)  
(See animation)

# Challenge: Move Straight (3 sec)



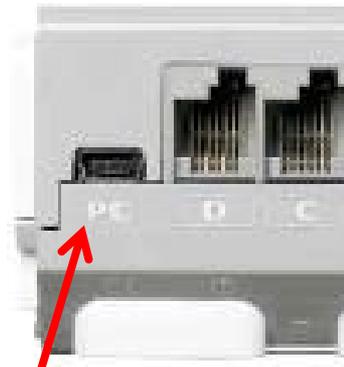
Step 3



STEP 1: Green Block Tab, Click and hold Move Steering and drag to programming area

STEP 2: Drop next to the Start Block (green arrow)

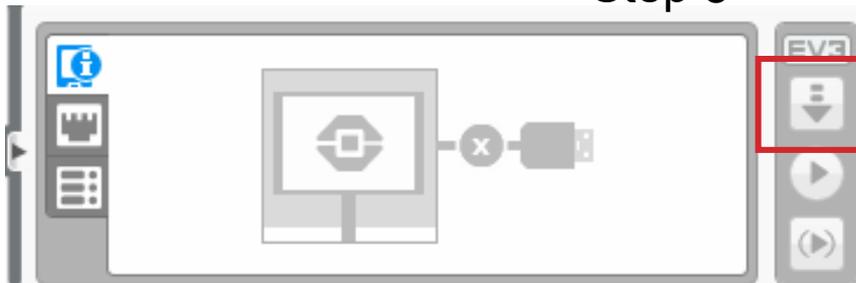
STEP 3: Select Options. Move "3 Seconds"



Step 4

STEP 4: Connect USB cable to EV3 and Laptop.

Step 5

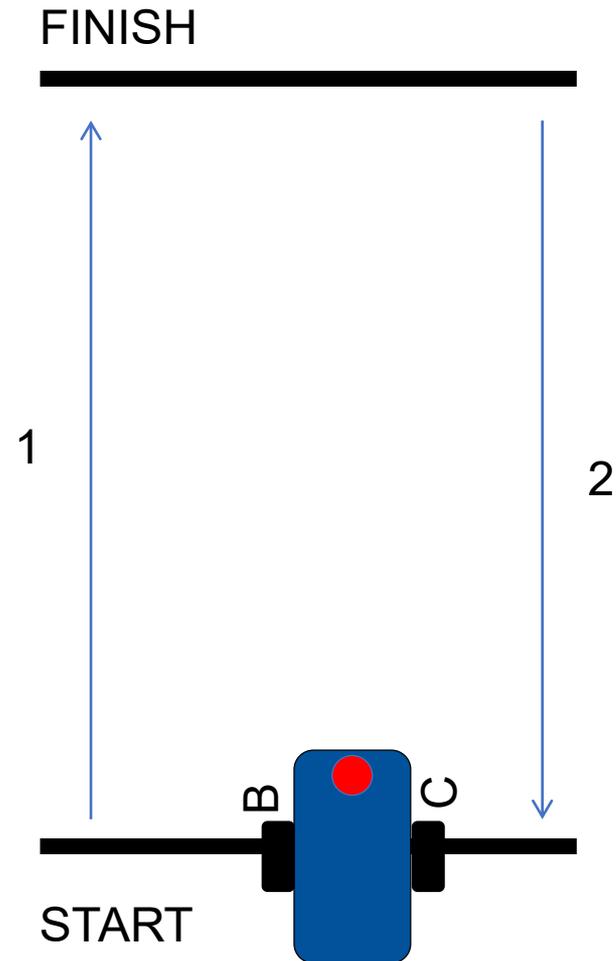


STEP 5: Download to EV3  
STEP 6: Run Program

# Compare: Seconds vs. degrees vs. rotations

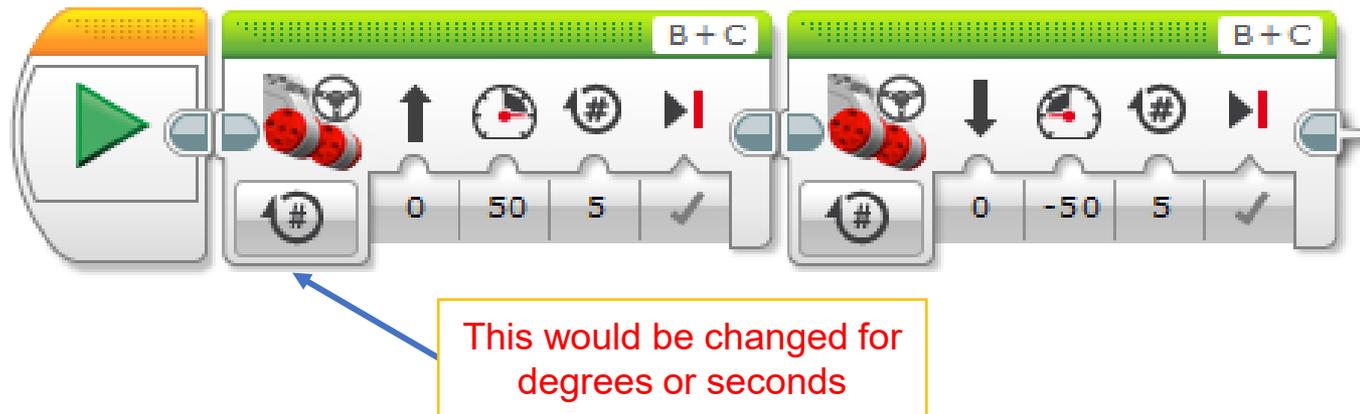
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- Now, move your robot forward from the start line to the finish line (1) and back to the start (2).
- Try mode SECONDS, DEGREES or ROTATIONS and adjust duration/distance
- Try different speeds



# Challenge Solutions

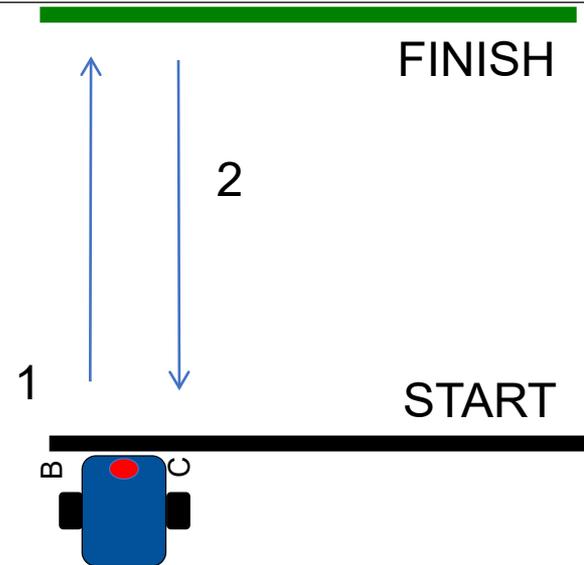
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- There is a better way (go to slide 11) to solve this challenge

# Using Port View

- Move your robot forward from the start line to the finish line (1) and back to the start (2).
- In this lesson, you had to use a lot of guess and check to stop exactly on the second line.
- Now try using Port View:
  - Go to one of the rotation sensors (Motor B or C for our robot on the right)
  - Make sure it is on degrees as the mode and that it starts at 0 degrees.
  - Move your robot with your hand from the start line to the end line. Make sure that your wheel turns smoothly and doesn't slip as the robot moves.
  - Read how many degrees your robot moved
  - Use this number in the Move Steering Block to move the correct distance.



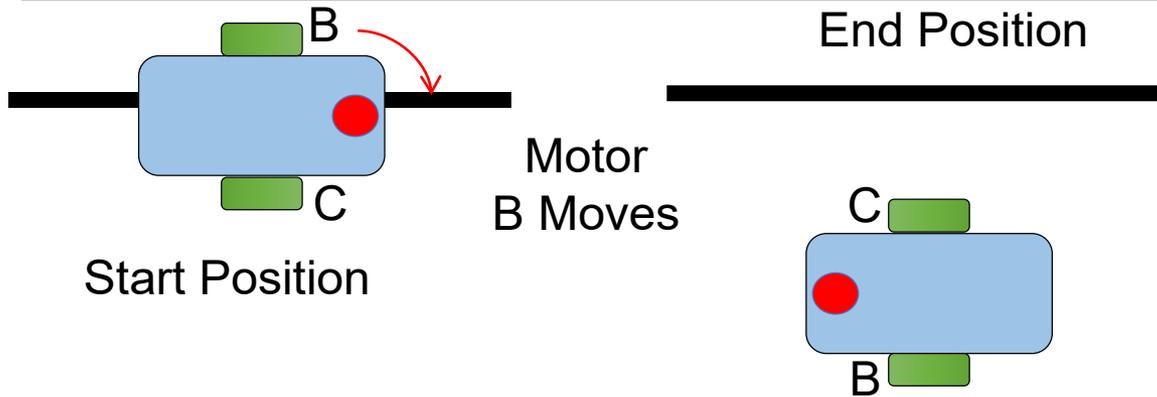
# Turning

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To access a SPIKE Prime version, download from [PrimeLessons.org](https://PrimeLessons.org)

# Pivot vs. Spin Turns

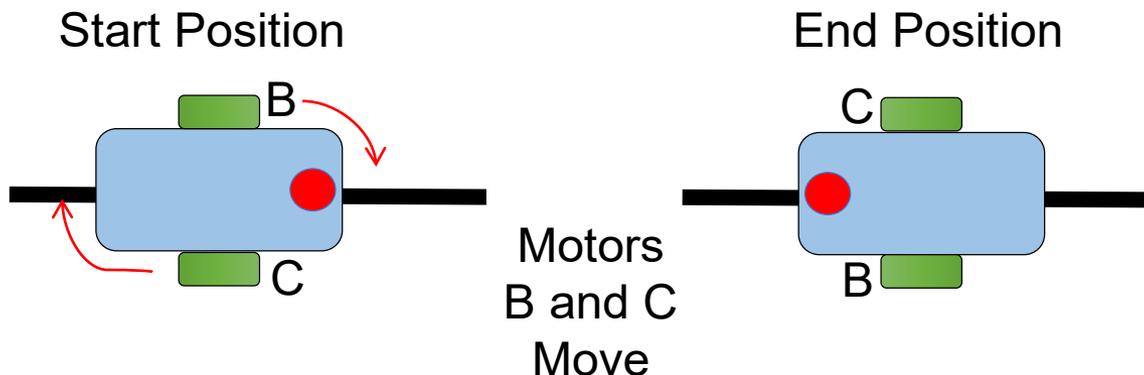
## 180 Degree Pivot Turn



Notice where the robot ends in both pictures after a 180 degree turn.

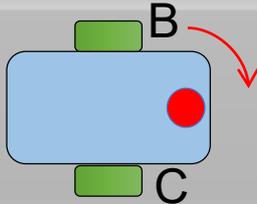
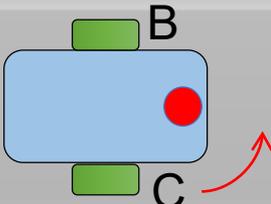
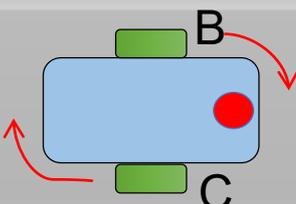
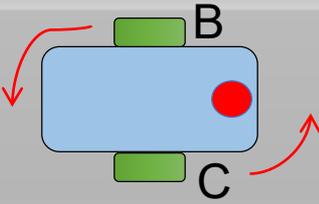
In the Spin Turn, the robot moves a lot less and that makes Spin Turns are great for tight positions. Spin turns tend to be a bit faster but also a little less accurate.

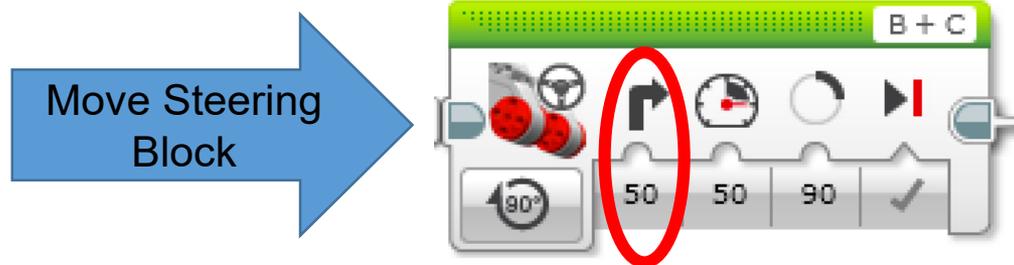
## 180 Degree Spin Turn



So when you need to make turns, you should decide which turn is best for you!

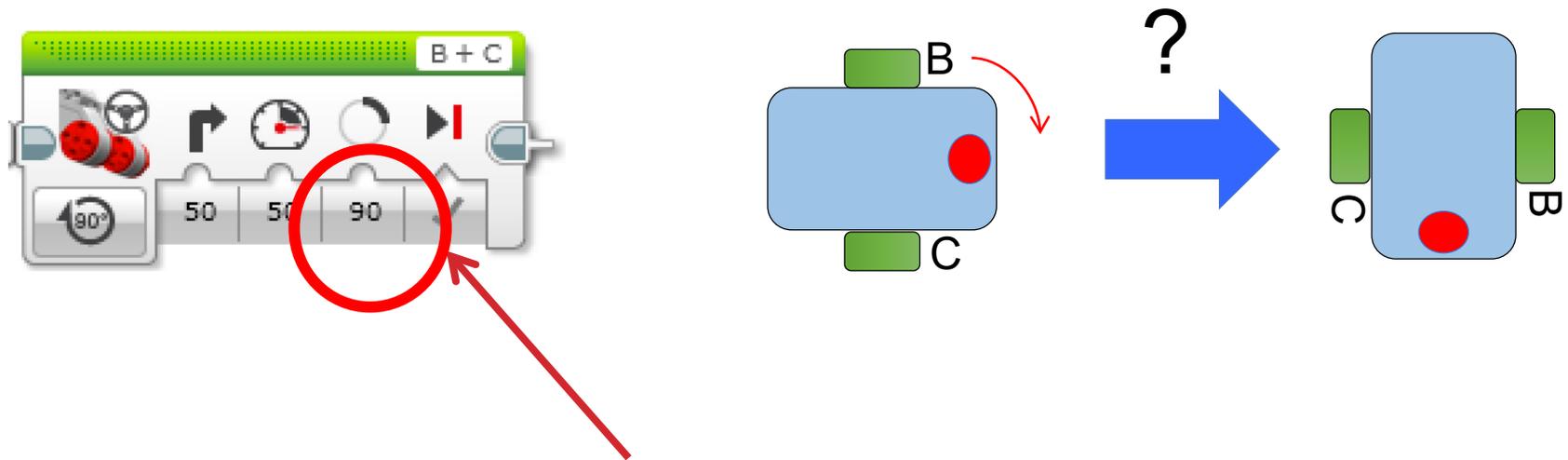
# How to Make Pivot and Spin turns

Steering Value			
50	-50	100	-100
			
Pivot Turn Right	Pivot Turn Left	Spin Turn Right	Spin Turn Left



Change Steering value here

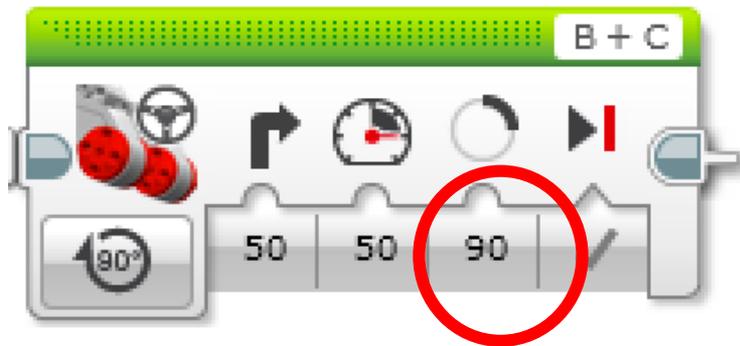
# Making a Pivot turn for 90 Degrees



Program your robot to turn 90 degrees....Does the robot actually turn 90 degrees if you just pick 90 degrees for distance? Ans. NO! Solution on next page

# How do you make the robot turn 90 degrees?

- Try using the port view to measure the turn and then input the correct number of degrees.



# Day 4

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# Core Values: Create a Mission Model

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- It's your turn to be a robot game designer
- Create a mission model that represents your problem/solution (a physical model or a CAD)
- Write out what the mission might be (what the robot needs to do with this mission model)



Example: The doctor does house visits instead of the citizen having to visit the hospital

# Innovation Project: Final Presentation

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- Create a poster, brochure or Google Slides presentation with all the information you have gathered.

Include all of the following:

- 1) The Problem you are trying to solve
- 2) Existing Solutions to your problem
- 3) Your Solution – how is your solution better, cheaper, etc.
- 4) Research Sources you used
- 5) Include your City Emblem and the Public Service Announcement

# Robot Game: Programming Lessons

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## Beginner:

Move until color

Move until Ultrasonic

Line following

## Advanced: (Download the lessons from [EV3Lessons.com](http://EV3Lessons.com))

Line Squaring

Proportional Control

Proportional Line Follower

# Move Until a Color

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To access a SPIKE Prime version, download from [PrimeLessons.org](https://PrimeLessons.org)

# What is the Color Sensor?

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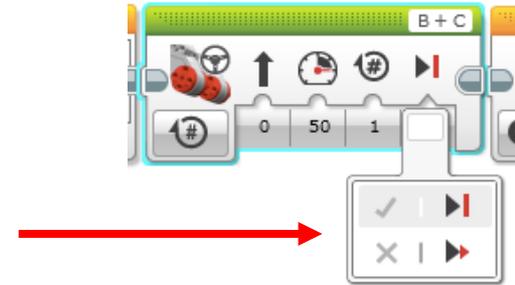
- What are they? Sensors that detect the intensity of light that enters it
- Three modes: Color, Reflected Light Intensity and Ambient Light Intensity
  - Color Mode: Recognizes 7 colors (black, brown, blue, green, yellow, red, white) and No Color
  - Reflected Light: Measures the intensity of the light reflected back from a lamp that emits a red light. (0=very dark and 100=very light)
  - Ambient Light: Measures the strength of the light that enters the sensor from the environment. (0=very dark and 100=very light)
- USES:
  - Move until a line, Follow a line, Find a color
  - Play a game using the color sensor



# Another Move Steering Tip: Coast or Brake?

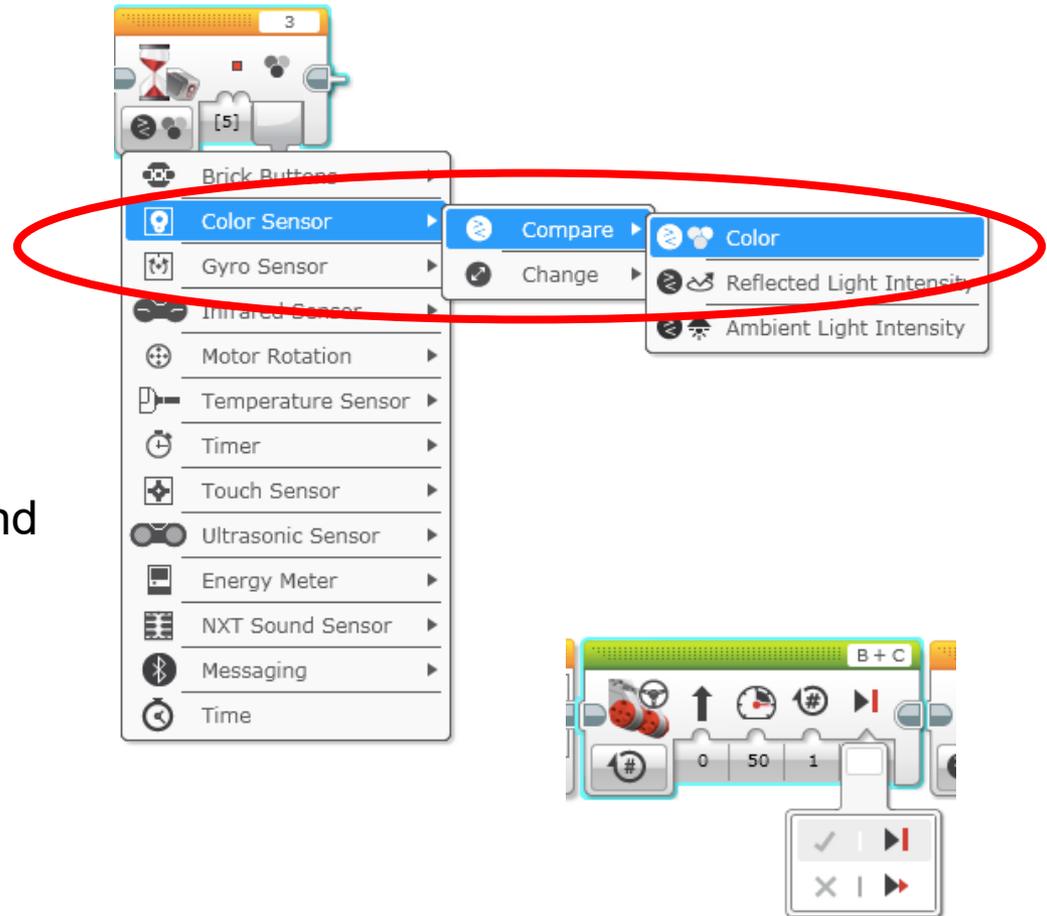
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- Something more about the Move Steering Block
- You will notice you have an option to COAST or BRAKE
- Coast will make the motors keep moving. Brake makes the motors stop immediately.
- Which do you use to stop EXACTLY on a colored line?

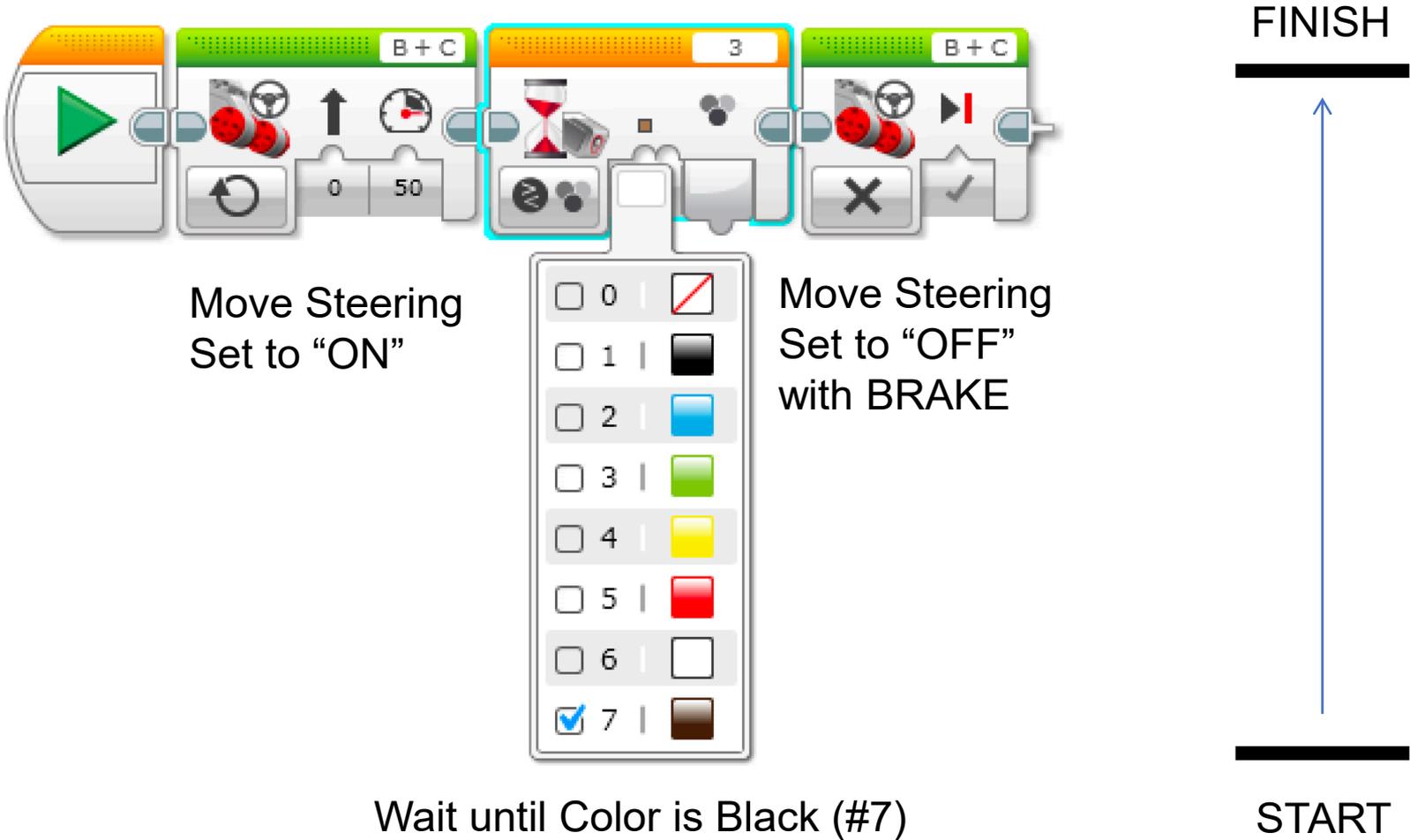


# Color Sensor Challenge

- Make the robot move up to a black line using the color sensor?
- Step 1: Use Wait For Color
- Step 2: Use the color sensor in color mode
- Step 3: Coast or Brake?
- Hint: You will use Move Steering (think about motor on and off) and Wait for “Color”



# Color Sensor Challenge Solution



# Move Until Ultrasonic

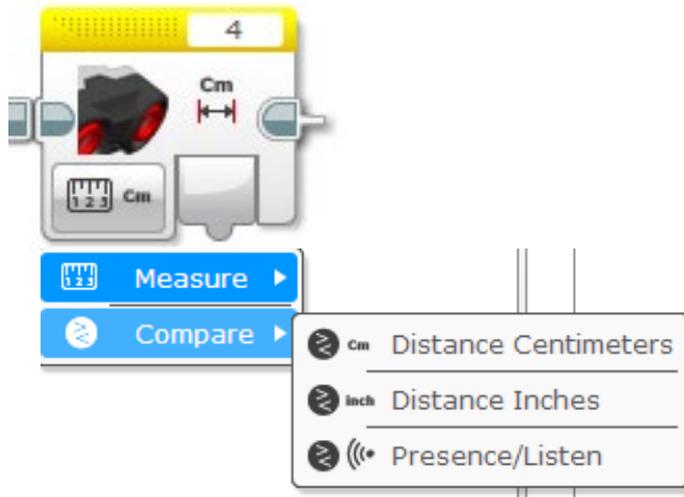
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To access a SPIKE Prime version, download from  
[PrimeLessons.org](https://PrimeLessons.org)

# Ultrasonic

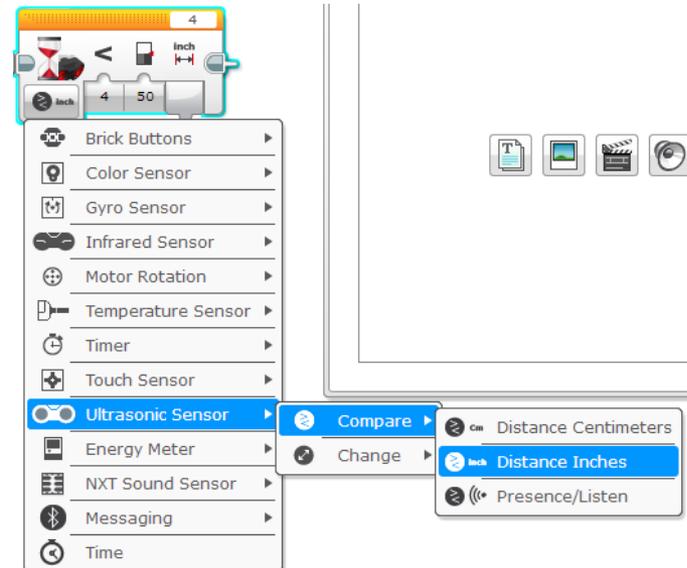
- An ultrasonic sensor measures distance.
- You use it when you need to make sure you are a certain distance away from a target.
- The distance can be measured in inches or centimeters.
- To read the ultrasonic sensor, you use the Ultrasonic Block. To use the ultrasonic to do an action until a distance, you use “Wait Until”

## Read Ultrasonic



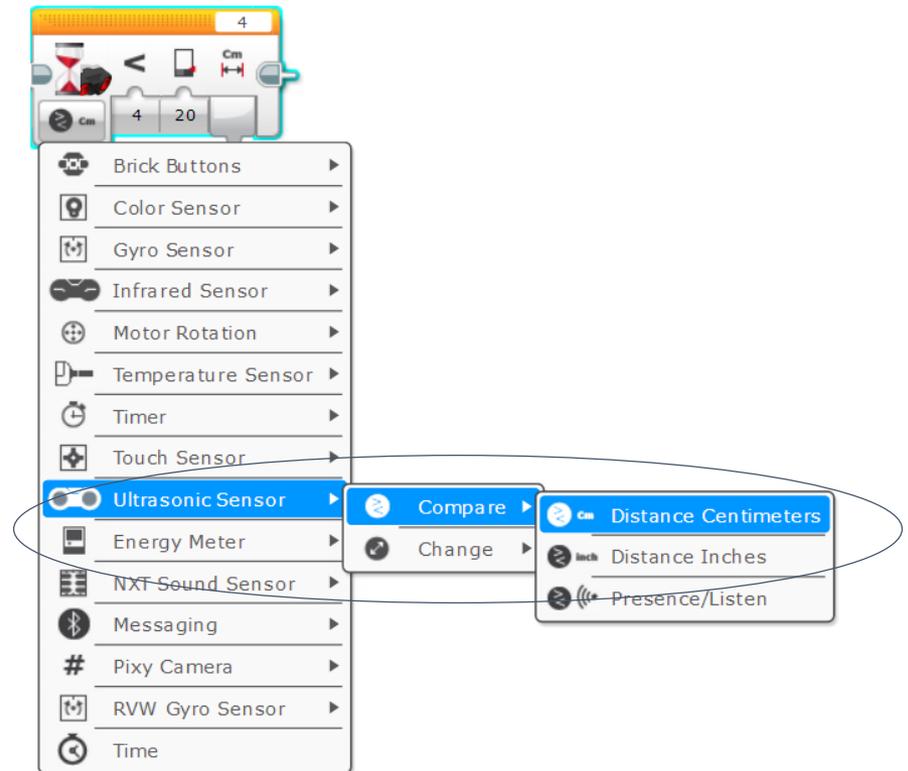
VS.

## Wait for Ultrasonic



# Ultrasonic Challenge

- Challenge: Make the robot move until it is 20cm away from the wall.
- Step 1: Make a new program
- Step 2: Set move to “on”
- Step 3: Set wait block to use the Ultrasonic
- Step 4: Set move block to “off”



# Challenge Solution

Challenge: Make the robot move until it is 20cm away from the wall.



Set Move Steering block to "on"

Set wait block to Ultrasonic Sensor->Compare->Distance Inches and second input (inches) to 5.

Set move steering block to "off"

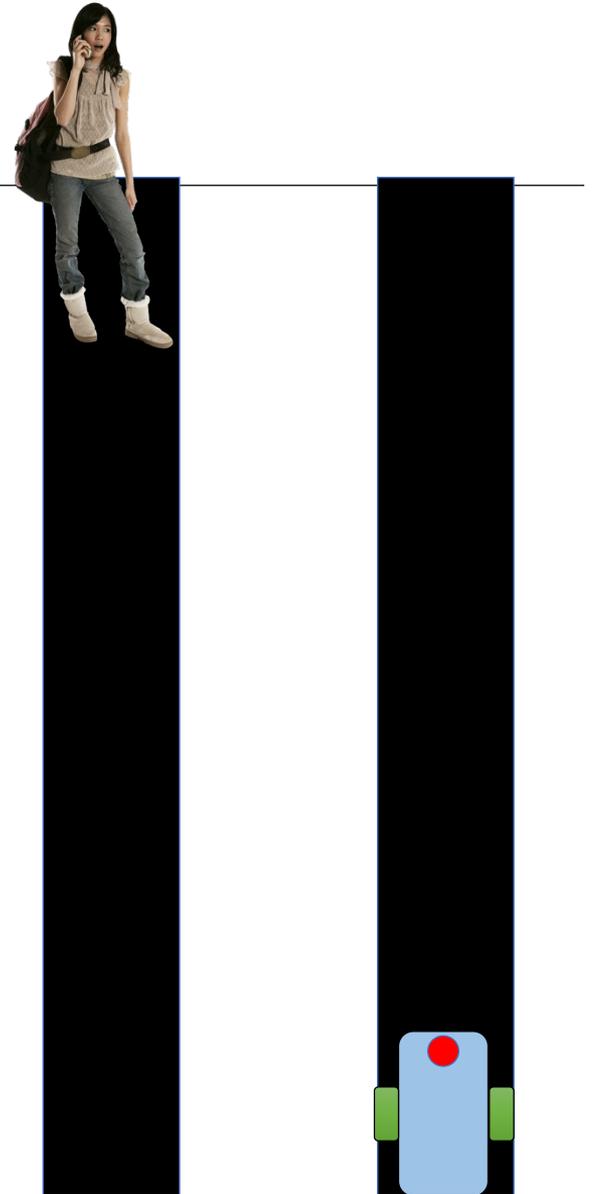
# Line Follower

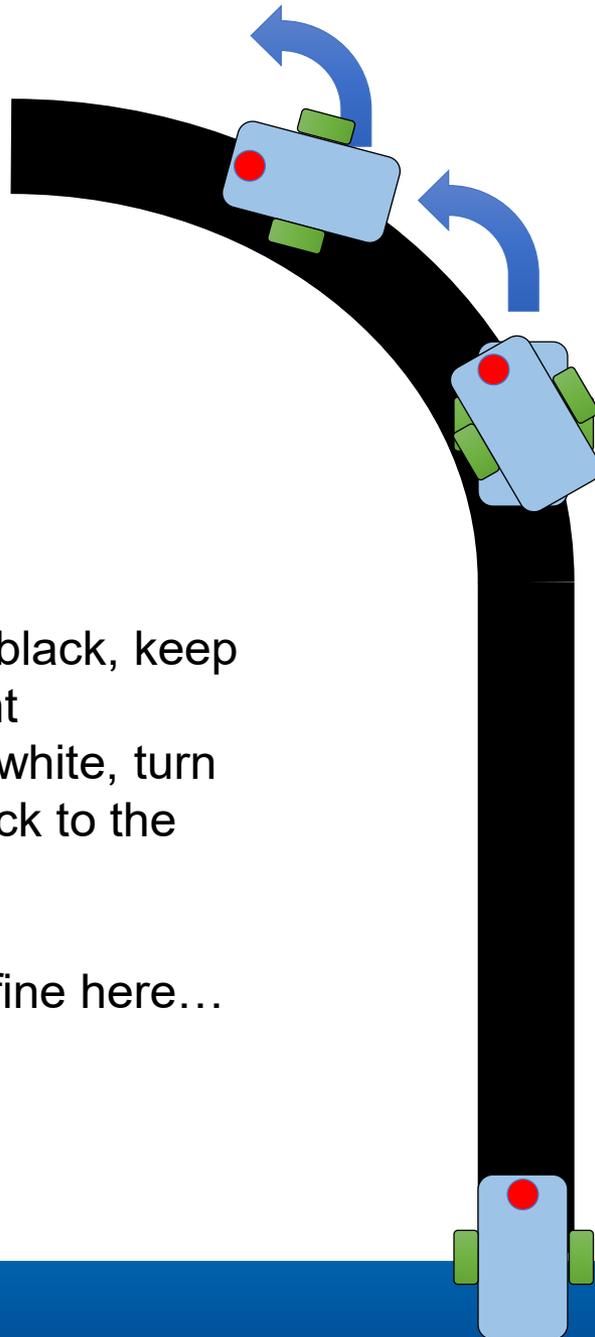
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To access a SPIKE Prime version, download from [PrimeLessons.org](https://PrimeLessons.org)

# Intro: Follow the Middle?

- Humans want to follow the line in the middle.
- Let's have the robot do the same thing using the Color Sensor
- What type of questions can we ask using this sensor
  - Are you on the line or not?





1. If we are on black, keep going straight
2. If we are on white, turn left to get back to the line

Seems to work fine here...



1. If we are on black, keep going straight
2. If we are on white, turn left to get back to the line

**OH NO... my robot is running away....**

**When the robot leaves the left side of the line, the program no longer works!**

# Line Following: ROBOT STYLE

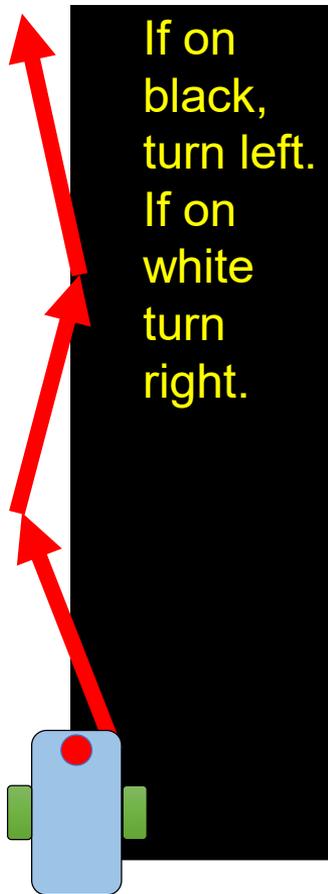
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- Why could the Human follow the middle?:
  - They can **see ahead**.
  - They can **see the whole line and its surroundings**
  - They **see both sides** and which side they left
  
- Why can't the Robot do the same thing?:
  - **Can't tell right or left side of the line**
  - How do we make sure the robot always veers off on the **SAME SIDE** of the line?
    - Instead of the middle, could the robot follow the "edge"?
  - So now the robot will fall off only the same side.
  - We will now show you how this works!

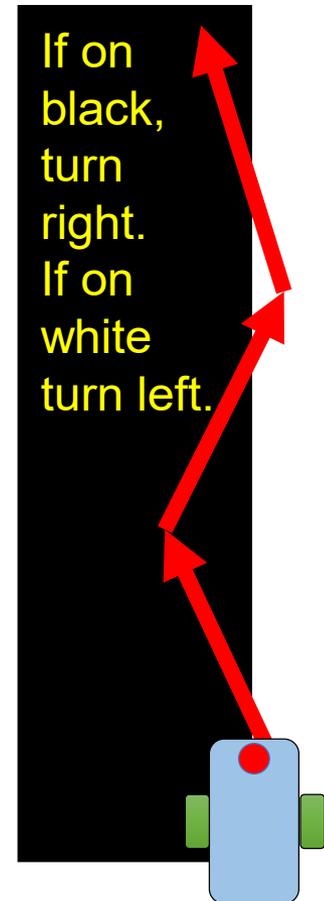


# Robot Line Following Happens on the Edges

Left side line following



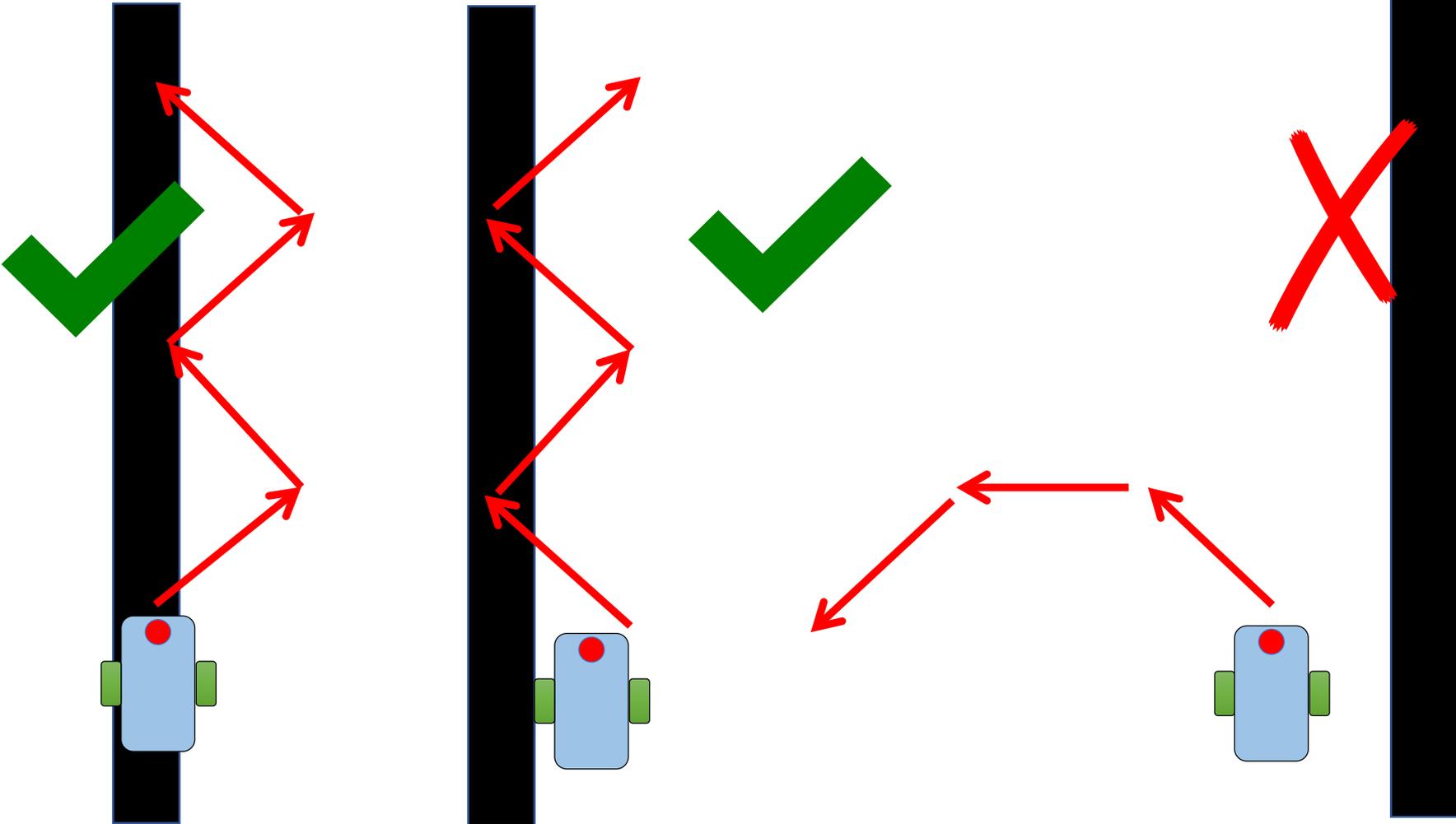
Right side line following



The robot has to choose which way to turn when the color sensor sees a different color.

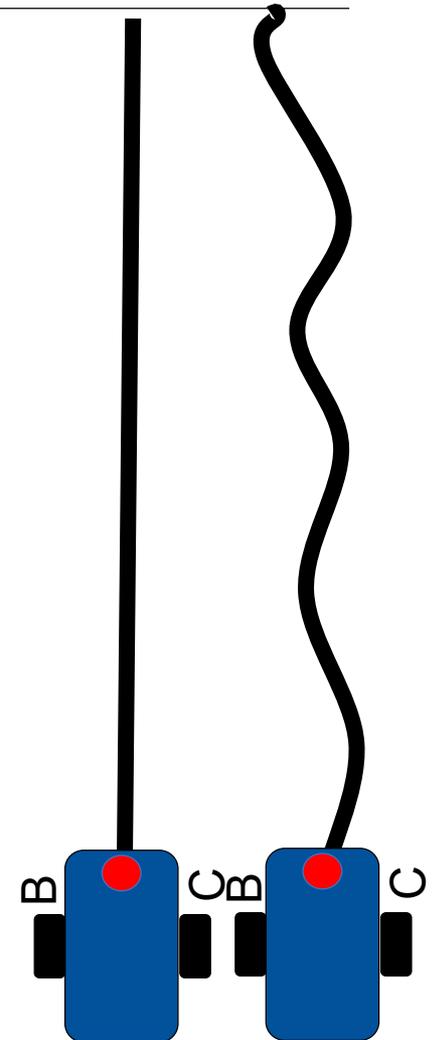
The answer depends on what side of the line you are following!

# Starting the Robot on the Correct Side



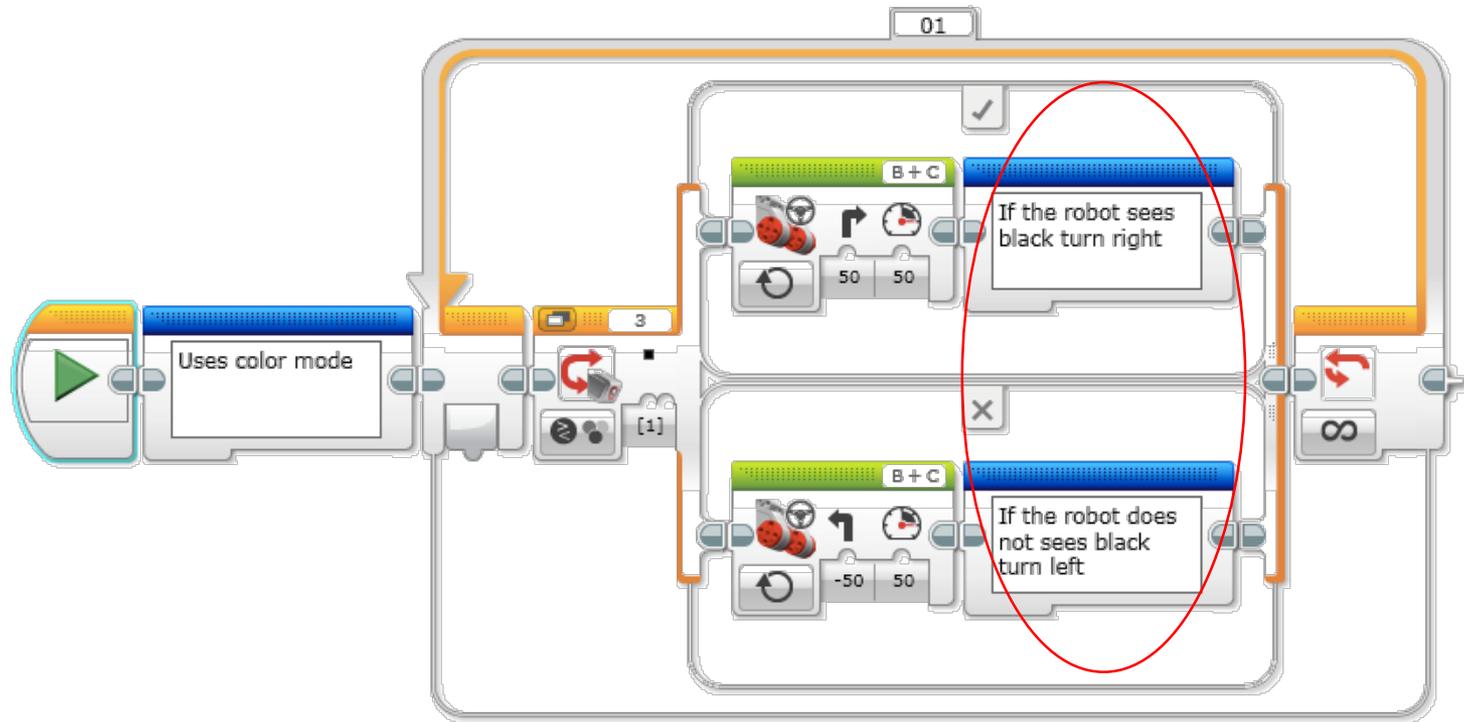
# Line Follower Challenge

- Step 1: Write a program that follows the RIGHT edge of a line.
- Hints: If your sensor sees black, turn right. If your sensor sees white, turn left. Use loops and switches!
- Step 2: Try it out on different lines.
- Did your line follower work the same on straight and curved lines?
- Step 3: If not, instead of turn Steering = 50, try smaller values.
- Is it better on the curved lines now?



# Challenge Solution

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- Q. Does this program follow the Right or Left side of a line?  
A. The robot is following the Right Side of the line.

# Day 5

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# Core Values: Develop Rules

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- Add the mission model you created yesterday to your final challenge
- Do you need to add any rules?

## Rules:

**R01:** Maintain social distancing at all times at the store. There is a line of people in front of the each store. Your robot must stay 6 inches away and move forward only when robot (box) in front is removed. (Hint: How can you use a sensor to maintain this distance?)

**R02:** You must use a sensor to accomplish all missions above



Example: The doctor does house visits instead of the citizen having to visit the hospital. This model represents the doctor.

# Innovation Project: Share

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Create a 5 min video explaining your project using the poster or slides you made.

Share your 5 min presentation with your coach, family members, experts, etc. and collect feedback.

Identify a  
Problem

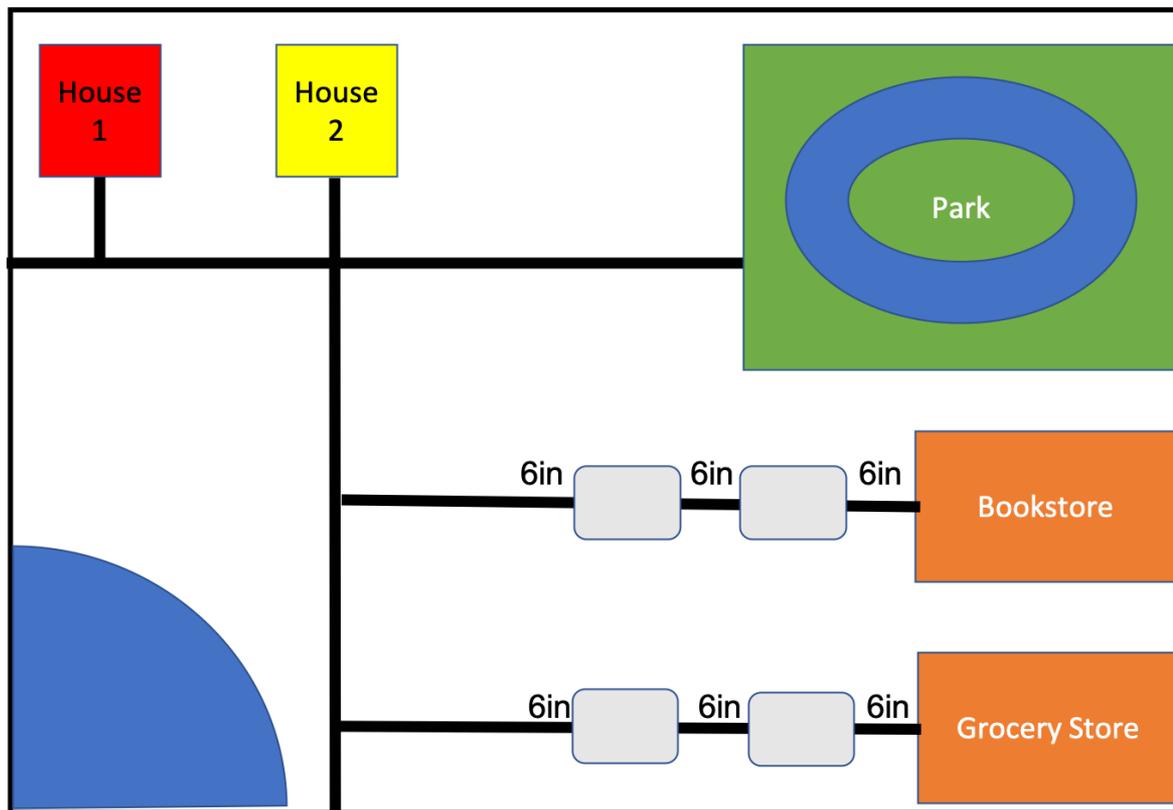
Do  
Research

Develop a  
Solution

Test and  
Share

# Robot Game: Solve the Missions

- Spend the day working on as many missions as you can solve using the programming tools you know. Remember to comment your code.



**M01:** The family in House 2 is bored and also want an extra resource to help the child with schoolwork. Go to bookstore. Pick up book (Model with Hoop) and deliver to House 2. Stay 6in away from people in line. (5pts per book delivered)

**M02:** The family in House 1 is running low on food. To stay healthy, they need milk, bread and eggs. Go to Grocery store. Pick up groceries (Models with hoop) and deliver to house 1. Stay 6in away from people in line. (5pts per grocery item delivered.)

**M03:** Go to Park to meet your friend and go for a walk together. You must be completely inside the park area and do 3 right turns and 3 left turns.

# Hope you had great week!

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- Hope you had a fun time learning
- What can you do next?
  - Learn more programming (see [EV3Lessons.com](http://EV3Lessons.com) and [PrimeLessons.org](http://PrimeLessons.org) for lots more lessons)
  - Share your innovation project solution. Get feedback and make improvements.
  - Use the Core Values both in and out of *FIRST*®
  - Start a *FIRST*® Team

