Table of Contents

Tech and Tape

Tech & Tape is an initiative of DIY Girls and 9 Dots. We make it easy for educators to teach STEM by providing clear curriculum, personalized training, and a sense of community.

DIY ("Do-It-Yourself") Girls' mission is to increase girls' interest and success in technology, engineering and making through innovative educational experiences and mentor relationships. DIY Girls develops and implements educational programs and events designed to encourage engagement with technology, promote self-confidence and support aspiration to technical careers.

9 Dots takes an innovative, structured approach to transforming education culture in a way that takes the whole student into account – in a way that can have a sustainable impact. Impact extends well beyond the walls of 9 Dots by offering parent workshops to give families additional support. 9 Dots works with schools and educators to teach best practices for how to teach kids STEM skills and deepen students' curiosity.

Coding

The coding series features game based curricula designed to introduce and reinforce conceptual learning in a fun and engaging way for students. These units include unplugged activities where students can explore coding in a physical space, worksheets to help organize student thinking, and online games to practice their skills.

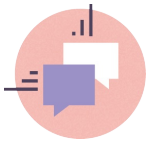
Craft STEM

Craft STEM empowers educators to teach kids the engineering design process. Our curriculum includes a series of hands-on projects aimed at encouraging kids to think, design, and create new products with everyday objects.

Creative Circuits

The creative circuits series empowers educators to teach kids technical skills in creative ways. It's an electronics curriculum that focuses on learning electronics concepts using creative materials like conductive thread and copper tape.

Paper Circuit



OVERVIEW

A simple paper circuit.

OBJECTIVES

- Students will be able to discuss how a circuit allows energy to flow from a battery through electrical components to do work (light an LED).
- Students will be able to construct a simple circuit to demonstrate their understanding of open and closed circuits.
- Students will be able to apply their understanding of simple circuits to build a light-up creation of their own.

AGENDA

Length: 90 minutes

VOCAB

Add vocab here

MATERIALS

Add materials here

STANDARDS

Add standards here

ACTIVITY 1 (delete this line)

ACTIVITY TITLE

Length: 15 minutes

Activity overview

Prep:

Teacher Actions	Student Actions
1 add teacher actions here with numbers like	1 Add student actions here and match numbers to teacher actions

ACTIVITY 2 (delete this line)

ACTIVITY TITLE

Length: 15 minutes

Activity overview

Prep:

Teacher Actions	Student Actions
1 add teacher actions here with numbers like	1 Add student actions here and match numbers to teacher actions

ACTIVITY 3 (delete this line)

ACTIVITY TITLE

Length: 15 minutes

Activity overview

Prep:

Teacher Actions	Student Actions
1 add teacher actions here with numbers like	1 Add student actions here and match numbers to teacher actions

Robotics

Robotics combines engineering and programming to create machines that are capable of performing tasks autonomously. Our robotics curriculum includes lessons plans, worksheets, and custom-designed games to teach foundational programming and problem solving skills with LEGO Mindstorms EV3.

Lessons

- build and prep
- move block
- move block computer
- design thinking
- the cowardly robot
- back to sumo code
- back to sumo build
- line follower

Download lesson plans

Download

Workbook

Download

Suggested classroom protocol

Download

Running programs on the EV3 tutorial

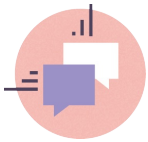
Download

EV3 software

Link to download

Build and Prep

Robotics



OVERVIEW

Students learn about robotics through watching videos and group discussion. For this lesson, stduents build the EV3 educator model using their Lego Mindstorm kits.

Download Lesson

OBJECTIVES

Students will be able to:

- Describe what it means to be a robotics engineer
- List three possible uses for robots

AGENDA

Length: 45 minutes

1. Introduction to robots
2. Introduction to EV3
3. Build

MATERIALS

- EV3 Educator Model Building Instructions http://robotsquare.com/wp-content/uploads/2013/10/45544_educator.pdf

INTRODUCTION TO ROBOTS

Length: 10 minutes

Students learn about the robotics field and explore cool things robots can do.

Teacher Actions	Student Actions
1 Introduce Tech and Tape: Tech and Tape is a collaboration between 9 Dots and DIY Girls -- two Los Angeles-based nonprofits dedicated to providing students with a fun tech education. The goal for this class is to create Sumo bots that will wrestle each other in a tournament. To create the Sumo bots we are going to have to learn about robotics!	
2 Watch [Darpa robotics challenge][video1]	
3 Discuss Which do you think was the coolest robot? Why?	3 Students raise their hands to offer answers.
4 Watch [A day in the life of a robotic engineer video] [video2]	

5 Discuss What do you think it means to be a robotic engineer? What are some ways that you think robots are used currently?	5 Students raise their hands to offer answers.
6 Talk about modern uses for robots: • Surgery • Factories • Search and rescue • Cleaning • Bomb disposal • Exploration (space, sea)	

INTRODUCTION TO EV3

Length: 5 minutes

Students learn specifics about how the Mindstorm EV3 robots work.

Prep:

Teacher Actions	Student Actions
1 Explain the sensors: • Motor - used for driving the robot. Also a strong building piece. • Touch sensor - used for detecting when the robot has touched an object. • Ultrasonic sensor - used for measuring distance. • Color sensor - used for checking colors.	1 Students take notes on their paper to clarify what the sensors are used for.
2 Show students the building plans for the EV3 Educator Model. Explain that this robot is helpful for learning how to program the robot, and that students will be coming up with their own designs later in the unit.	
3 Discuss Why is it important to organize Lego pieces properly? • Future building can be more efficient and more fun if it is not necessary to hunt for every little piece.	3 Students raise their hands to offer answers.

BUILD

Length: 30 minutes

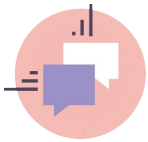
Student build their robots using the LEGO EV3 Educator Model instructions

Prep:

Teacher Actions	Student Actions
1 Tell students that the first step is to organize their building materials. Students should use the organizer chart that is on the box cover in their EV3 kits.	1 Students organize their lego box according to the diagram provided with the boxes.
2 Tell students they have the rest of the class to build their robots according to the instructions. Emphasize the importance of using the correct Lego pieces for each step. Rushing and using the wrong ones will lead to robots that do not function properly.	2 Students should now begin building using the plans.

Move block

robotics



OVERVIEW

This lesson serves as an introduction to programming using the EV3 software (this is useable with the older NXT bricks as well). Students have their first programming challenge to guide their teacher through a maze using programming instructions.

Download Lesson

OBJECTIVES

- Students will decompose a problem
- Students will be able to use decomposed elements to solve a problem

AGENDA

Length: 45 minutes

1. Explore
2. Programming
3. Building

VOCAB

- decompose - the act of developing a problem story, identify the requirements to solve the problem, and form a plan to connect the required components.
- sequence - the order in which the coding elements are executed

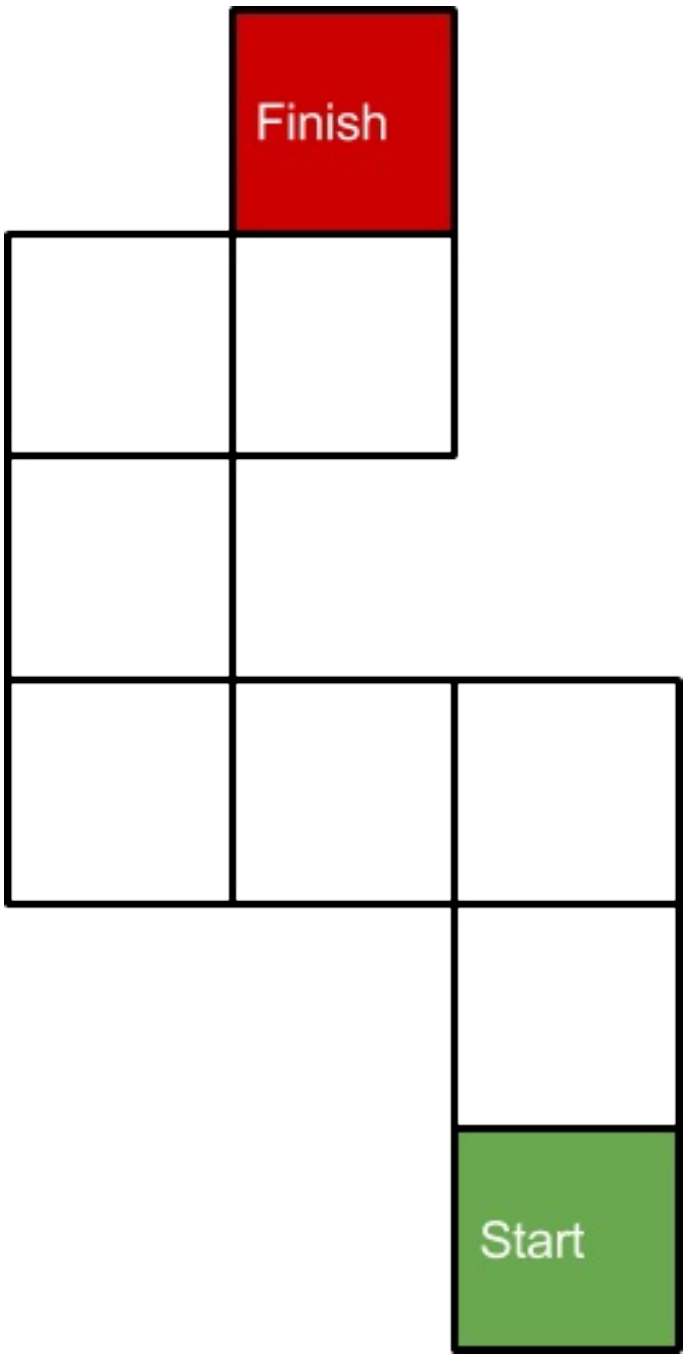
MATERIALS

- Lego Mindstorm Kit
- Completed Mindstorm Robot (from lesson 1)
- Computer with EV3 Software
- Programming Instruction Video
- Teacher-created Maze with Duct Tape (2 colors)
- Move block cut outs

Lesson Prep:

- Print and cut Move block cut outs
- Make a teacher maze using tape on the floor.

  Example:


Finish
Start

EXPLORE

Length: 10 minutes

Introduce the idea of being a programmer to students by watching videos and having a group discussion.

Prep:

- Set up projector
- Cue up videos

Teacher Actions	Student Actions
1 Start a discussion with students by asking, "What do programmers do?" Programmers give detailed instructions to computers to solve problems and accomplish tasks.	1 Students raise their hands to provide answers.
2 Watch: A Day in the Life of a Software Engineer: https://www.youtube.com/watch?v=vt79JcPfZQA	2 Students watch the video.
3 Why is it important to have a diverse group of people creating software for the world?	3 Students raise their hands to provide answers.
4 Watch: A Day in the Life of a Roboticist: https://www.youtube.com/watch?v=90Z3cFzV_j4	4 Students watch the video.
5 How does learning how to code play a role in making robots?	5 Students raise their hands to provide answers.

PROGRAMMING

Length: 25 minutes

Introduce programming with an exercise on paper called teacher robot.

Teacher Actions	Student Actions
1 Show students the maze and explain the first step to solving a problem is to decompose the problem. Decomposition consists of developing a problem story, identify the requirements to solve the problem, and form a plan to connect the required components.	
2 Ask the students to come up with a story to explain what the problem is that they are facing.	2 Students develop a problem story
3 Guided discussion Target: "The robot needs to get from the start zone to the finish zone."	
4	4

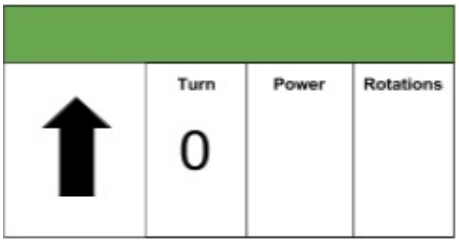
	Ask students to turn to a person sitting next to them and discuss the requirements (what the robot needs to be able to do) for achieving their goal.	Students discuss with their partner the requirements to achieve the goal.
5	Guided discussion Target: • Move forward • Turn right • Turn left	
6	What do those three requirement have in common? Is it possible to describe them all as moving the wheels of the robot? • What is the difference between the movements? • What do you need to be able to change about the movement to allow for turning and covering different distances?	
7	Guided discussion Target: • Rotation (distance) • Turn (angle)	
8		

Give each student a set of the [move block cutouts] [worksheet1]. The move block can control:

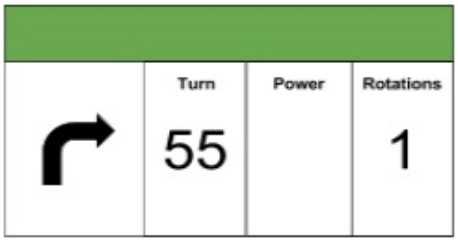
- steering - turning direction (already filled in)
- power - how fast the robot moves
- rotations - how far to move

9

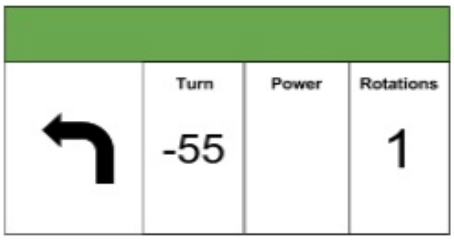
As a group discuss what each of the three different move blocks mean.



move forward



turn right 90 degrees



turn left 90 degrees

10

10

Tell students to create a sequence (from left to right) of blocks to program the teacher robot to solve the maze. The teacher robot performs the student instructions. If there are bugs, return the paper to the student.

How to be teacher robot:

- Forward: Walk forward one box for each rotation
- Turn left: turn 90 degrees left (this does not move you to a new space)
- Turn right: turn 90 degrees right (this does not move you to a new space)

```
Make sure to follow student i
nstructions exactly as they a
re written!
```

Students develop and create a list of commands using their move block cutouts. When they are done, the teacher reads and enacts their list of instructions.

BUILDING

Length: 10 minutes

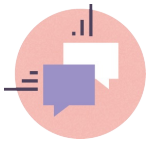
Introduce students to building attachments.

Teacher Actions	Student Actions
1 Show students the maze again and explain that their robot has to push a lego through the maze. To accomplish this, students need to build an attachment. `An attachment is an additiona l piece that can be added ont o a robot to help it achieve new goals.`	
2 Give students 2 minutes to brainstorm problems their current robot might have while trying to push a lego.	2 With a partner, students brainstorm problems that the robot might run into while trying to push a block.
3 Guided Discussion Target: • Lego gets stuck under robot • Lego slides off to the side • Lego blocks wheels	3 Students offer answers by raising their hands.

4 Think To develop a solution, students start by sketching 3 ideas on a piece of paper.	4 Each student sketches 3 ideas for their attachment.
5 Pair Put students in groups of 2	5 Students sit with a partner.
6 Share Tell students to share their sketches and explain how each design deals with the problems the class discovered.	6 Students share their sketches and explain how each design deals with the problems the class discovered.

Move block online

Robotics



OVERVIEW

Students continue learning about simple and complex behaviors by programming their Mindstorm robots. Start by teaching how to program in the EV3 environment and download programs to the robot for testing. Students demonstrate learning by giving their robots commands to navigate a maze.

Download Lesson

OBJECTIVES

1. Students will be able to create a sequence on the computer.
2. Students will be able to use the move block.

AGENDA

Length 45 minutes

1. Explore - Watch a video of a robot and discuss the importance of building in robotics.
2. Explain - Show students how to program the robot in the EV3 software.
3. Engage - Students program their robots to solve the maze.

VOCAB

MATERIALS

1. Finished robot

2. Hand written program and lego attachment from move block lesson
3. Computer with EV3 Software
4. Move Steering Handout
5. Teacher-created Maze
6. Iteration Log

EXPLORE

Length: 10 minutes

Watch a video of a good lego robot and discuss the importance of building.

Teacher Actions	Student Actions
1 Show the video of the world champion robot from 2013-14 First Lego League challenge as an example of a very well designed and programmed EV3 robot.	1 Students watch the video.
2 Discuss with students the importance of combining good engineering and good programming.	2 Students raise their hands to offer answers.

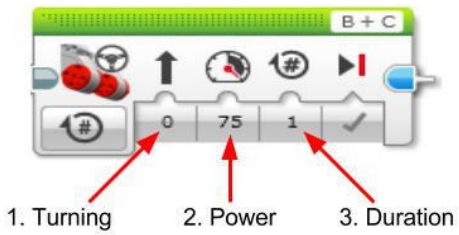
EXPLAIN

Length: 15 minutes

Show students how to program the robot in the EV3 software.

Prep:

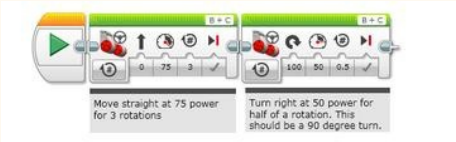
Teacher Actions	Student Actions
1 Distribute the Move Steering handout and show students the maze that the robot has to navigate.	
2 What do you think the blanks on the handout are used for when programming the robot?	
3 Guided Discussion • Turning: Positive numbers turn right, Negative numbers turn left, and 0 means straight. • Power: How fast the motor spins. 0 is the slowest; 100 is the fastest. • Duration: How long the motor turns on for in rotations. 1 rotation is one full spin of the motor.	3 Students fill in the 3 parts of the Move Steering block on their handout: • Turning: Positive numbers turn right, Negative numbers turn left, and 0 means straight. • Power: How fast the motor spins. 0 is the slowest; 100 is the fastest. • Duration: How long the motor turns on for in rotations. 1 rotation is one full spin of the motor.



4 To create a sequence, connect multiple blocks together from left to right Give students time to complete the rest of the handout.

5 Show students the EV3 software and demonstrate where to find the Move steering block

5 On the handout, students describe the behaviors for each move steering block. The finished answer should look like this:



6 Show students the iteration log and ask students about why it is important to identify where in their code a bug occurred.

7 Show students the iteration log and ask students about why it is important to identify where in their code a bug occurred.

ENGAGE

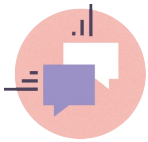
Length: 20 minutes

Students program their robots to solve the maze.

Teacher Actions	Student Actions
1 Tell students to get a computer, open the Mindstorm EV3 software, and create a new program.	1 Students get a computer, open the Mindstorm EV3 software, and create a new program.
2 Ask students what they notice about all of the turns on the maze? What parts of the move block do they need to it to change how much the robot turns?	
3 Guided discussion Target: • All of the turns are 90 degrees • Students will need to adjust turn and rotation to successfully complete a turn.	3 Students raise their hands to give answers.

4 Tell students that their first goal is to edit a move block on their computer to complete a 90 degree turn.	4 Students can now begin programming their robot to complete a 90 degree turn.
5 Student create a program to solve the maze. The goal is to create the robot that finishes the maze the quickest.	5 Students begin programming their robot to complete the maze from previous lesson. • Students should use their program (the written down instructions) from the 'teacher robot' activity to help organizing the behaviors for the actual maze challenge. • Students keep a log of where each attempt could be improved using their iteration log handout.

Design thinking
Robotics



OVERVIEW

Students will be able to use the design thinking method to creatively design their sumo robots.

Download Lesson

OBJECTIVES

1. Students will be able to list the steps of the design thinking process.
2. Students will be able to apply the concepts of design thinking.

AGENDA

Length: 90 minutes

1. Explain - Students see the sumo ring and start to think about how to build in terms of defense, offense, and simple attachments.
2. Engage - Students learn about design thinking, then prototype and test their attachments in a sumo battle.

VOCAB

- Design thinking process - An iterative process that cycles through developing ideas, creating prototypes, and testing solutions.

MATERIALS

1. Design thinking handout
2. Mindstorm robot kits
3. Lego EV3 software

EXPLAIN

Length: 10 minutes

Students see the sumo ring and start to think about how to build in terms of defense, offense, and simple attachments.

Teacher Actions	Student Actions
1 Show students the Sumo ring. Explain that the goal of the game is for one robot to push the other one outside of the ring.	
2 Guided discussion - Now that students have learned how to program a robot, what is another important part to robotics? Target: Developing a good design is very important for robotics.	2 Students raise their hands to provide answers.
3 Explain that before building, students will go through the design thinking process to think creatively and systematically about building the best robot.	

4 The three most important aspects students should consider are: defense, offense, and simple attachments.

- defense - your robot should be able to defend itself from attacking robots
- offense - effectively knock over, wedge, or push opponent off sumo mat
- simple attachments - clip attachments on and off in less than 3 minutes.

ENGAGE

Length: 35 minutes

Students learn about design thinking, then prototype and test their attachments in a sumo battle.

Teacher Actions	Student Actions
1 Distribute the design thinking worksheet.	1 Students fill in the blanks on the first page of the worksheet as the steps are explained.
2 Start by explaining the steps to the design thinking process: • Empathize: Understand the way your users do things and why, their physical and emotional needs, how they think about world, and what is meaningful to them. • Define: Define the challenge you are taking on, based on what you have learned about your users and about the context. • Ideate: You ideate in order to move from identifying problems to creating solutions for your users. Ideation is your chance to combine the understanding you have	

	of the problem and people you are designing for with your imagination to create ideas for solutions. • Prototype: Build samples of your ideas that can be tested. Don't get too attached to any one design. • Test: Put your prototypes to the test. Take notes on what works and what needs to change in the next iteration.	
3	Demo a sumo battle using two robots that have no attachments. The robots should start facing each other and be running a simple program that moves straight forward.	3 Students watch the battle and take notes on their handout.
4	Tell students to work on the first three sections of the handout by themselves.	4 Students fill in the empathize, define, and ideate sections of their handout individually.
5	Share - Split students into groups of two. Each student will explain and justify their ideas with a partner.	5 Students explain and justify their ideas with a partner.
6	Tell students that collaboration (working together) is an important part of creating a	6 With their partner, students sketch an idea for their attachment that incorporates

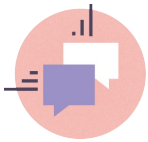
good product. With their partner, students will create a new sketch that uses the best pieces from each participant.	the best ideas from each partner.
7 Ask students what happens after ideate. What do students think is the most important part of that process?	7 Still in groups, students build their first prototype.
8 Guided discussion Target: • Prototype comes after ideate • When prototyping, it is important for the students to build quickly instead of working on a perfect version. The idea will have to be fixed many times before the final product is ready.	8 Students raise their hands with suggestions. After the discussion, students start to build their prototypes with their group.
9 Students begin prototyping their design. Whenever two groups are ready, they should test their robots by doing a Sumo battle with them. For today, the robots will always be aimed directly at each other and should move in a straight line towards the other robot.	9 Students battle their robots, and then fill out the test section of their handout.

10 After the test, students either improve their current design or go back and build another prototype from their ideas.

If a group is satisfied with their front attachments, have their robot start faced away fr
om their opponent. Tell students that their robot needs have good defense on all sides!

The cowardly robot

Robotics



OVERVIEW

In this lesson, students learn about loops, event handlers, and practice design thinking.

Download Lesson

OBJECTIVES

Students will be able to

- Define and utilize a loop
- Define and utilize event listeners (wait block)
- Practice design thinking

AGENDA

Length: 90 minutes

1. Explore - Introduce students to sensors
2. Explain - Show students how to program the sensors
3. Engage - Students use knowledge to program their robot

VOCAB

- Loop - A block of code that repeats.
- Event handler - Code that runs after a specific input.

MATERIALS

- Lego Mindstorms
- Lesson 5 | Worksheet 1
- Iteration log

EXPLORE

Length: 15 minutes

Introduce students to the concept of sensors.

Prep: Set up projector with video https://www.youtube.com/watch?v=8df0OemCLFo

Teacher Actions	Student Actions
1 Watch - https://www.youtube.com/watch?v=8df0OemCLFo Sumo bots example	1 Students watch the sumo bots video
2 Guided discussion - Now that students have tested their robots sumo prowess in the last lesson, what could make their robots better fighters? Target: Sensors! (and updating their build designs)	2 Students raise their hands to provide answers.
3 Relate human senses to robotic sensors and discuss how those senses can be used to react to external stimuli.	
4	4 Students raise their hands to provide answers.

	Discuss with students how people use their senses to react to their environment • What would you do if something was chasing you? • What of your senses do you use to know if something is chasing you?	
5	Explain that the robot uses sensors to mimic human senses and allow it to react to its surroundings.	
6	Show students the ultrasonic sensor and ask what they think this sensor might be used for. Explain that it is similar to the eyes of the robot. It allows your ev3 to measure distance.	

EXPLAIN

Length: 20 minutes

Explain the goal for the robot and show students how to use the sensors in the EV3 software.

Teacher Actions	Student Actions
1 Explain the goal for this class is to make the cowardly robot.	
2 The robot should run away whenever something is closer than 2 feet.	2 Students fill in their worksheet.
3 If the robot does not see anything that close, it continuously spins so it can not be snuck up on.	3 Student raise their hands to provide ideas.
4 Distribute [Lesson 5 | Worksheet 1][worksheet1] and set up a projector that has it displayed. Students work on finding the difference between the two move blocks. When students have finished individually working on the questions, they discuss their answers with a partner.	4 Student raise their hands to provide ideas.

5 Guided Discussion - What is the difference between the two move blocks? Target: The image on the left has more options because it has a number of rotations. The block on the right is set to move forever.	
6 Guided Discussion - What input makes the robot decide to run away? Which sensor provides that input? Target: The ultrasonic sensor measuring that an object is closer than 24 inches.	
7 On the projector, introduce students to the orange flow control tab. To add an event handler grab the wait block. The wait block will let the robot continue what it has been doing (turning forever) until a specified event happens. In the case of the cowardly robot, it can be customized to use the ultrasonic sensor.	
8 To repeat a set of actions put them inside of a loop (also inside of the orange tab).	

ENGAGE

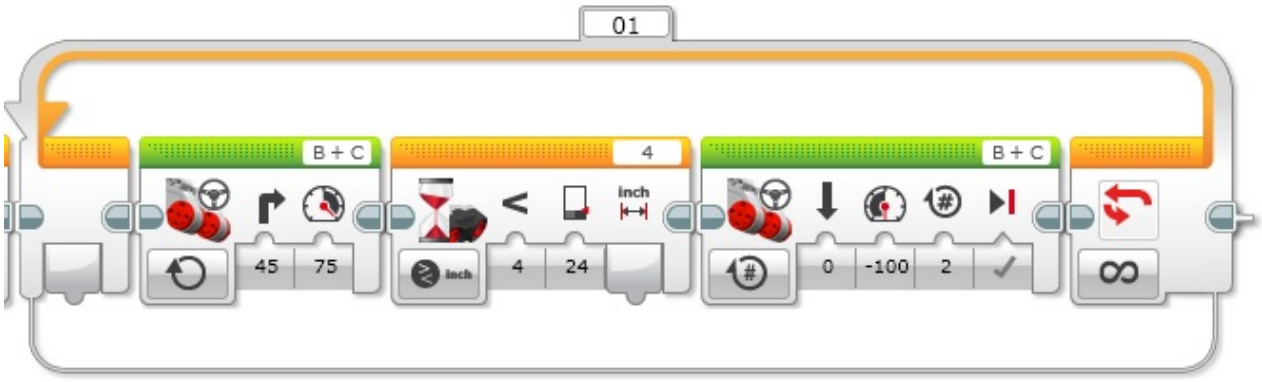
Length: 55 minutes

Students build and program their robots.

Prep:

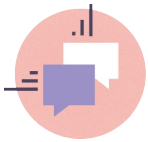
Teacher Actions	Student Actions
1 Explain that students need to find a way to attach the ultrasonic sensors to their robot. The ultrasonic sensor should be plugged into port number 4 on the robot and needs to have a clear line of sight in front of it.	1 Students work on attaching the ultrasonic sensor.
2 Tell students to program their robots. Remind them that the robot needs to be able to: 1. Turn forever 2. Wait for the ultrasonic sensor to measure an object closer than 24 inches 3. Run away 4. Repeat 1-3	2 Students program their robot.
3 Students test their robots to make sure it runs away.	3 Students test their robots. • Students keep a log of where each attempt could be improved using their iteration log handout.
4 If students finish early they should try to use the touch sensor and color sensor.	

Code reference (for teacher)



Back to sumo code

Robotics



OVERVIEW

In this lesson, students use their new programming techniques to upgrade their robots and have another sumo battle.

Download Lesson

OBJECTIVES

Students will be able to

- Implement event handlers and loops
- Iterate on robot design

AGENDA

Length: 45 minutes

1. Review - Review what students know about coding the EV3 robots.
2. Explain - Have a group discussion about how the code the event handlers and loops can make their robots better sumo bots.
3. Engage -Students program their sumo bots using the new concepts.

VOCAB

Iterate - a procedure in which repetition of a sequence of operations yields results successively closer to a desired result

MATERIALS

- Sumo worksheet
- EV3 robots
- Computer

REVIEW

Length: 10 minutes

Review what students know about coding the EV3 robots.

Teacher Actions	Student Actions
1 Start by asking students questions to review concepts from previous lessons. 1. What is an event handler? ◦ An event handler is code that runs after a specific event or input (such as a sensor being activated). 2. What does a loop do? ◦ A loop repeats a section of code. 3. Which sensor is used to measure distance? ◦ The ultrasonic sensor measures distances.	1 Students raise their hands to provide answers to these questions.

EXPLAIN

Length: 10 minutes

Have a group discussion about how the code the event handlers and loops can make their robots better sumo bots.

Teacher Actions	Student Actions
1 Explain that now when the sumo competition starts, the robots will be faced a way from each other.	
2 Guided Discussion: How can you use these new concepts to make a better sumo bot? What are the steps of the program? • Target: The simplest version of the sumo robot program is: 1. Spin around in a circle forever. 2. Wait for the ultrasonic sensor to measure an object closer than 18 inches. 3. Move toward that object to ram it. 4. Repeat.	2 Students raise their hands to provide answers.

ENGAGE

Length: 25 minutes

Students program their sumo bots using the new concepts.

Teacher Actions	Student Actions
1 Tell students that now it is time for them to work on the code for their sumo bots. The new code should include loops and event handlers.	1 Students work on creating new sumo programs for their robots.
2 Remind students that this is an iterative process. This means that students should code, test their code, and then try to improve on it.	
3 Once students have the basic code working, give the students coding worksheet.	3 Students use the worksheet to develop code that goes beyond the basic programming.

Back to sumo build

Robotics

OVERVIEW

Students iterate on their design ideas for their sumo robot.

OBJECTIVES

Students will iterate on and improve their sumo robot designs.

Download Lesson

AGENDA

Length: 45 minutes

1. Explain - Discuss the importance of iteration.
2. Engage - Student work on improving their sumo designs.

MATERIALS

1. Working on your build worksheet
2. EV3 robots
3. EV3 Lego kits

EXPLAIN

Length: 5 minutes

Explain to students about why iteration is important for building.

Teacher Actions	Student Actions
1 Ask students, "What is iteration?" • Iteration is the process of building, testing, and then improving the design in a continuous cycle.	1 Students raise their hands to provide answers.
2 Ask students, "Why is iteration important in building an designing?" • It is impossible to develop the perfect solution on the first attempt. Testing and iterating allows designers to see how their product works in the real world and then improve on flaws. Each cycle moves the product closer to an optimal design.	2 Students raise their hands to provide answers.
3 Explain that today, students are going to iterate and test their sumo designs. Now that their robots move around more, it may be important to design their robot differently.	

ENGAGE

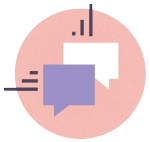
Length: 40 minutes

Students use the working on your build worksheet to guide their thinking as they build and test their sumo designs.

Teacher Actions	Student Actions
1 Split students into their groups and distribute the working on your build worksheet.	1 Students split into groups and gather their computers, robots and building kits.
2 Tell students do an initial test by participating in a sumo battle. After the test students will fill in the worksheet. • In these battles the robots should start facing away from each other.	2 Students do an initial battle, then fill in the worksheet.
3 Explain that each time students build and test they should think about the questions on the handout to plan improvements.	3 After each cycle, students discuss the questions from the handout with their groups and plan new improvements.

Line follower

Robotics



OVERVIEW

Students learn about switch statements while creating a robot that can follow a line.

Download Lesson

OBJECTIVES

Students will be able to use a switch statement.

AGENDA

Length: 90 minutes

1. Explore - Get students thinking about how a red line can help their robot navigate to a desired location.
2. Explain - Show students the line and demonstrate the simple behaviors needed to program a robot to follow the line.
3. Engage - Students build an attachment for the color sensor and program their robot.

VOCAB

Switch statement - A type of selection that changes the flow of a program based on the value of a variable or expression.

MATERIALS

- Lego Mindstorm Kit
- Computer with EV3 Software
- Iteration Log

EXPLORE

Length: 10 minutes

Get students thinking about how a red line can help their robot navigate to a desired location.

Teacher Actions	Student Actions

1 Set up the projector and show students the the video of the google self driving car. Ask follow up questions:
1. Is the google car a robot?
  ◦ yes - the car uses its sensors and programming to drive autonomously (by itself)
2. What are some reasons the self driving car could be safer than a normal car?
  ◦ It can see in 360 degrees
  ◦ It can not be distracted
3. What are some similarities between the car and our robots.
  ◦ They both need to be able to navigate on their own.
	1 Watch the video of the google self driving car and answer the questions

2	2

	Show students the red masking tape maze that the robot needs to navigate through and ask the following questions.
	1. What markers on the robot playing surface could help navigate the robot?
	   ◦ Red lines placed on the field mat can help the robot decide where to move.
	2. Which sensor can allow the robot see those red lines?
	   ◦ The color sensor can detect the colors on the mat are.
		Raise their hands to answer questions

EXPLAIN

Length: 20 minutes

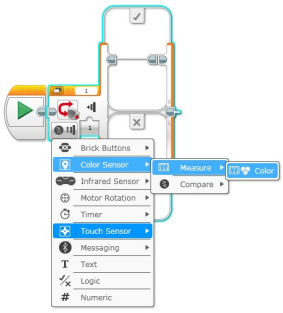
Show students the line and demonstrate the simple behaviors needed to program a robot to follow the line.

Teacher Actions	Student Actions

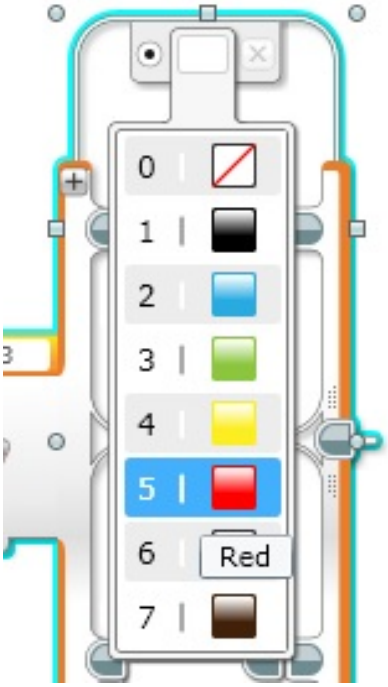
1 With a turned off robot, demonstrate the situations the robot will face and what students think the robot should do in those situations.
• The robot is to the right of the line:
  ◦ Turn left
• The robot is on the line:
  ◦ Turn right
	1 Students raise their hands to provide answers.

2 Student's first idea is often to go straight when the robot is on the line. Explain that when the line curves to the right, the robot would go off the path and the turn to the left.	
3 With the strategy figured out, teach students about the the programming blocks required to execute this strategy.	3 Students watch as the teacher previews the code.

1. The switch statement takes the readings from the sensor and breaks it into two possible cases, just like the two rules in our strategy.
2. For the color sensor, the two cases are red or not red. To set up the switch:
    - Select the color sensor
    - Click on measure
    - Select color

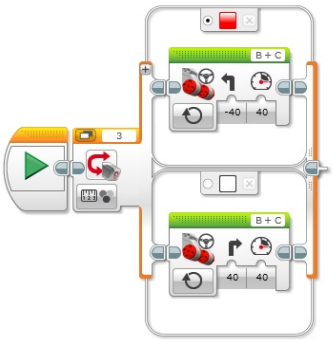


3. Change the color of the top track to red



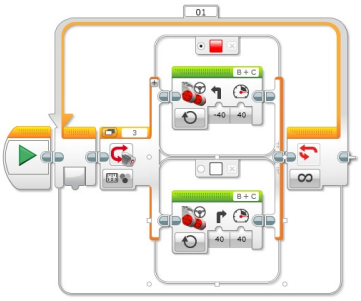
4. Change color of the bottom track to white

5. Using the previously discussed strategy as the guide, add the move steering blocks. Make sure to set the move steering blocks to 'On'. The finished product should look like:



4	Ask, "How can you make that process repeat indefinitely?" • Put that entire switch statement in a loop so that the process repeats forever. If there is no loop	4 Students raise their hands to provide answers.

it will move once and be done.



ENGAGE

Length: 60 minutes

Students build an attachment for the color sensor and program their robot.

Teacher Actions	Student Actions
1 Remind students about the goal for their robot.	
2 Tell students to build an attachment for the color sensor.	2 Students build their attachment for the color sensor. • It is important that the color sensor be faced toward the ground (where the line is). • The color sensor should be close to the ground (within 1/2 inch). If it gets too close though, it will not work.
3 Once students have finished their attachment they can start programming their robot. • After each attempt, students should write down what work and what they should change using the iteration log handout. • When everyone is done, have a competition and time each of the robots.	3 Students program their robot using the switch statement.
4 The robot that completes the entire maze the quickest is the winner.	

> To change the speed of the robot the students need to alter the values of the turning and the power in the move blocks.