

DISTANCE SENSOR



DISTANCE SENSOR

Learning Goals

- Build knowledge about coding and robotics by coding a sensor and making a robot move.
- Read, debug, and alter code featuring conditional statements to use sensor input to determine how a robot should move.
- Have FUN learning!



DISTANCE SENSOR

Do you need to review the Getting Started document?

Do you have the Robocar with the EV3 attached?
Is the EV3 turned on?

Is the LEGO EV3 Classroom app open and on screen?
Is the EV3 connected and ready to use?

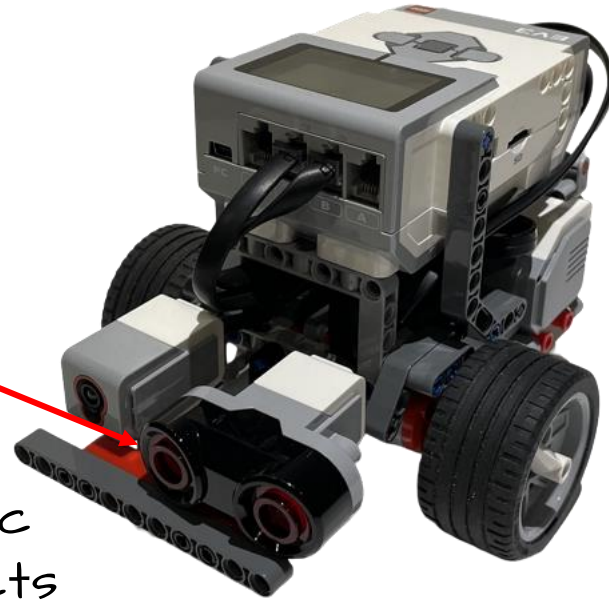
Do you know how to download programs to the EV3 and
select programs from the EV3?

Do you know how to move and steer the Robocar?



DISTANCE SENSOR

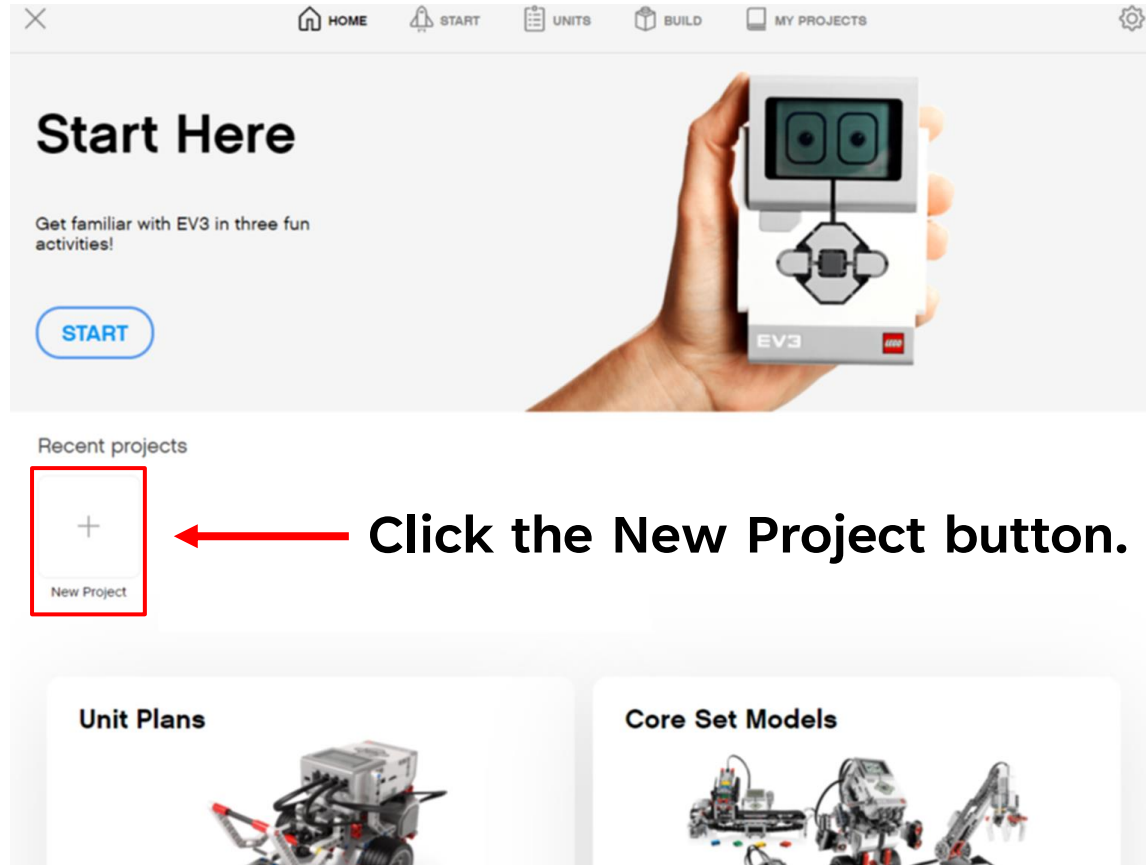
This is the LEGO EV3 distance sensor.



The distance sensor uses ultrasonic sound frequencies to detect objects and determine their distance in the same way that some animals use echo-location.



DISTANCE SENSOR



The screenshot shows the LEGO EV3 software interface. At the top, there is a navigation bar with icons for HOME, START, UNITS, BUILD, and MY PROJECTS, along with a settings gear icon. The main content area features a large image of a hand holding the EV3 brick. Below this, the text "Start Here" is displayed, followed by "Get familiar with EV3 in three fun activities!" and a blue "START" button. Underneath, the "Recent projects" section contains a "New Project" button, which is a square with a plus sign and the text "New Project" below it. A red box highlights this button, and a red arrow points to it from the text "Click the New Project button." Below the "Recent projects" section, there are two categories: "Unit Plans" and "Core Set Models", each with a corresponding image of a robot.

Start Here

Get familiar with EV3 in three fun activities!

START

Recent projects

+

New Project

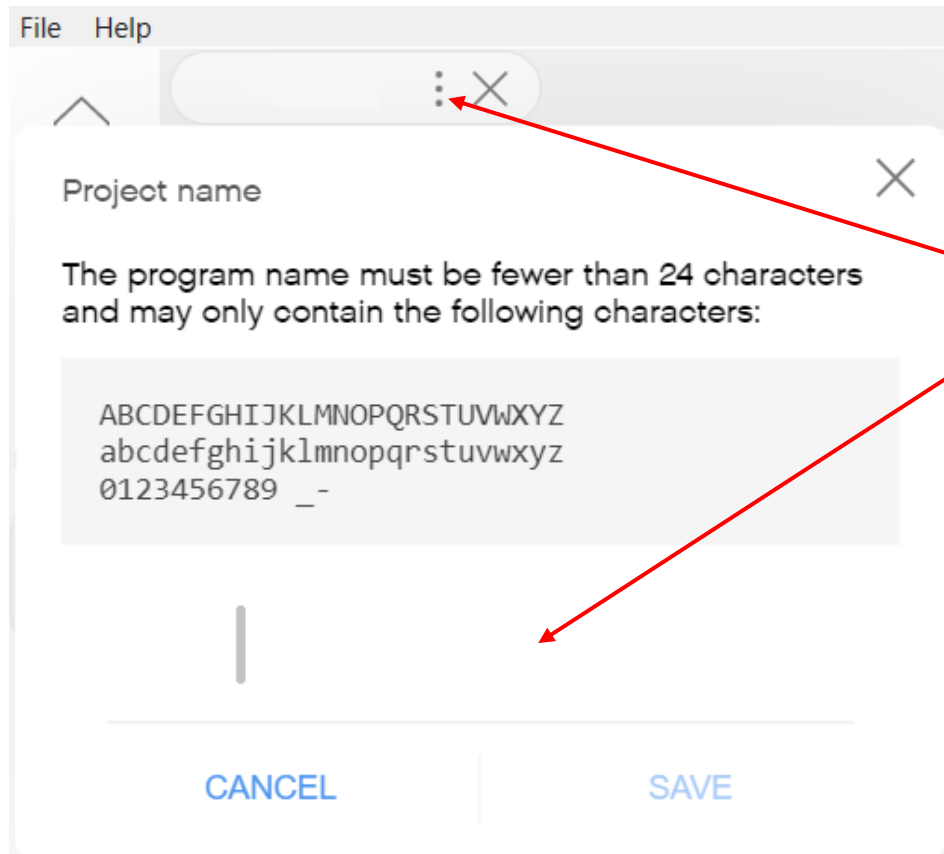
Click the New Project button.

Unit Plans

Core Set Models



DISTANCE SENSOR



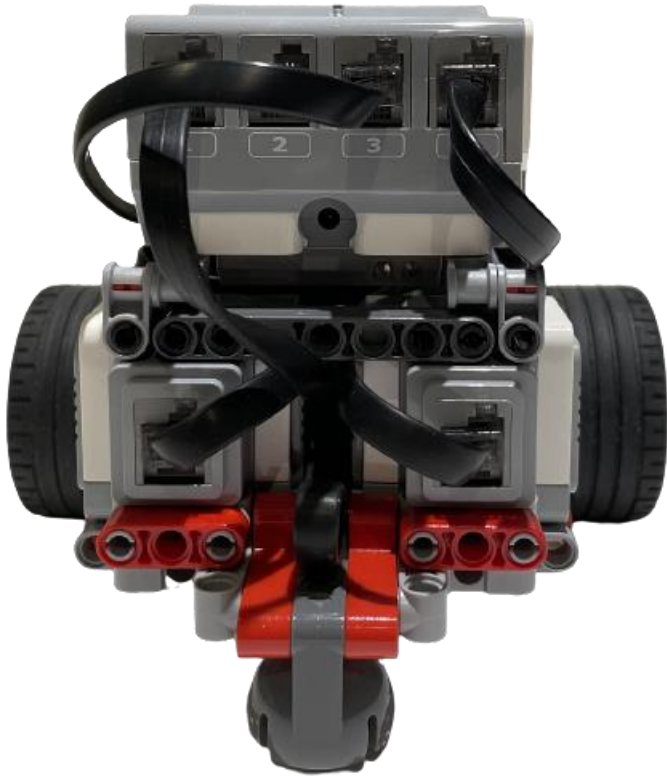
Name your program.

- Click the three dots.
- In the project name window type:

Distance- _____
(your names).



DISTANCE SENSOR



The Robocar motors are connected to ports B and C. The distance sensor is connected to port 4 and the touch sensor is connected to port 1.

If for some reason any of these devices are not connected to the proper ports, please let Mr. Desmond know so that the proper adjustments can be made.



DISTANCE SENSOR

Distance Sensor - Exploration 1

Activity Goals

- 1) To explore how to use the distance sensor to allow the robot to independently respond to environmental situations using input information from the sensor to direct robot actions.
- 2) To demonstrate precision of movement of the robot while using the distance sensor.
- 3) To understand coding using the wait until conditional statement in combination with the distance sensor.



DISTANCE SENSOR

Distance Sensor - Exploration 1

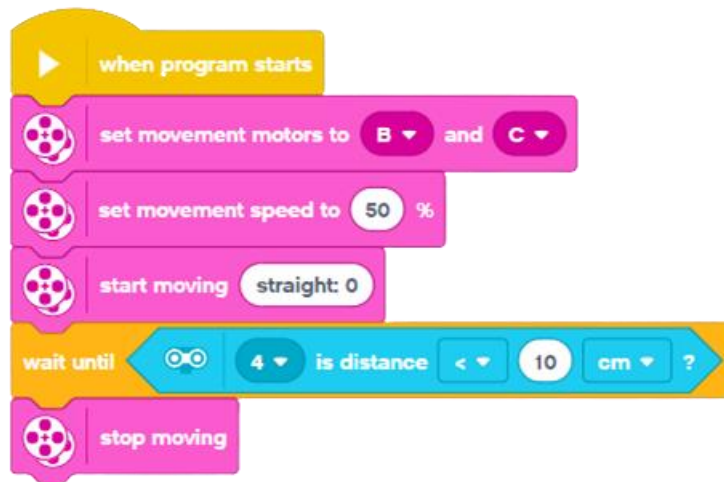
Activity Steps

- 1) Create the Go There code sequence to move the Robocar and test how the distance sensor works. [Go There](#)
- 2) Learn about the wait until conditional statement. [Code Explained](#)
- 3) Create the Sense and Turn code sequence. [Sense and Turn](#)
- 4) Answer questions and explain your ideas. [Explain](#)

DISTANCE SENSOR

Distance Sensor - Exploration 1 - Go There

Create a code sequence to have the Robocar move toward a large wooden block and use the distance sensor to stop 10 cm from the block.



Do not download your code yet.



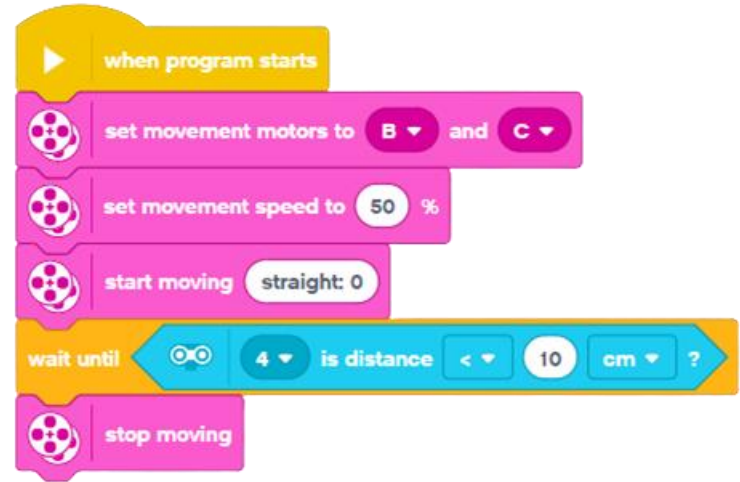
DISTANCE SENSOR

Distance Sensor - Exploration 1 - Go There

Download the program to the EV3.

Run the program from the EV3.

Observe how the Robocar moves.

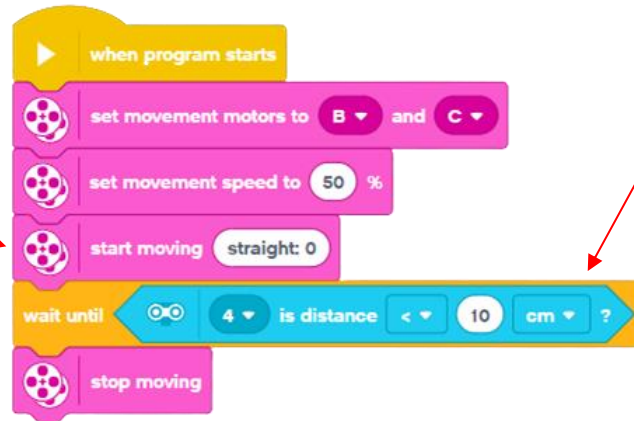


DISTANCE SENSOR

Distance Sensor - Exploration 1

The "wait until" command is a conditional statement that monitors what the distance sensor is doing. The "wait until" code block allows the commands prior to it to perform until the distance sensor senses an object a specified distance in front of it. Only then will the coding sequence continue.

This means move - the duration is not defined. The duration is unlimited: it could be any value above zero to infinity.



The "wait until" condition is equivalent to saying "always check to see if the distance sensor senses an object closer than 10 cm to it, if true then run the next command".



DISTANCE SENSOR

Distance Sensor - Exploration 1 - Sense and Turn

Modify your code to have the Robocar move toward an object and use the distance sensor to stop 5 cm from the object. Have the EV3 move backward and then complete a 180° turn.



Download the program to the EV3.
Run the program from the EV3.
Observe how the Robocar moves.



DISTANCE SENSOR

Distance Sensor - Exploration 1

Think about it, discuss your ideas as a group, and then write down your answer on a sheet of paper.

1) How is the function of the touch sensor different than the distance sensor?

Show Mr. Desmond your coding and the Robocar in action using the distance sensor to stop the Robocar within a certain distance of an object.

Be prepared to explain what is happening with the Robocar and the distance sensor and why.



DISTANCE SENSOR

Distance Sensor - Exploration 2

Activity Goals

- 1) To explore how to use the distance sensor to allow the robot to independently respond to environmental situations using input information from the sensor to direct robot actions.
- 2) To demonstrate precision of movement of the robot while using the distance sensor.
- 3) To understand coding using the if then conditional statement in combination with the distance sensor.



DISTANCE SENSOR

Distance Sensor - Exploration 2

Activity Steps

- 1) Create the Go There Again code sequence. [Go There Again](#)
- 2) Learn about if then conditional statements. [Code Explained](#)
- 3) Create the Go There and Spin code sequence.
[Go There and Spin](#)
- 4) Answer questions and explain your ideas. [Explain](#)

DISTANCE SENSOR

Distance Sensor - Exploration 2 - Go There Again

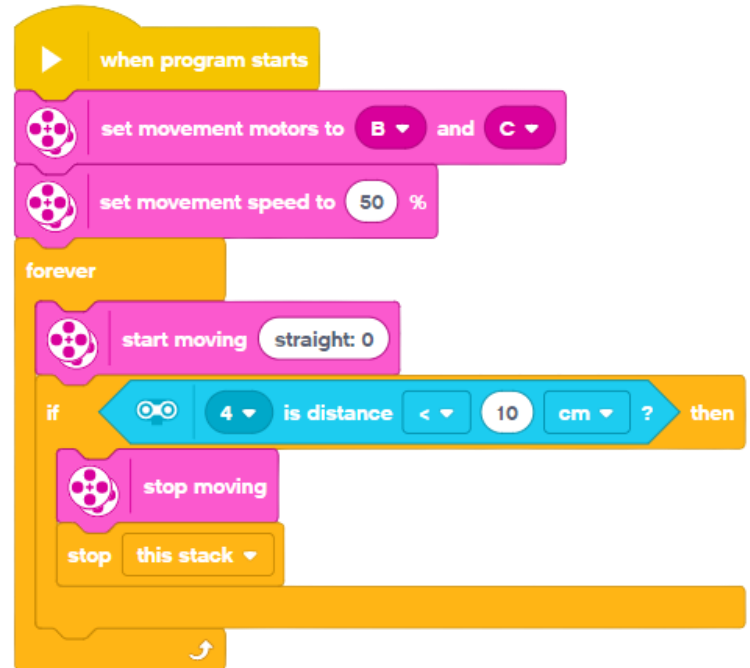
Create a code sequence to have the Robocar move toward a large wood block and use the distance sensor to stop 10 cm from the object.

Download the program to the EV3.

Run the program from the EV3.



Observe how the Robocar moves.



DISTANCE SENSOR

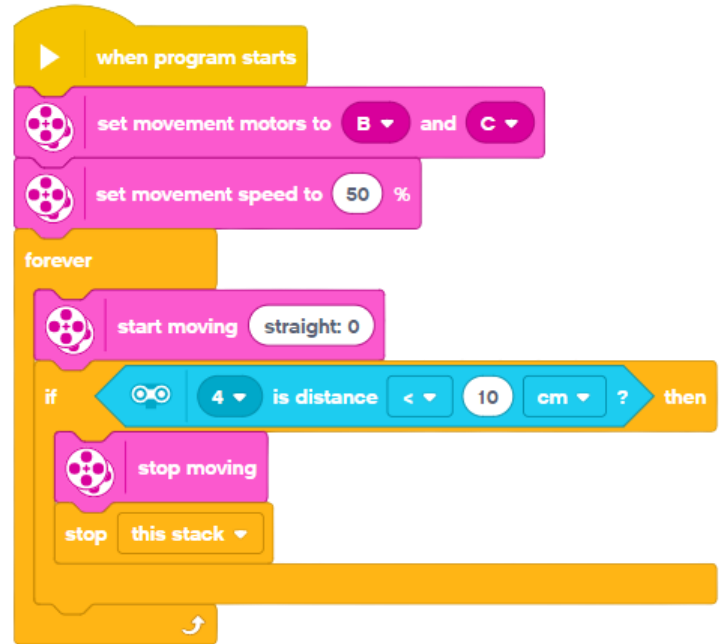
Distance Sensor - Exploration 2

"If then" is a conditional statement. Without thinking about it you use it all the time.

If my hands are dirty, then I will wash them.

If I am cold, then I will put on a coat.

In this code sequence if the distance sensor senses an object closer than 10 cm then the motors will stop moving.



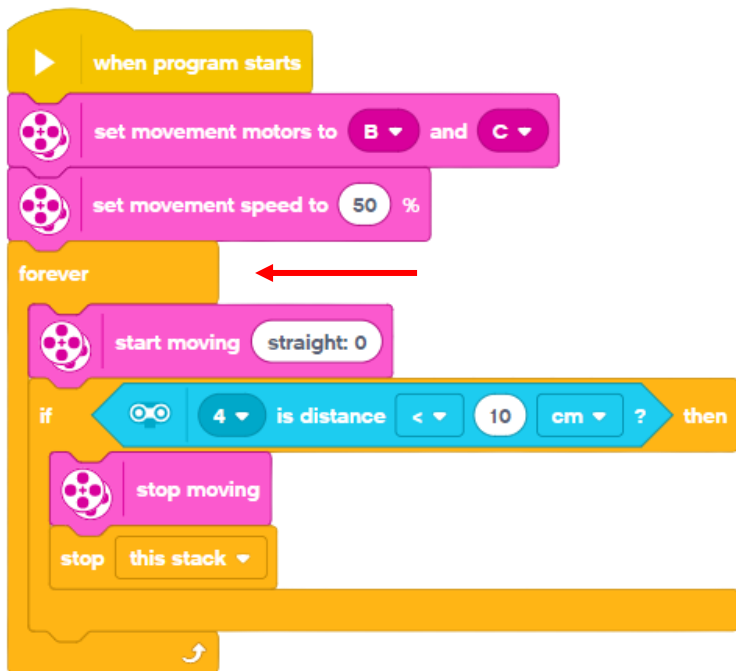
```
when program starts
  set movement motors to B and C
  set movement speed to 50 %
  forever loop
    start moving straight: 0
    if 4 is distance < 10 cm ? then
      stop moving
      stop this stack
```

The image shows a Scratch script for a distance sensor. It starts with a 'when program starts' block, followed by two 'set movement' blocks: 'set movement motors to B and C' and 'set movement speed to 50 %'. A 'forever' loop contains a 'start moving' block with 'straight: 0'. Inside the loop is an 'if' block with the condition '4 is distance < 10 cm ?'. If true, it executes 'stop moving' and 'stop this stack'.



DISTANCE SENSOR

Distance Sensor - Exploration 2



Adjust the code sequence.
Remove the "forever" block (make sure to re-connect all the blocks that were inside the "forever" block).

Download and run the program.

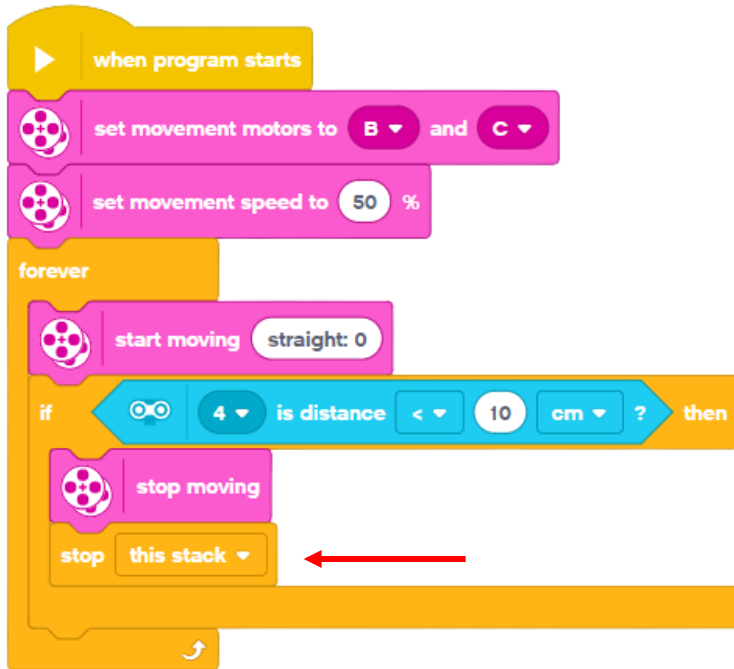
Observe and make note of what happens.

Put the "forever" block back.



DISTANCE SENSOR

Distance Sensor - Exploration 2



Adjust the code sequence.
Remove the "stop this stack" block.

Download and run the program.

Observe and make note of what happens.

Put the "stop this stack" block back.



DISTANCE SENSOR

Distance Sensor - Exploration 2 - Go There and Spin

Create a code sequence using the "if then" condition to have the Robocar move toward an object and use the distance sensor to stop 5 cm from the object. After the stop have the Robocar move backward and then complete a fun robot spin maneuver.



Download the program to the EV3.

Move to an appropriate test area.

Run the program from the EV3.



Observe how the Robocar moves.



DISTANCE SENSOR

Distance Sensor - Exploration 2

Think about it, discuss your ideas as a group, and then write down your answers on a sheet of paper.



- 1) How are these two code sequences the same?
- 2) How are these two code sequences different?

```
when program starts
  set movement motors to B and C
  set movement speed to 50 %
  start moving straight: 0
  wait until 4 is distance < 10 cm?
  stop moving
```

```
when program starts
  set movement motors to B and C
  set movement speed to 50 %
  forever
    start moving straight: 0
    if 4 is distance < 10 cm? then
      stop moving
    stop this stack
```



DISTANCE SENSOR

Distance Sensor - Exploration 2

Think about it, discuss your ideas as a group, and then write down your answers on a sheet of paper.



- 3) What is the purpose of the "forever" block?
- 4) What is the purpose of the "stop this stack" block?

```
when program starts
  set movement motors to B and C
  set movement speed to 50 %
  forever loop
    start moving straight: 0
    if 4 is distance < 10 cm ? then
      stop moving
      stop this stack
```



DISTANCE SENSOR

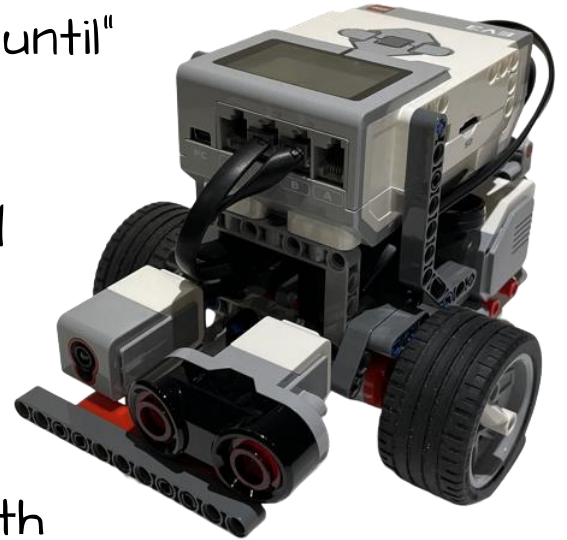
Distance Sensor - Exploration 2

Think about it, discuss your ideas as a group, and then write down your answer on a sheet of paper.

5) Why are conditional statements like "wait until" and "if then" paired with sensors?

Show Mr. Desmond your "if then" coding and the Robocar in action using the distance sensor to stop the Robocar when it senses an object.

Be prepared to explain what is happening with the Robocar and the distance sensor and why.



DISTANCE SENSOR

Distance Sensor - Exploration 3

Activity Goals

- 1) To explore how to use the distance sensor to allow the robot to independently respond to environmental situations using input information from the sensor to direct robot actions.
- 2) To demonstrate precision of movement of the robot while using the distance sensor and a repeat block.
- 3) To deepen understanding of how to use conditional statements in combination with the distance sensor.



DISTANCE SENSOR

Distance Sensor - Exploration 3

Activity Steps

- 1) Create the Ping-Pong code sequence. [Ping-Pong](#)
- 2) Demonstrate your work and explain your ideas. [Explain](#)

DISTANCE SENSOR

Distance Sensor - Exploration 3 - Ping-Pong

Create a code sequence to make the Robocar go back and forth between two wooden blocks three times using input from the distance sensor to determine when to turn around.

Pair the distance sensor with either the "wait until" condition or the "if then" condition in your coding.

Keep the wood blocks about 50 cm apart.

Precision of movement is required to keep the Robocar as straight as possible and not veer in different directions after each turn.



DISTANCE SENSOR

Distance Sensor - Exploration 3 - Ping-Pong

Download the program to the EV3.

Run the program from the EV3.

Observe how the Robocar moves
and modify the program as needed.

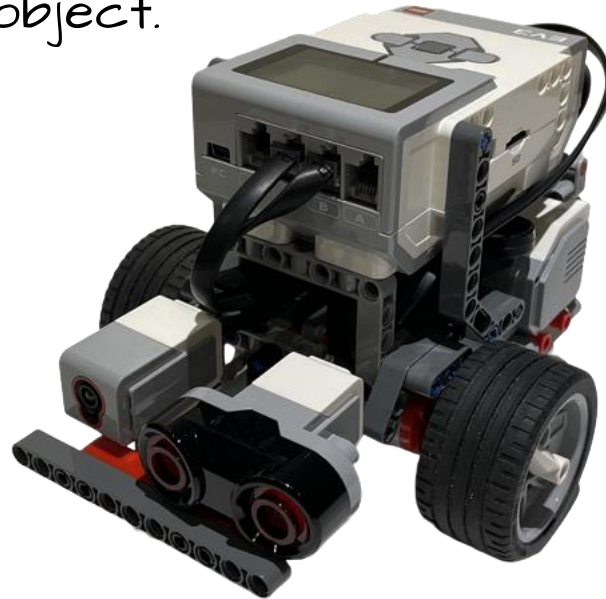


DISTANCE SENSOR

Distance Sensor - Exploration 3 - Ping-Pong

Show Mr. Desmond your "ping-pong" coding and the robot in action using the distance sensor to make the Robocar repeatedly stop and change direction when within a certain distance of an object.

Be prepared to explain what is happening with the Robocar and the distance sensor and why.



DISTANCE SENSOR

Distance Sensor - Consider This

A sensor is designed to provide input information to the robotic system. As a form of artificial intelligence (AI) the robot will respond to the environmental circumstances noted by the sensor and take specific actions in response.

The coding provides the robotic system the ability to perform this feat of machine intelligence. Conditional statements are essentially true or false questions that provide the logic that allows the robot to read the sensor input and then make a decision (according to the code) based on what the information was.



DISTANCE SENSOR

Distance Sensor - Exploration 4

Activity Goals

- 1) To explore how to use the distance sensor to allow the robot to independently respond to environmental situations using input information from the sensor to direct robot actions.
- 2) To understand coding using variables to collect data in combination with conditional statements and a sensor.



DISTANCE SENSOR

Distance Sensor - Exploration 4

Activity Steps

- 1) Create the Ping-Pong Count code sequence to move the Robocar and count each time it contacts a block and the distance sensor is pressed. [Ping-Pong Count](#)
- 2) Demonstrate your work and explain your ideas. [Explain](#)

DISTANCE SENSOR

Distance Sensor - Exploration 4 - Ping-Pong Count

Modify your repeated sequence code from Exploration 3.

Create a variable called count.

Have the Robocar count each time the distance sensor is pressed.

Include the count as part of the conditional coding as the Robocar "ping-pongs" back and forth between the two wooden blocks.

Have the Robocar continue to move between the two wooden blocks until the count has reached nine.



DISTANCE SENSOR

Distance Sensor - Exploration 4




Show Mr. Desmond your coding using the count variable and the Robocar in action.

Be prepared to explain what is happening with the Robocar and the distance sensor and why.



DISTANCE SENSOR CHALLENGE

Learning Goals

-  Build knowledge about coding and robotics by coding a sensor and making a robot move.
-  Independently create code featuring conditional statements to use sensor input to determine how a robot should move.
-  Have FUN learning!



DISTANCE SENSOR CHALLENGE

AMAZing Distance Sensor Challenge!

Create a maze of your own design. Create the code that will allow the Robocar to independently navigate the maze using the distance sensor to determine when to stop moving and turn.

You are expected to demonstrate your success to Mr. Desmond. Be prepared to show both the Robocar in action and your code.



*Placement of maze blocks must allow ample space for the Robocar to move forward and backward as well as to turn.