

FIRST LEGO LEAGUE: SHARE & LEARN BEGINNER WORKSHOP





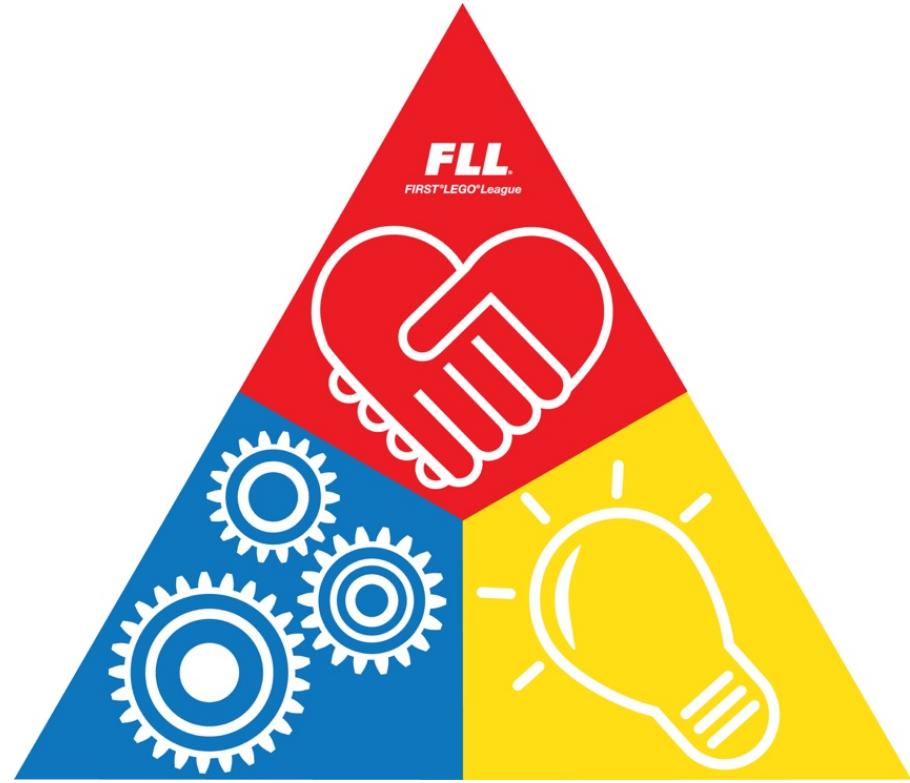
INTRODUCTIONS

THREE PARTS OF FIRST LEGO LEAGUE

Robot Game: Design & program a MINDSTORMS robot to autonomously complete missions in 2.5 mins on a themed course

Core Values: Demonstrate teamwork and cooperation

Research Project: Develop an innovative solution for a real-world problem



Spend time on all three parts

COMPETITION HIERARCHY IN YOUR STATE

Customize
this slide

November-December

REGIONAL or
QUALIFIER

December-January

STATE
CHAMPIONSHIP

April-June

WORLD
FESTIVAL and
INTERNATIONAL
OPENs

March-June

GLOBAL
INNOVATION
AWARD

AWARDS

Robot Performance: Highest robot performance scores

Robot Game: Robot Design, Programming, Strategy & Innovation

Research Project: Research, Innovative Solution, Presentation

Core Values: Inspiration, Teamwork, Gracious Professionalism

Customize
this slide

Champion's Award

- Best all-rounded team
- Must make 40% cut-off in Robot Performance

Different tournaments give a different number awards based on the region as well as how large the tournament is.
Please check with your region.

SIX HIGH LEVEL TIPS

- 1) Read the challenge documents carefully (videos of missions/rules do not count). Read any updates posted during the season.
- 2) Refer to the rubrics provided by FIRST often. The rubrics will help a team know what they need to do in each category
- 3) Develop your own team style. Set your own goals.
- 4) Make mistakes – Learn – Revise. It's all part of the process.
- 5) Make sure everyone on the team is involved and has an understanding of other sections even if they were not the lead on it
- 6) Don't hesitate to ask for help. The FIRST community is very supportive.



CORE VALUES

CORE VALUES RUBRIC

Core Values																			
 <p>Core Values</p> <p>Directions: For each skill area, clearly mark the box that best describes the team's accomplishments. If the team does not demonstrate skill in a particular area, then put an 'X' in the first box for Not Demonstrated (ND). Please provide as many written comments as you can to acknowledge each team's hard work and to help teams improve. When you have completed the evaluation, please circle the team's areas of strength.</p>																			
Inspiration:	Beginning	Developing	Accomplished																
	Exemplary																		
	<table border="1"> <thead> <tr> <th>Discovery</th> <th>Balanced emphasis on all three aspects (Robot, Project, Core Values) of FLL; it's not just about winning awards.</th> </tr> </thead> <tbody> <tr> <td>N D</td> <td>emphasis on only one aspect; others neglected</td> </tr> <tr> <td>D</td> <td>emphasis on two aspects; one aspect neglected</td> </tr> <tr> <td></td> <td>emphasis on all three aspects</td> </tr> <tr> <td></td> <td>balanced emphasis on all three aspects</td> </tr> </tbody> </table>			Discovery	Balanced emphasis on all three aspects (Robot, Project, Core Values) of FLL; it's not just about winning awards.	N D	emphasis on only one aspect; others neglected	D	emphasis on two aspects; one aspect neglected		emphasis on all three aspects		balanced emphasis on all three aspects						
	Discovery	Balanced emphasis on all three aspects (Robot, Project, Core Values) of FLL; it's not just about winning awards.																	
N D	emphasis on only one aspect; others neglected																		
D	emphasis on two aspects; one aspect neglected																		
	emphasis on all three aspects																		
	balanced emphasis on all three aspects																		
<table border="1"> <thead> <tr> <th>Team Spirit</th> <th>Enthusiastic and fun expression of the team identity</th> </tr> </thead> <tbody> <tr> <td>N D</td> <td>minimal enthusiasm AND minimal identity</td> </tr> <tr> <td>D</td> <td>minimal enthusiasm OR minimal identity</td> </tr> <tr> <td></td> <td>team is enthusiastic and fun; clear identity</td> </tr> <tr> <td></td> <td>team engages others in their enthusiasm & fun; clear identity</td> </tr> </tbody> </table>			Team Spirit	Enthusiastic and fun expression of the team identity	N D	minimal enthusiasm AND minimal identity	D	minimal enthusiasm OR minimal identity		team is enthusiastic and fun; clear identity		team engages others in their enthusiasm & fun; clear identity							
Team Spirit	Enthusiastic and fun expression of the team identity																		
N D	minimal enthusiasm AND minimal identity																		
D	minimal enthusiasm OR minimal identity																		
	team is enthusiastic and fun; clear identity																		
	team engages others in their enthusiasm & fun; clear identity																		
Comments:	<table border="1"> <thead> <tr> <th>Integration</th> <th>Application of FLL values and skills outside FLL (ability to describe current and potential examples from daily life)</th> </tr> </thead> <tbody> <tr> <td>N D</td> <td>team does not apply FLL values and skills outside FLL</td> </tr> <tr> <td></td> <td>team able to describe at least one example</td> </tr> <tr> <td></td> <td>team able to describe multiple examples</td> </tr> <tr> <td></td> <td>team able to describe multiple examples, incl. individual stories</td> </tr> </tbody> </table>			Integration	Application of FLL values and skills outside FLL (ability to describe current and potential examples from daily life)	N D	team does not apply FLL values and skills outside FLL		team able to describe at least one example		team able to describe multiple examples		team able to describe multiple examples, incl. individual stories						
	Integration	Application of FLL values and skills outside FLL (ability to describe current and potential examples from daily life)																	
	N D	team does not apply FLL values and skills outside FLL																	
		team able to describe at least one example																	
	team able to describe multiple examples																		
	team able to describe multiple examples, incl. individual stories																		
<table border="1"> <thead> <tr> <th colspan="4">Effectiveness</th> </tr> <tr> <th colspan="4">Problem solving and decision making processes help team achieve their goals</th> </tr> </thead> <tbody> <tr> <td>N D</td> <td>team goals AND team processes unclear</td> <td>team goals OR team processes unclear</td> <td>clear team goals and processes</td> </tr> <tr> <td>D</td> <td></td> <td>clear processes enable team to accomplish well defined goals</td> <td></td> </tr> </tbody> </table>				Effectiveness				Problem solving and decision making processes help team achieve their goals				N D	team goals AND team processes unclear	team goals OR team processes unclear	clear team goals and processes	D		clear processes enable team to accomplish well defined goals	
Effectiveness																			
Problem solving and decision making processes help team achieve their goals																			
N D	team goals AND team processes unclear	team goals OR team processes unclear	clear team goals and processes																
D		clear processes enable team to accomplish well defined goals																	
<table border="1"> <thead> <tr> <th colspan="4">Efficiency</th> </tr> <tr> <th colspan="4">Resources used relative to what the team accomplishes (time management, distribution of roles and responsibilities)</th> </tr> </thead> <tbody> <tr> <td>N D</td> <td>limited time management AND unclear roles</td> <td>limited time management OR unclear roles</td> <td>excellent time management and role definition allows team to accomplish most goals</td> </tr> <tr> <td>D</td> <td></td> <td>excellent time management and role definition allows teams to accomplish all goals</td> <td></td> </tr> </tbody> </table>				Efficiency				Resources used relative to what the team accomplishes (time management, distribution of roles and responsibilities)				N D	limited time management AND unclear roles	limited time management OR unclear roles	excellent time management and role definition allows team to accomplish most goals	D		excellent time management and role definition allows teams to accomplish all goals	
Efficiency																			
Resources used relative to what the team accomplishes (time management, distribution of roles and responsibilities)																			
N D	limited time management AND unclear roles	limited time management OR unclear roles	excellent time management and role definition allows team to accomplish most goals																
D		excellent time management and role definition allows teams to accomplish all goals																	
<table border="1"> <thead> <tr> <th colspan="4">Kids Do the Work</th> </tr> <tr> <th colspan="4">Appropriate balance between team responsibility and coach guidance</th> </tr> </thead> <tbody> <tr> <td>N D</td> <td>limited team responsibility AND excessive coach guidance</td> <td>limited team responsibility OR excessive coach guidance</td> <td>Good balance between team responsibility and coach guidance</td> </tr> <tr> <td>D</td> <td></td> <td></td> <td>team independence with minimal coach guidance</td> </tr> </tbody> </table>				Kids Do the Work				Appropriate balance between team responsibility and coach guidance				N D	limited team responsibility AND excessive coach guidance	limited team responsibility OR excessive coach guidance	Good balance between team responsibility and coach guidance	D			team independence with minimal coach guidance
Kids Do the Work																			
Appropriate balance between team responsibility and coach guidance																			
N D	limited team responsibility AND excessive coach guidance	limited team responsibility OR excessive coach guidance	Good balance between team responsibility and coach guidance																
D			team independence with minimal coach guidance																
Comments:	<table border="1"> <thead> <tr> <th colspan="4">Inclusion</th> </tr> <tr> <th colspan="4">Consideration and appreciation for the contributions (ideas and skills) of all team members, with balanced involvement</th> </tr> </thead> <tbody> <tr> <td>N D</td> <td>unbalanced team involvement AND lack of appreciation for contributions</td> <td>unbalanced team involvement OR lack of appreciation for contributions</td> <td>balanced team involvement AND appreciation for contributions of most team members</td> </tr> <tr> <td>D</td> <td></td> <td>balanced team involvement AND appreciation for contributions of all team members</td> <td></td> </tr> </tbody> </table>			Inclusion				Consideration and appreciation for the contributions (ideas and skills) of all team members, with balanced involvement				N D	unbalanced team involvement AND lack of appreciation for contributions	unbalanced team involvement OR lack of appreciation for contributions	balanced team involvement AND appreciation for contributions of most team members	D		balanced team involvement AND appreciation for contributions of all team members	
	Inclusion																		
	Consideration and appreciation for the contributions (ideas and skills) of all team members, with balanced involvement																		
	N D	unbalanced team involvement AND lack of appreciation for contributions	unbalanced team involvement OR lack of appreciation for contributions	balanced team involvement AND appreciation for contributions of most team members															
D		balanced team involvement AND appreciation for contributions of all team members																	
<table border="1"> <thead> <tr> <th colspan="4">Respect</th> </tr> <tr> <th colspan="4">Team members act and speak with integrity so others feel valued-- especially when solving problems or resolving conflicts</th> </tr> </thead> <tbody> <tr> <td>N D</td> <td>not evident with majority of team members</td> <td>evident with majority of team members</td> <td>almost always evident with all team members</td> </tr> <tr> <td>D</td> <td></td> <td>always evident, even in most difficult situations</td> <td></td> </tr> </tbody> </table>			Respect				Team members act and speak with integrity so others feel valued-- especially when solving problems or resolving conflicts				N D	not evident with majority of team members	evident with majority of team members	almost always evident with all team members	D		always evident, even in most difficult situations		
Respect																			
Team members act and speak with integrity so others feel valued-- especially when solving problems or resolving conflicts																			
N D	not evident with majority of team members	evident with majority of team members	almost always evident with all team members																
D		always evident, even in most difficult situations																	
<table border="1"> <thead> <tr> <th colspan="4">Coopertition®</th> </tr> <tr> <th colspan="4">Team competes in the spirit of friendly competition and cooperates with others</th> </tr> </thead> <tbody> <tr> <td>N D</td> <td>not evident with majority of team members</td> <td>evident with majority of team members</td> <td>almost always evident with all team members</td> </tr> <tr> <td>D</td> <td></td> <td>always evident, even in difficult situations--and team actively helps other teams</td> <td></td> </tr> </tbody> </table>			Coopertition®				Team competes in the spirit of friendly competition and cooperates with others				N D	not evident with majority of team members	evident with majority of team members	almost always evident with all team members	D		always evident, even in difficult situations--and team actively helps other teams		
Coopertition®																			
Team competes in the spirit of friendly competition and cooperates with others																			
N D	not evident with majority of team members	evident with majority of team members	almost always evident with all team members																
D		always evident, even in difficult situations--and team actively helps other teams																	
<table border="1"> <thead> <tr> <th>Strengths:</th> <th>Inspiration</th> <th>Teamwork</th> <th>Gracious Professionalism®</th> </tr> </thead> </table>				Strengths:	Inspiration	Teamwork	Gracious Professionalism®												
Strengths:	Inspiration	Teamwork	Gracious Professionalism®																

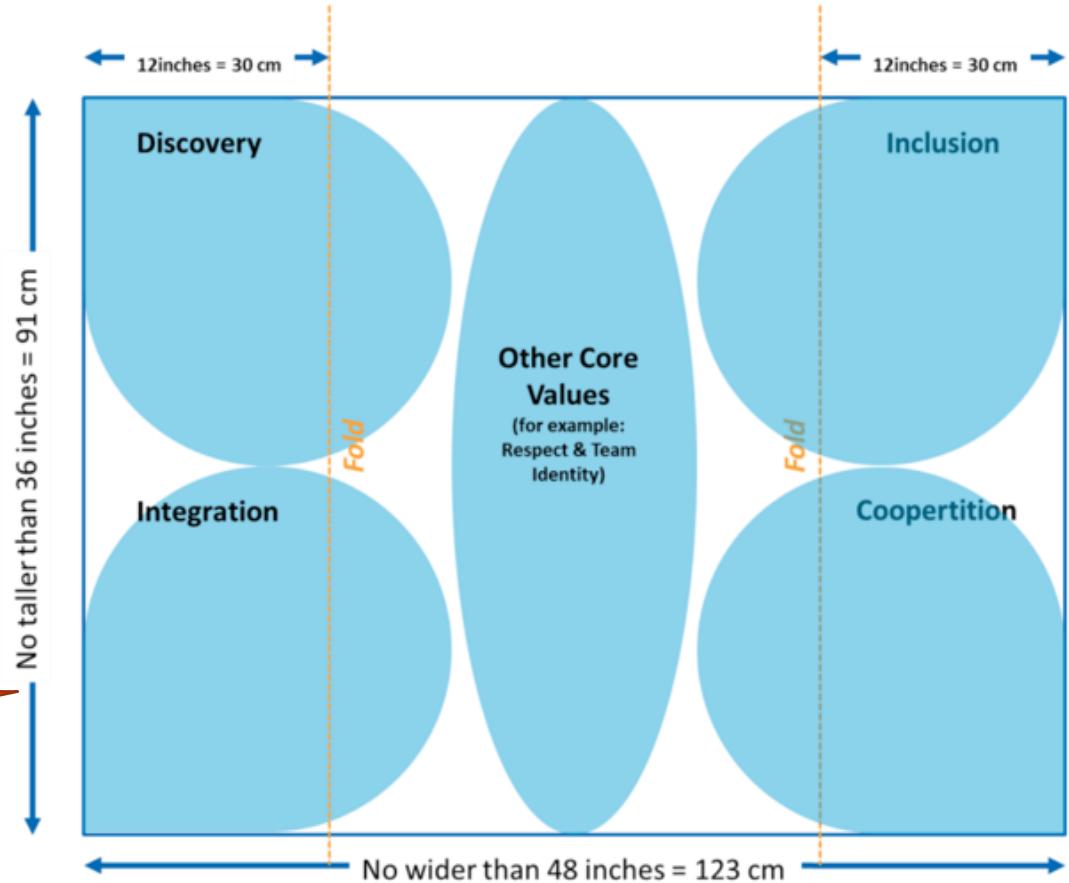
© 2016 The United States Foundation for Inspiration and Recognition of Science and Technology (FIRST®) and The LEGO Group. Used by special permission. All rights reserved.

- **Discovery:** Spend equal time on all three parts of FLL
- **Team Spirit:** What's your team identity
- **Integration:** Use what you learn outside of FIRST
- **Effectiveness:** How well do you plan the task?
- **Efficiency:** How much do you get done?
- **Kids Do the Work:** Is there too much adult involvement?
- **Inclusion:** Include all team members
- **Respect:** Respect teammates
- **Coopertition:** Respect other teams. Practice good sportsmanship.

CORE VALUES POSTER

- Used to guide discussion in Core Values judging
- Optional in some regions (check with your organizers)

Customize this slide



SHARING OUR EXPERIENCES: OUTREACH ACTIVITIES

Goal is to spread FIRST and STEM

Example Outreach Events:

- Public Library
- School
- Museum
- Mall
- Mini Maker Faire
- Barnes & Noble
- State Fair



IMPROVING TEAMWORK

- Doing Core Value Activities within your team or with other teams can help you become a better team
- Team we coached improved teamwork skills through the activities we gave them
- Where can you get sample team building activities activities?
 - [EV3Lessons.com \(Resources\)](#) has 37 activities to try

The screenshot displays a 'Hand-Pencil-Hand' activity page from EV3Lessons.com. The page includes:

- Author:** Cadmes Creators
- Objectives:** Learning to work together and coordinate
- Materials:** Pens or pencils (enough for each pair of students on the team)
- Instructions to Teams:**
 - Pick a partner.
 - Each of you may only use one finger. One of you may only touch the tip of the pencil and the other only the eraser.
 - Work together to keep the pencil upright between your two fingers.
 - Next, walk from one end of the room to the other holding the pencil upright together.
- Notes:** What was the most difficult part of this challenge? How did team members communicate or coordinate?
 - 1) Placing obstacles in the room
 - 2) Timing the teams to see who is the fastest
 - 3) Increasing the number of people holding pencils from two to three or four (as in the photo above)
- Variations:** can include
- Team Building Activity:**

GRACIOUS PROFESSIONALISM & COOPERTITION

- Supporting other teams at events
- Helping them at events (sharing parts)
- Presenting projects to another team to get feedback



NOW LET'S DO A CORE VALUES ACTIVITY NOW

- Have each team attending do an activity



14

RESEARCH PROJECT

WHAT IS THE RESEARCH PROJECT?

- A group research project related to the year's theme
- Come up with an innovative solution to a real-world problem
- Themes:
 - 2011: Food Factor (food safety)
 - 2012: Senior Solutions (senior citizens)
 - 2013: Nature's Fury (natural disasters)
 - 2014: World Class (education)
 - 2015: Trash Trek (garbage)
 - 2016: Animal Allies (animals)
 - 2017: Hydro Dynamics (water)





Project

Team Number _____
Judging Room _____

Directions: For each skill area, clearly mark the box that best describes the team's accomplishments. Teams should demonstrate everything at the level; if they are missing part, mark the level below. If the team does not demonstrate an area, put an 'X' in the first box for Not Demonstrated (ND). Please provide as many written comments as you can to acknowledge each team's hard work and to help teams improve. When you have completed the evaluation, please circle the team's areas of strength.

	Beginning	Developing	Accomplished	Exemplary	
Research Comments	Problem Identification * Clear definition of the problem being studied				
	N D	unclear; few details	partially clear; details missing	mostly clear; detailed	clear; very detailed
	Sources of Information Quality and variety of data/evidence and sources cited				
N D	minimal quality; variety limited	quality OR variety need improvement; did not include professionals	sufficient quality and variety; included professional(s)	extensive quality and variety; included multiple professionals	
Problem Analysis Depth to which the problem was studied and analyzed by the team, including extent of analysis of existing solutions					
N D	minimal study; no analysis	minimal study; some analysis	sufficient study and analysis	extensive study and analysis	
Innovative Solution Comments	Team Solution* Clear explanation of the proposed solution and description of how it solves the problem				
	N D	difficult to understand	some parts confusing	understandable	easy to understand by all
	Innovation Degree to which the team's solution makes life better by improving existing options, developing a new application of existing ideas, or solving the problem in a completely new way.				
	N D	existing solution/application	solution/application contains some original element(s)	original solution/application; potential added value	original solution/application; demonstrated added value
Solution Development Systematic process used to select, develop, evaluate, test, and improve the solution (Implementation could include cost, ease of manufacturing, etc.)					
N D	process AND explanation need improvement	process OR explanation need improvement	systematic process included evaluation	systematic process included evaluation; implementation considered	
Presentation Comments	Sharing* Degree to which the team shared their Project before the tournament with others who might benefit from the team's efforts				
	N D	shared within the team and/or relatives	shared once outside the team	shared with one audience who may benefit OR one professional	shared with multiple audiences who may benefit OR multiple professionals
	Creativity Imagination used to develop and deliver the presentation				
	N D	minimally engaging OR unimaginative	engaging OR imaginative	engaging AND imaginative	very engaging AND exceptionally imaginative
Presentation Effectiveness Message delivery and organization of the presentation					
N D	unclear OR disorganized	partially clear; minimal organization	mostly clear; mostly organized	clear AND well organized	
Strengths: Research Innovative Solution Presentation					

*Required for Award Consideration

© 2017 For Inspiration and Recognition of Science and Technology (FIRST®) and The LEGO Group. Used by special permission. All rights reserved.

PROJECT RUBRIC

■ Research

- Identify a problem and analyze existing solutions

■ Innovative Solution

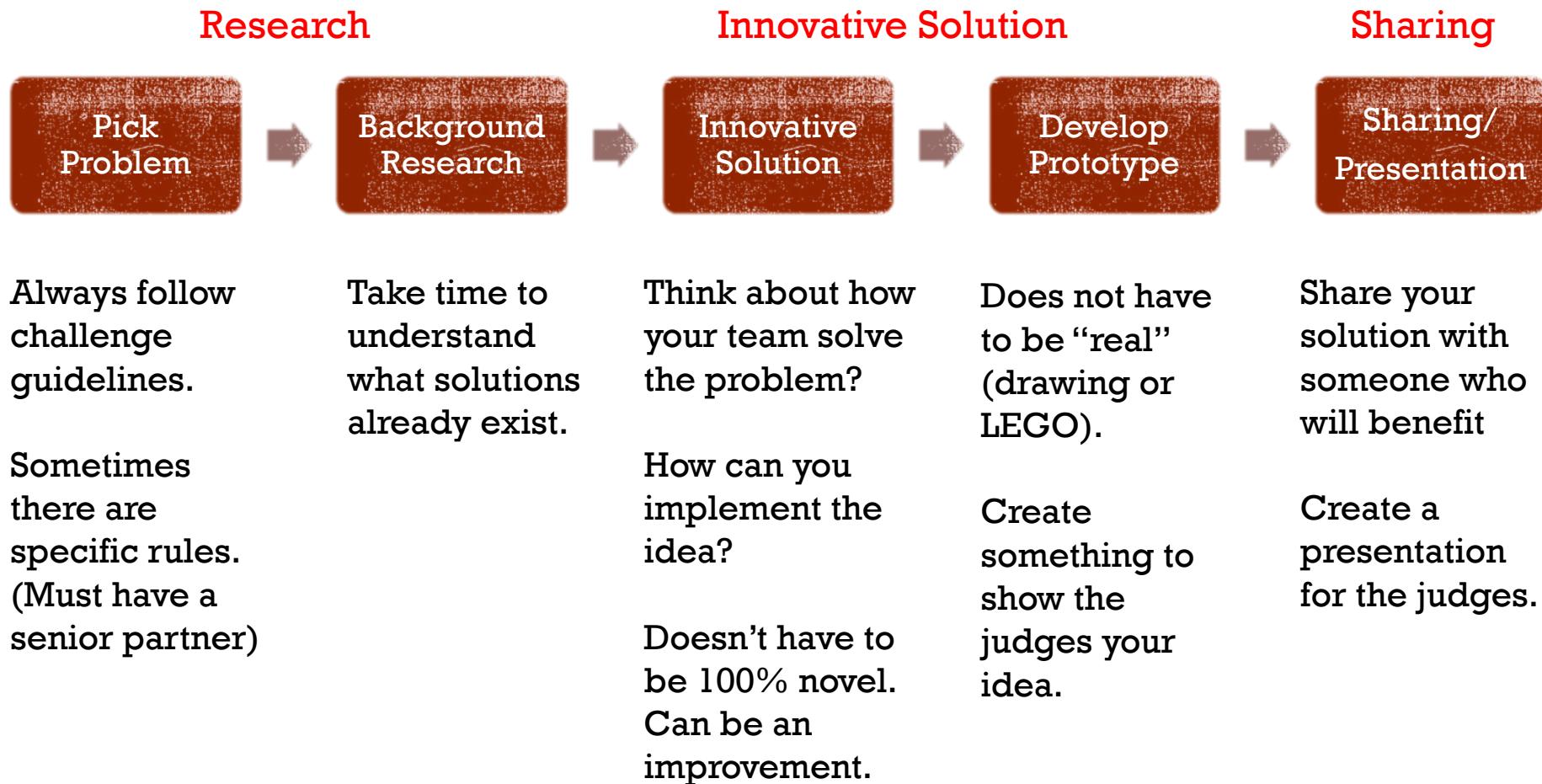
- Develop a solution to your problem and understand what it would take to implement this idea.

■ Presentation

- Share your project with people/organizations
- Create an effective presentation for judges

■ Note: New Rubric for 2017

PROJECT PROCESS: TIPS



TYPES OF PRESENTATIONS

- No one way to present
- Game Show
 - Example: Shark Tank
- Movie/Cartoon Theme
 - Example: Snow White
- Informative Lecture
- Magic Show
- Connected to your team name
 - Example: Star Wars



Photo Credit: Razorback Open, 2015



SAMPLE PROJECTS

- **2011: Food Factor (food safety)**
 - Detecting spoilt milk
- **2012: Senior Solutions (senior citizens)**
 - Helping seniors remember where they left their processio...
- **2013: Nature's Fury (natural disasters)**
 - An early-warning ash detection system for airplanes
- **2014: World Class (education)**
 - A better way to learn to program the EV3 (EV3Lessons.com)
- **2015: Trash Trek (garbage)**
 - A more efficient way to recycle batteries (InvisiSort)
- **2016: Animal Allies (animals)**
 - Bats getting killed by wind turbines



WATCH A SAMPLE PRESENTATION VIDEO NOW

- There are many project videos available on YouTube.
- Encore Performances from World Festival are available online.



Customize
this slide

GLOBAL INNOVATION AWARD

Customize
this slide

- Nominated by local tournament (usually the highest scoring team in Innovative Solution, but can vary in some regions)
- Fill in online application in March
- Top 20 invited to D.C.
- Present to a panel of judges
- Attend workshops on patents and innovation





ROBOT GAME

IMPORTANT ASPECTS OF THE GAME

- Rules changes in recent years and get familiar with some of these terms

- Height
- Junk
- Sprawl
- Touch Penalties
- Base rules about in/out
- Partially in versus fully in

- Scoring
 - Track your own score during the season
 - <http://ev3lessons.com/resources/scorer/>

Sample Scorer

Scorer Timers Saves

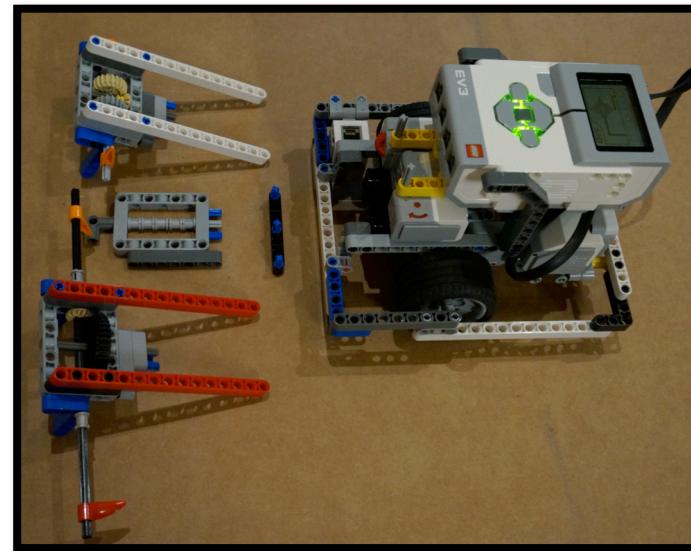
by  EV3Lessons.com
Let's Learn Together

Animal Allies Scorer (v2.0)

	M01 - Shark Shipment: 0 Is the Tank and the Shark completely in Target 1 (Left Box)? <input type="button" value="Yes"/> <input type="button" value="No"/>		M09 - Training and Research: 0 Are the Dog and Trainer completely in the Training and Research Area? <input type="button" value="Yes"/> <input type="button" value="No"/>
	Is the Tank and the Shark completely in Target 2 (Right Box)? <input type="button" value="Yes"/> <input type="button" value="No"/>		Is the Zoologist completely in the Training and Research Area? <input type="button" value="Yes"/> <input type="button" value="No"/>
	Is the Shark only touching the tank floor? <input type="button" value="Yes"/> <input type="button" value="No"/>		How many Manure Samples are completely in the Training and Research Area? <input type="button" value="0"/> <input type="button" value="0"/>
	Note: After Launch, nothing is allowed to touch the Shark except the Tank.		Note: Only one Manure Sample may be Transported at a time
	M02 - Service Dog Action: 0 Is the Warning Fence down? <input type="button" value="Yes"/> <input type="button" value="No"/>		M10 - Beekeeping: 0 Is the Bee on the Beehive and there is no Honey in the Beehive? <input type="button" value="Yes"/> <input type="button" value="No"/>
Points: 0 <input type="button" value="Reset"/>			

TERMS TO KNOW

- A **mission** is one of the approx. 15 tasks that the robot must complete on the FIRST LEGO League table.
- A **Run** (sortie) is every time the robot leaves the base area. During this run, the robot may complete one or more missions.
- A **base robot** is just the main MINDSTORMS robot chassis. The **attachments** are other mechanisms added to the base robot to complete a mission (e.g. an arm)



PICKING MISSIONS

- Each mission has different points, is in a different location, and often is activated differently.
- **Time Limit:** 2 mins 30 seconds
 - Do the greatest number of missions/points you can in this time
- **Beginner Team:**
 - Try to group missions (by area). These might be doable together (in one run)
 - Missions closer to base first
 - Once those missions are reliable, work your way out
- **Intermediate Team**
 - Do missions further away on the game board
 - Combine more missions together
 - See if one attachment might be able to accomplish more than one mission

ROBOT DESIGN RUBRIC

Mechanical Design:

- Durable, efficient, and capable of executing tasks

Programming:

- Clear and concise code that allows the robot to be autonomous and consistent

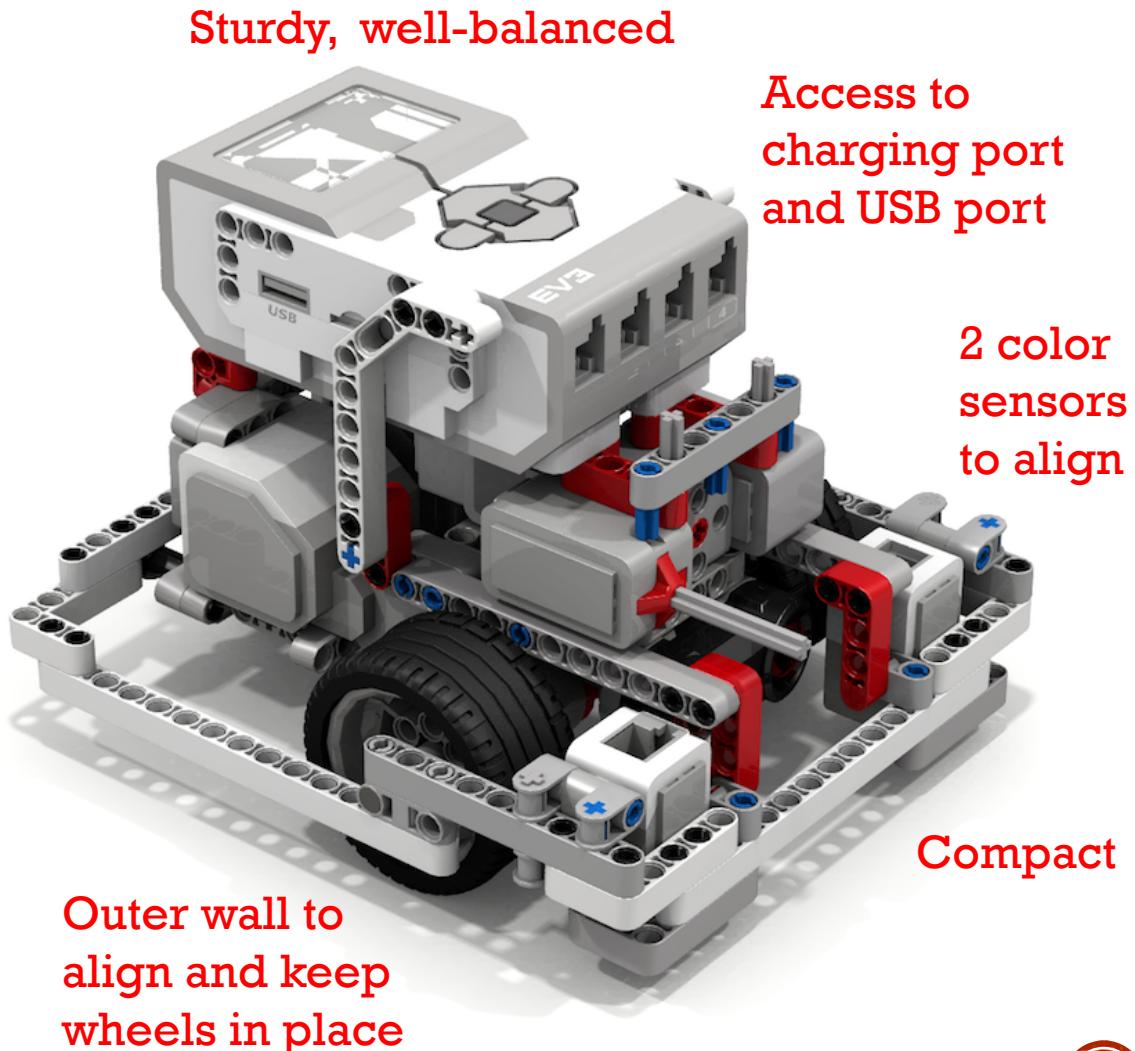
Strategy & Innovation

- Clever robot designs and programming and well developed strategy

Robot Design				Team Number Judging Room																																																																																																														
<p>FLL <i>FIRST LEGO League</i></p> <p>Directions: For each skill area, clearly mark the box that best describes the team's accomplishments. If the team does not demonstrate skill in a particular area, then put an 'X' in the first box for Not Demonstrated (ND). Please provide as many written comments as you can to acknowledge each team's hard work and to help teams improve. When you have completed the evaluation, please circle the awards for which you would like this team to be considered.</p> <table border="1"> <thead> <tr> <th colspan="2"></th> <th>Beginning</th> <th>Developing</th> <th>Accomplished</th> <th>Exemplary</th> </tr> </thead> <tbody> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">Mechanical Design</td> <td>Durability</td> <td colspan="4">Evidence of structural integrity; ability to withstand rigors of competition</td> </tr> <tr> <td>N D</td> <td>quite fragile; breaks a lot repair/modify</td> <td>frequent or significant faults/repairs</td> <td>rare faults/repairs</td> <td>sound construction; no repairs</td> </tr> <tr> <td>Mechanical Efficiency</td> <td colspan="4">Economic use of parts and time; easy to repair and modify</td> </tr> <tr> <td>N D</td> <td>excessive parts or time to repair/modify</td> <td>inefficient parts or time to repair/modify</td> <td>appropriate use of parts and time to repair/modify</td> <td>streamlined use of parts and time to repair/modify</td> </tr> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">Comments:</td> <td>Mechanization</td> <td colspan="4">Ability of robot mechanisms to move or act with appropriate speed, strength and accuracy for intended tasks (propulsion and execution)</td> </tr> <tr> <td>N</td> <td>imbalance of speed, strength and accuracy on most tasks</td> <td>imbalance of speed, strength and accuracy on some tasks</td> <td>appropriate balance of speed, strength and accuracy on most tasks</td> <td>appropriate balance of speed, strength and accuracy on every task</td> </tr> <tr> <td>Programming</td> <td colspan="4">Programs are appropriate for the intended purpose and would achieve consistent results, assuming no mechanical faults</td> </tr> <tr> <td>N D</td> <td>would not achieve purpose AND would be inconsistent</td> <td>would not achieve purpose OR would be inconsistent</td> <td>should achieve purpose repeatedly</td> <td>should achieve purpose every time</td> </tr> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">Comments:</td> <td>Programming Efficiency</td> <td colspan="4">Programs are modular, streamlined, and understandable</td> </tr> <tr> <td>N D</td> <td>excessive code and difficult to understand</td> <td>inefficient code and challenge to understand</td> <td>appropriate code and easy to understand</td> <td>streamlined code and easy for anyone to understand</td> </tr> <tr> <td>Automation/Navigation</td> <td colspan="4">Ability of the robot to move or act as intended using mechanical and/or sensor feedback (with minimal reliance on driver intervention and/or program timing)</td> </tr> <tr> <td>N D</td> <td>frequent driver intervention to aim AND retrieve robot</td> <td>frequent driver intervention to aim OR retrieve robot</td> <td>robot moves/acts as intended repeatedly w/ occasional driver intervention</td> <td>robot moves/acts as intended every time with no driver intervention</td> </tr> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">Comments:</td> <td>Design Process</td> <td colspan="4">Ability to develop and explain improvement cycles where alternatives are considered and narrowed, selections tested, designs improved (applies to programming as well as mechanical design)</td> </tr> <tr> <td>N D</td> <td>organization AND explanation need improvement</td> <td>organization OR explanation need improvement</td> <td>systematic and well-explained</td> <td>systematic, well-explained and well-documented</td> </tr> <tr> <td>Mission Strategy</td> <td colspan="4">Ability to clearly define and describe the team's game strategy</td> </tr> <tr> <td>N D</td> <td>no clear goals AND no clear strategy</td> <td>no clear goals OR no clear strategy</td> <td>clear strategy to accomplish the team's well defined goals</td> <td>clear strategy to accomplish most/all game missions</td> </tr> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">Comments:</td> <td>Innovation</td> <td colspan="4">Creation of new, unique, or unexpected feature(s) (e.g. designs, programs, strategies or applications) that are beneficial in performing the specified tasks</td> </tr> <tr> <td>N D</td> <td>original feature(s) with no added value or potential</td> <td>original feature(s) with some added value or potential</td> <td>original feature(s) with the potential to add significant</td> <td>original feature(s) that add significant value</td> </tr> <tr> <td>Awards Consideration:</td> <td>Mechanical Design</td> <td>Programming</td> <td>Strategy & Innovation</td> </tr> <tr> <td colspan="5"> <small>© 2011 The United States Foundation for Inspiration and Recognition of Science and Technology (FIRST®) and The LEGO Group. Used by special permission. All rights reserved.</small> </td> </tr> </tbody> </table>							Beginning	Developing	Accomplished	Exemplary	Mechanical Design	Durability	Evidence of structural integrity; ability to withstand rigors of competition				N D	quite fragile; breaks a lot repair/modify	frequent or significant faults/repairs	rare faults/repairs	sound construction; no repairs	Mechanical Efficiency	Economic use of parts and time; easy to repair and modify				N D	excessive parts or time to repair/modify	inefficient parts or time to repair/modify	appropriate use of parts and time to repair/modify	streamlined use of parts and time to repair/modify	Comments:	Mechanization	Ability of robot mechanisms to move or act with appropriate speed, strength and accuracy for intended tasks (propulsion and execution)				N	imbalance of speed, strength and accuracy on most tasks	imbalance of speed, strength and accuracy on some tasks	appropriate balance of speed, strength and accuracy on most tasks	appropriate balance of speed, strength and accuracy on every task	Programming	Programs are appropriate for the intended purpose and would achieve consistent results, assuming no mechanical faults				N D	would not achieve purpose AND would be inconsistent	would not achieve purpose OR would be inconsistent	should achieve purpose repeatedly	should achieve purpose every time	Comments:	Programming Efficiency	Programs are modular, streamlined, and understandable				N D	excessive code and difficult to understand	inefficient code and challenge to understand	appropriate code and easy to understand	streamlined code and easy for anyone to understand	Automation/Navigation	Ability of the robot to move or act as intended using mechanical and/or sensor feedback (with minimal reliance on driver intervention and/or program timing)				N D	frequent driver intervention to aim AND retrieve robot	frequent driver intervention to aim OR retrieve robot	robot moves/acts as intended repeatedly w/ occasional driver intervention	robot moves/acts as intended every time with no driver intervention	Comments:	Design Process	Ability to develop and explain improvement cycles where alternatives are considered and narrowed, selections tested, designs improved (applies to programming as well as mechanical design)				N D	organization AND explanation need improvement	organization OR explanation need improvement	systematic and well-explained	systematic, well-explained and well-documented	Mission Strategy	Ability to clearly define and describe the team's game strategy				N D	no clear goals AND no clear strategy	no clear goals OR no clear strategy	clear strategy to accomplish the team's well defined goals	clear strategy to accomplish most/all game missions	Comments:	Innovation	Creation of new, unique, or unexpected feature(s) (e.g. designs, programs, strategies or applications) that are beneficial in performing the specified tasks				N D	original feature(s) with no added value or potential	original feature(s) with some added value or potential	original feature(s) with the potential to add significant	original feature(s) that add significant value	Awards Consideration:	Mechanical Design	Programming	Strategy & Innovation	<small>© 2011 The United States Foundation for Inspiration and Recognition of Science and Technology (FIRST®) and The LEGO Group. Used by special permission. All rights reserved.</small>				
		Beginning	Developing	Accomplished	Exemplary																																																																																																													
Mechanical Design	Durability	Evidence of structural integrity; ability to withstand rigors of competition																																																																																																																
	N D	quite fragile; breaks a lot repair/modify	frequent or significant faults/repairs	rare faults/repairs	sound construction; no repairs																																																																																																													
	Mechanical Efficiency	Economic use of parts and time; easy to repair and modify																																																																																																																
N D	excessive parts or time to repair/modify	inefficient parts or time to repair/modify	appropriate use of parts and time to repair/modify	streamlined use of parts and time to repair/modify																																																																																																														
Comments:	Mechanization	Ability of robot mechanisms to move or act with appropriate speed, strength and accuracy for intended tasks (propulsion and execution)																																																																																																																
	N	imbalance of speed, strength and accuracy on most tasks	imbalance of speed, strength and accuracy on some tasks	appropriate balance of speed, strength and accuracy on most tasks	appropriate balance of speed, strength and accuracy on every task																																																																																																													
	Programming	Programs are appropriate for the intended purpose and would achieve consistent results, assuming no mechanical faults																																																																																																																
N D	would not achieve purpose AND would be inconsistent	would not achieve purpose OR would be inconsistent	should achieve purpose repeatedly	should achieve purpose every time																																																																																																														
Comments:	Programming Efficiency	Programs are modular, streamlined, and understandable																																																																																																																
	N D	excessive code and difficult to understand	inefficient code and challenge to understand	appropriate code and easy to understand	streamlined code and easy for anyone to understand																																																																																																													
	Automation/Navigation	Ability of the robot to move or act as intended using mechanical and/or sensor feedback (with minimal reliance on driver intervention and/or program timing)																																																																																																																
N D	frequent driver intervention to aim AND retrieve robot	frequent driver intervention to aim OR retrieve robot	robot moves/acts as intended repeatedly w/ occasional driver intervention	robot moves/acts as intended every time with no driver intervention																																																																																																														
Comments:	Design Process	Ability to develop and explain improvement cycles where alternatives are considered and narrowed, selections tested, designs improved (applies to programming as well as mechanical design)																																																																																																																
	N D	organization AND explanation need improvement	organization OR explanation need improvement	systematic and well-explained	systematic, well-explained and well-documented																																																																																																													
	Mission Strategy	Ability to clearly define and describe the team's game strategy																																																																																																																
N D	no clear goals AND no clear strategy	no clear goals OR no clear strategy	clear strategy to accomplish the team's well defined goals	clear strategy to accomplish most/all game missions																																																																																																														
Comments:	Innovation	Creation of new, unique, or unexpected feature(s) (e.g. designs, programs, strategies or applications) that are beneficial in performing the specified tasks																																																																																																																
	N D	original feature(s) with no added value or potential	original feature(s) with some added value or potential	original feature(s) with the potential to add significant	original feature(s) that add significant value																																																																																																													
	Awards Consideration:	Mechanical Design	Programming	Strategy & Innovation																																																																																																														
<small>© 2011 The United States Foundation for Inspiration and Recognition of Science and Technology (FIRST®) and The LEGO Group. Used by special permission. All rights reserved.</small>																																																																																																																		

ROBOT DESIGN TIPS

- DroidBot is recommended by FIRST Steps (curriculum written by FIRST)
- Link for FIRST Steps <http://info.firstinspires.org/fllfirststepsrequest>
- Can download design from EV3Lessons
- Consider adding these features basic to your robot



LEARNING TO PROGRAM: EV3LESSONS.COM

The image shows a screenshot of the EV3Lessons.com website. It features a header with the site's name in large, bold, black letters. Below the header, there are two main sections of content, each with its own title and list of lessons.

Left Section (Programming Lessons):

- Header:** Programming Lessons
- Text:** EV3Lessons has tested and approved all lessons in Beginner, Intermediate, Advanced, Beyond, and Workshops. If you use any of the lessons in your own classrooms/workshops, or use any techniques/code presented on this site in a contest, you must credit the original author for the work/idea.
- Filter Buttons:** All, Beginner, Intermediate, Advanced, Beyond, WRO
- Search Bar:** Search: Go!
- Lessons:**
 - How to use these lessons
 - Build a Base Robot
 - Updating Software and Firmware
 - Introduction to Brick and Software
 - Common Brick Issues
 - Port View
 - Moving Straight
 - Pseudocode
 - Basic Turning
 - Displaying Text and Graphics
 - Custom Images and Sounds
 - Introduction to Touch Sensor

Right Section (Programming Lessons):

- Header:** Programming Lessons
- Text:** EV3Lessons has tested and approved all lessons in Beginner, Intermediate, Advanced, Beyond, and Workshops. If you use any of the lessons in your own classrooms/workshops, or use any techniques/code presented on this site in a contest, you must credit the original author for the work/idea.
- Filter Buttons:** All, Beginner, Intermediate, Advanced, Beyond, WRO
- Search Bar:** Search: Go!
- Lessons:**
 - Basic Ultrasonic Wall Follower
 - Brick Buttons as Sensors
 - Data Wires
 - My Blocks with Inputs or Outputs
 - Moving with My Blocks
 - Turning with My Blocks
 - Color Line Follower with My Blocks
 - Infrared Sensor
 - Debugging Techniques
 - Move Blocks
 - Reliability Techniques
 - Parallel Beam Synchronization
 - Arrays
 - Introduction to Proportional Control
 - Proportional Line Follower
 - Proportional Control with the Sound Sensor
 - Ramping Up
 - Introduction to Gyro Sensor
 - Gyro Sensor - Turns
 - Squaring on Lines
 - Stall Detection
 - Menu System
 - Data Logging

RECOMMENDED PROGRAMMING CONCEPTS TO LEARN

▪ Beginner Team

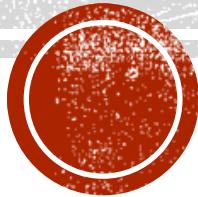
- Move Until a Color (a line on the mat)
- Move Until Touch (wall or mission model)
- Move Until Ultrasonic (a mission model)
- Loops and Switches
- Comments in code
- Basic Line Follower

▪ Intermediate Team

- Using My Blocks (reusable code blocks)
- Align on a Line/Squaring on a Line (increasing reliability)
- Parallel Beams
- Intermediate-level Line Follower (3-state, proportional)

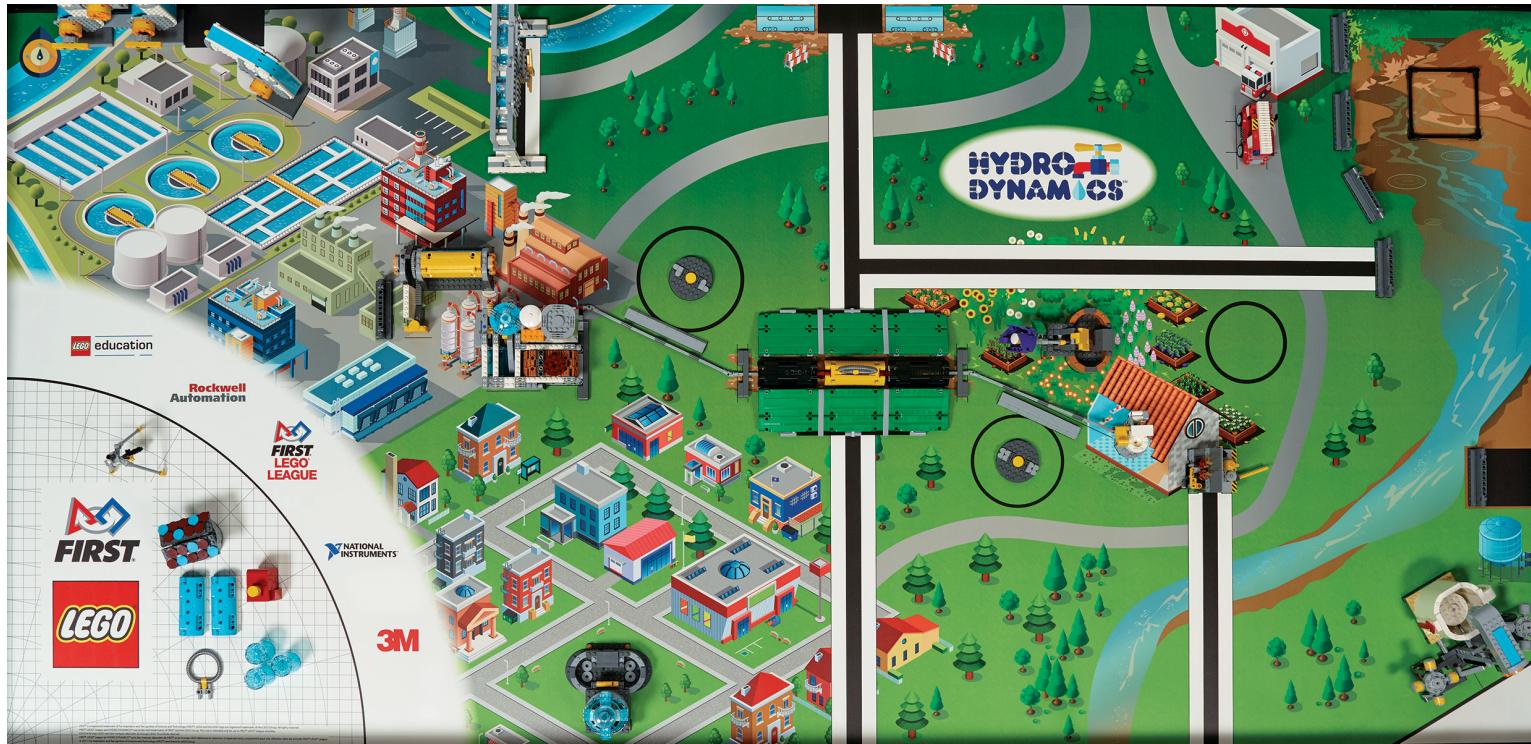


RELIABILITY



HOW CAN YOU INCREASE RELIABILITY?

- Consistent aligning in base
- Frequent aligning during a run

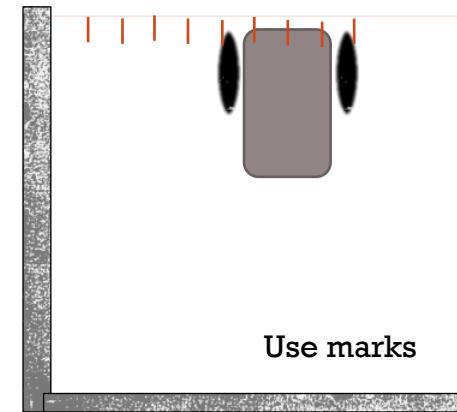
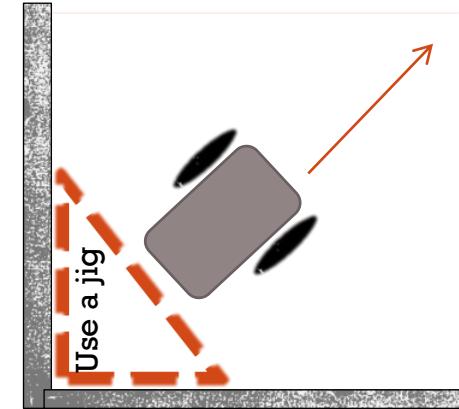


STARTING POINTS IN BASE ARE CRITICAL

- In FIRST LEGO League, teams need to figure out where to start in base
 - Jigs: a LEGO ruler/wall that your robot can align against them in base
 - Same start each time: pick one spot and start there no matter what the mission for easy starts
 - Marks/Radial lines: Use the marks to pick a starting spot for each run
 - Words: Base has words. If you aren't near an inch mark, pick a word or letter to start on.



Mission



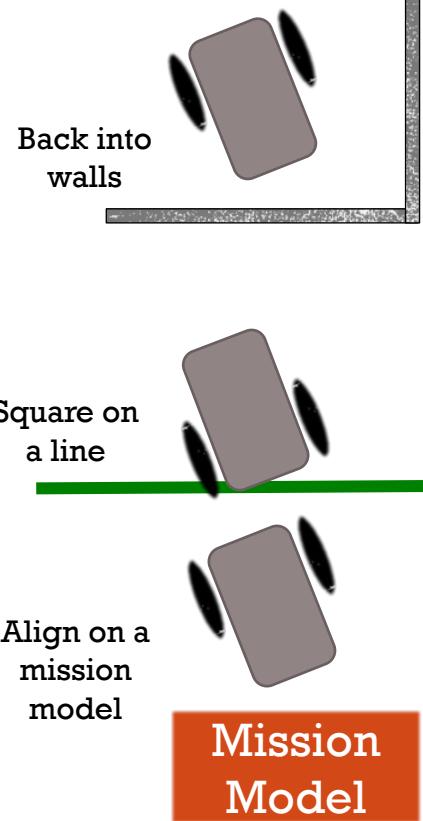
ERRORS ACCUMULATE OVER TIME

- By the time you get to the far side of the table, you are no longer in the right position
- Solution: Repeat alignment techniques multiple times in a run for better reliability (see next slide)



WHERE ARE YOU ON THE FLL TABLE?

- Consider these alignment strategies that are commonly used:
 - Move until a sensor reading**— E.g., travel until you find a line so you know where you are on the mat (See Beginner: Color, Ultrasonic and Touch Sensors)
 - Align on walls/mission models** – deliberately back into a wall/model to straighten out (note: You may stall doing this – Tip: use move seconds or a touch sensor)
 - Square/Align on lines** –If you are moving angled, you can straighten out whenever you see a line. (See Advanced: Squaring Lesson)

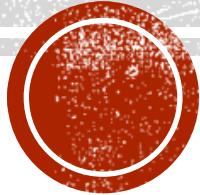


PROGRAMMING: WHY USE SENSORS

- Using sensors in FIRST LEGO League is very important (even in your rookie year)
- Sensors improve reliability
- Sensors can help you know where you are during a run



MOVE UNTIL



MOVE UNTIL

- Move Until is very valuable in FLL:
 - A black line (color)
 - A mission model (touch)
 - A distance (ultrasonic)



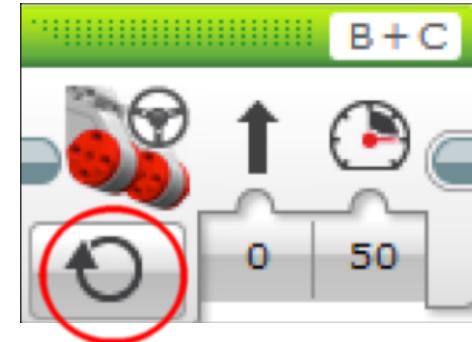
MAKING THE ROBOT MOVE

What would happen if you placed a Move Steering Block and left the motor “On”?

Would the robot...

- 1) Move?
- 2) Move for a little while?
- 3) Not move at all?

ANS. Not move at all.

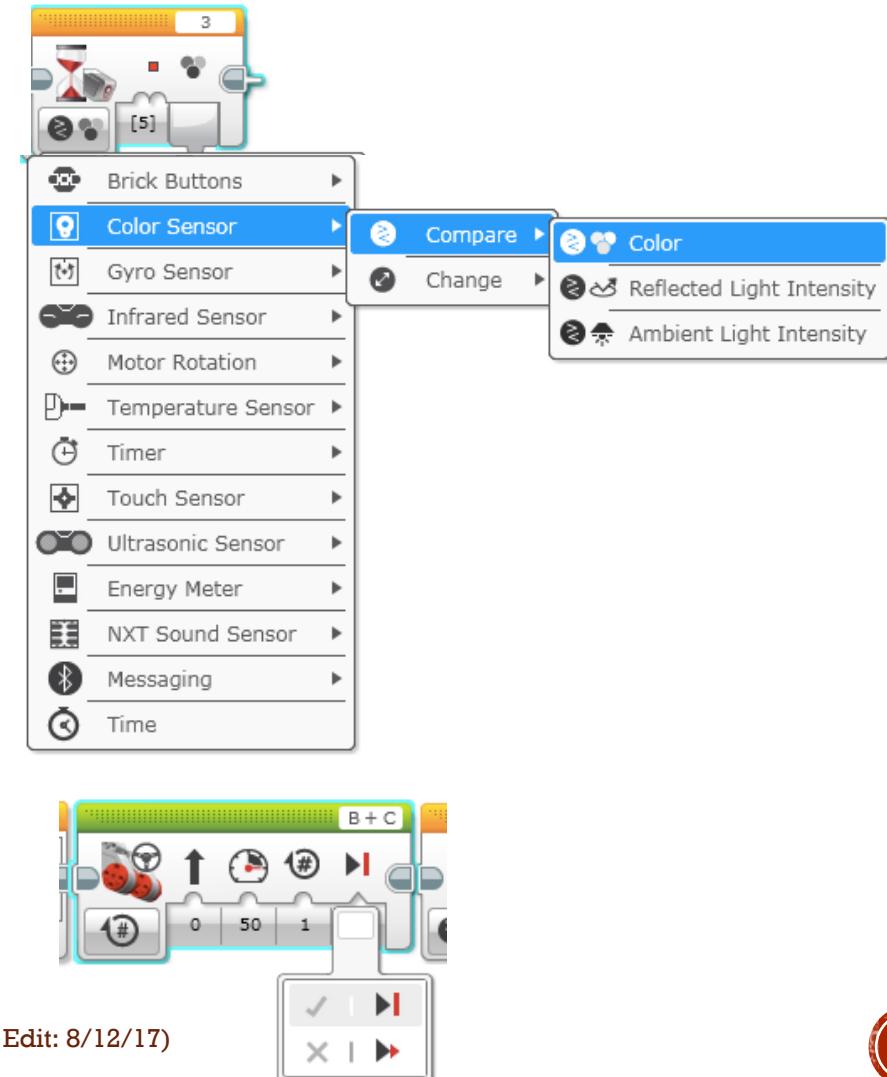


Rookie Tip: Motor On needs to be followed by another block (e.g. Wait Block)

What does Motor Off do?

COLOR SENSOR CHALLENGE

- Make the robot move up to a black 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



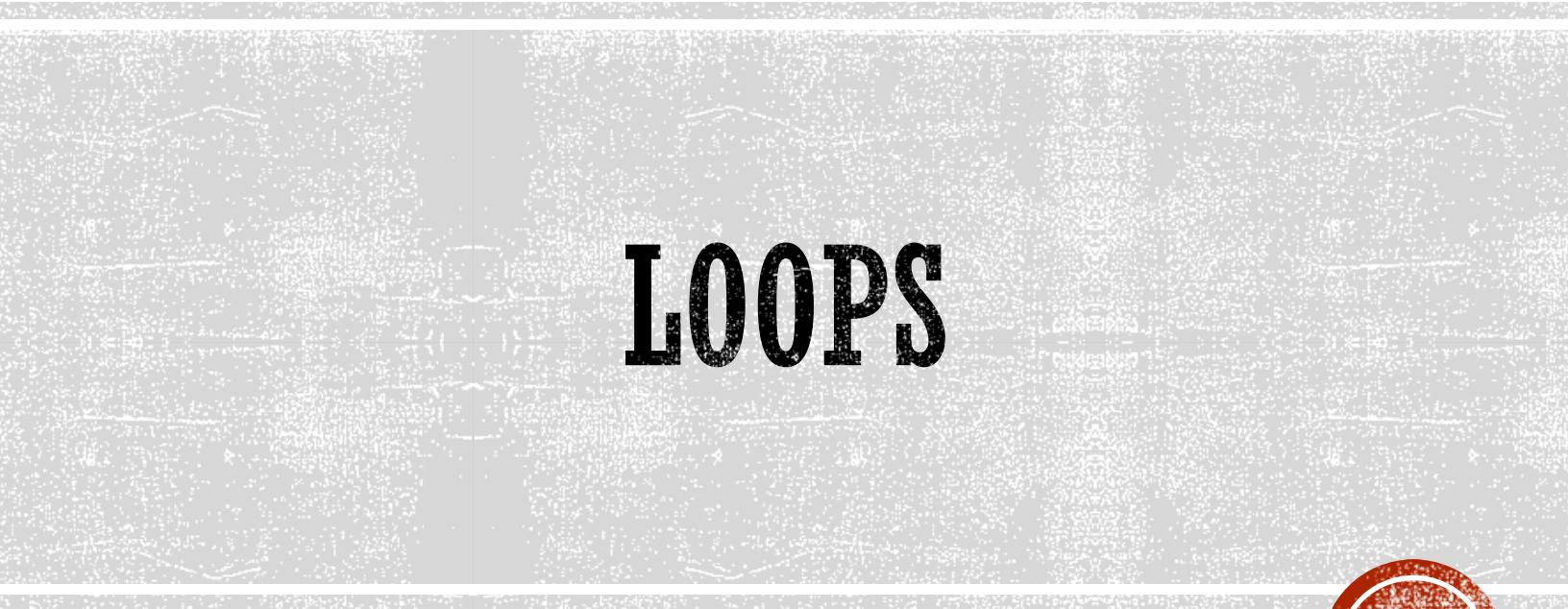
Wait until Color is Black (#1)

Copyright 2017, EV3Lessons (Last Edit: 8/12/17)

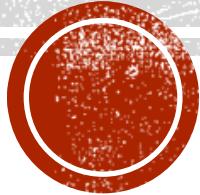
FINISH



START

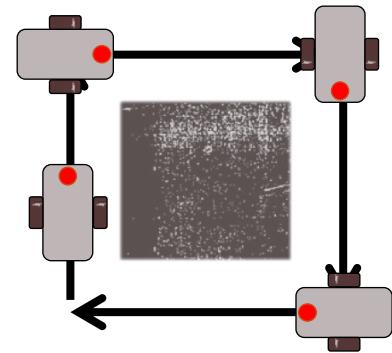


LOOPS



REPEATING AN ACTION

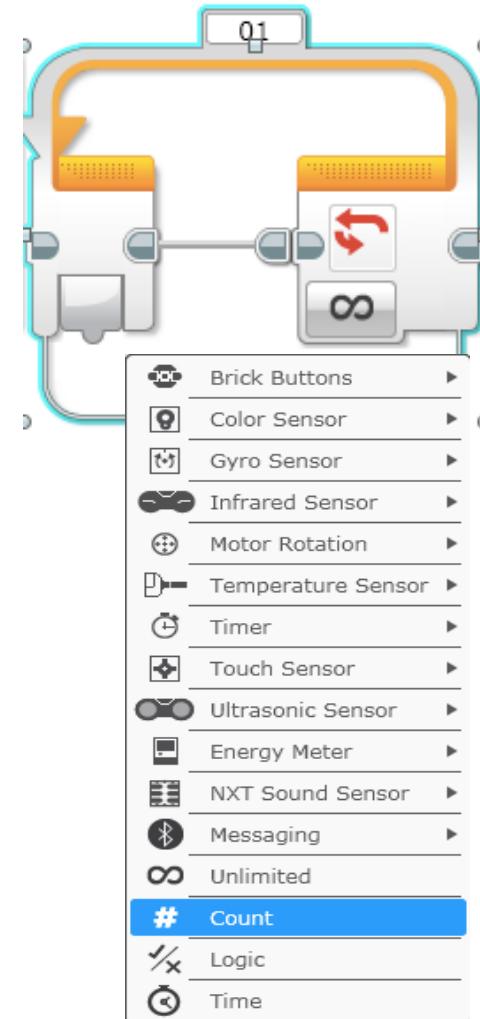
- Let's say we want the robot to repeat an action over and over again.
- Would you just copy the block multiple times?
 - Sure, that could work!
- What if I want to repeat that block forever?
 - Now what?



Loops

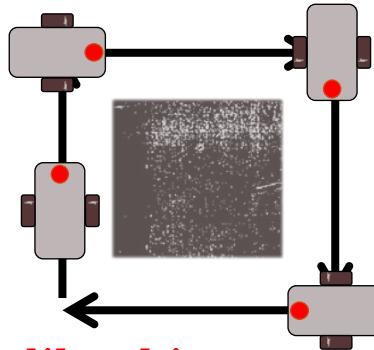


- Loops make repeating a task multiple times easy
- The added benefit is that a loop can end whenever you want (a specific number of times, run forever, a specific condition, etc)

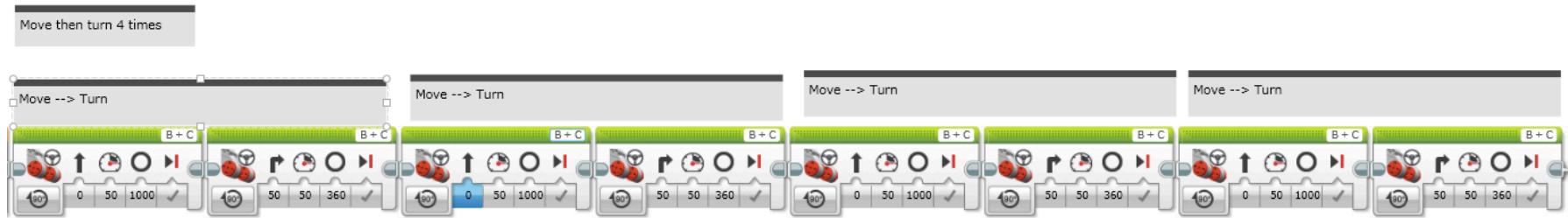


LOOP CHALLENGE

- Challenge: Write a program to go around a box once.



- The simple way is to code it like this:



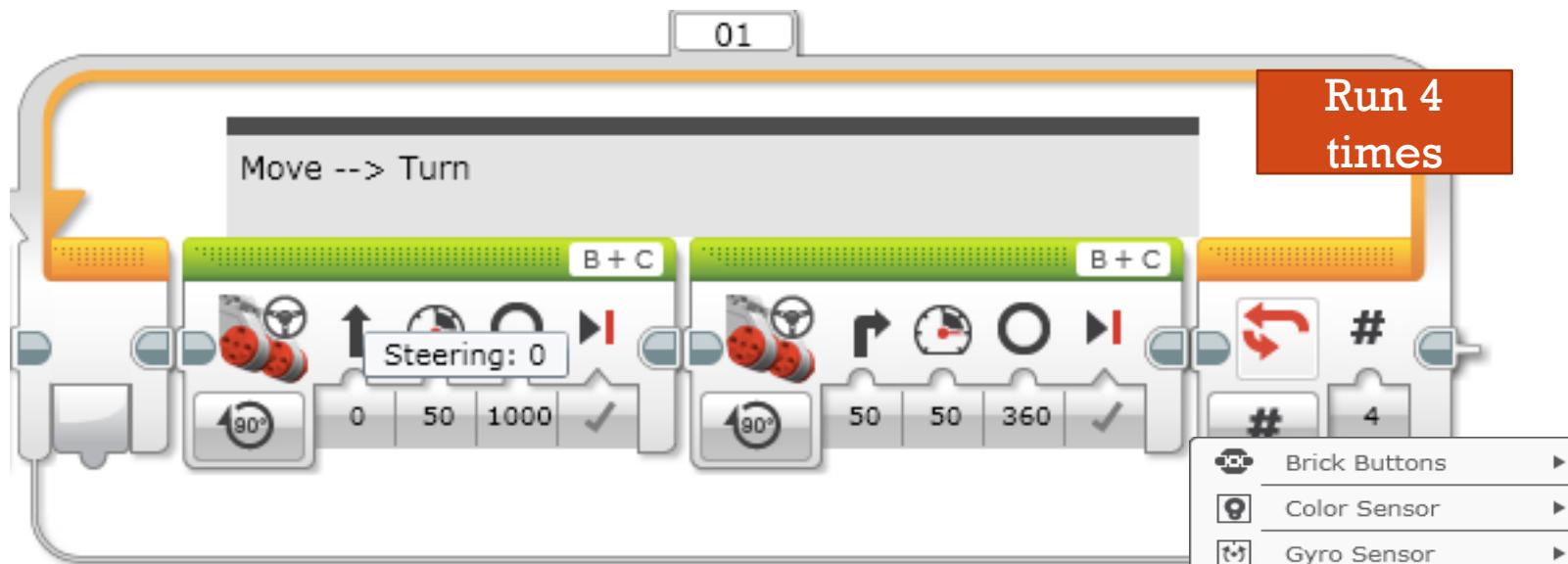
- Use a loop to improve the code

LOOP CHALLENGE SOLUTION

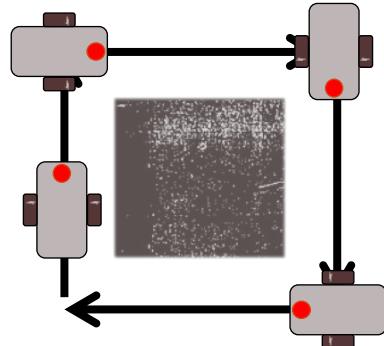
01

Move --> Turn

Run 4 times



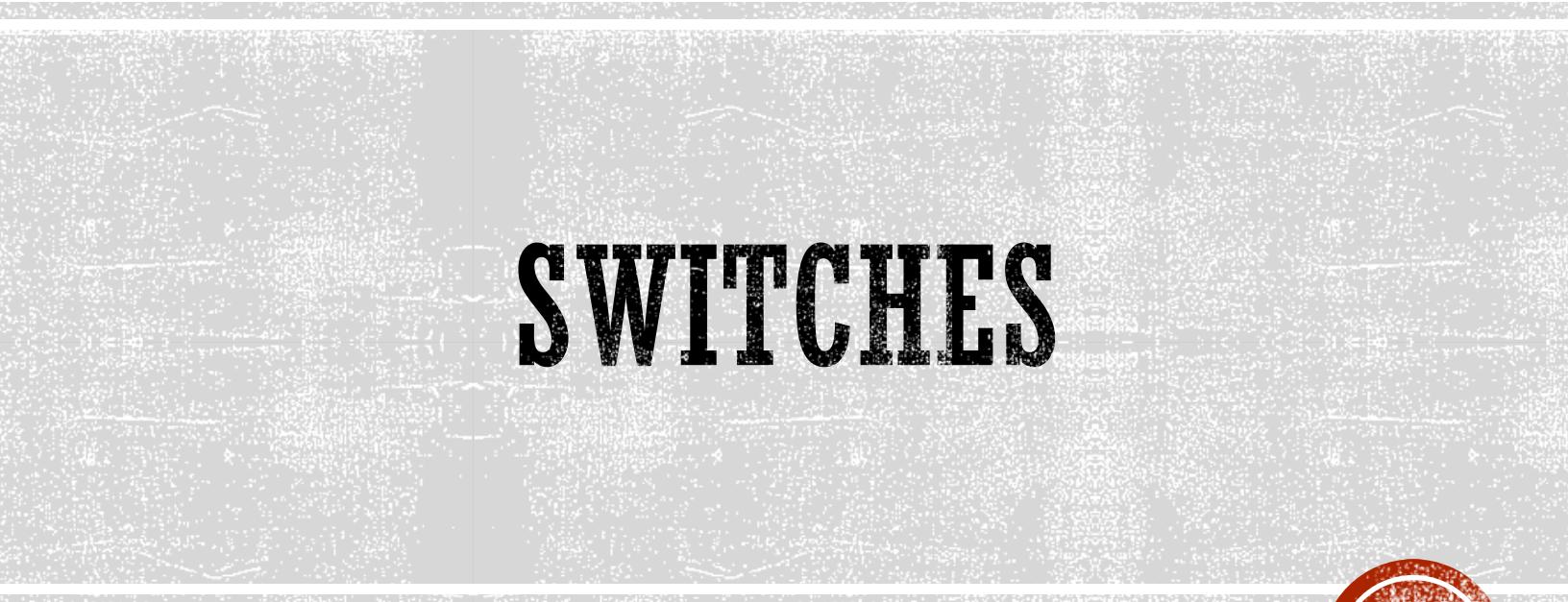
The EV3 script titled "Move --> Turn" consists of a sequence of four parallel loops. Each loop starts with a "Move" block (steering 0) followed by a "Turn" block (90°). The first two loops have a "Steering: 0" value of 0, while the third and fourth loops have a "Steering: 0" value of 50. A "Run 4 times" control block at the end of the sequence triggers the four loops sequentially.



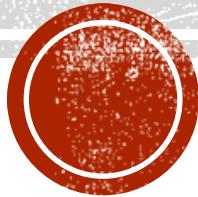
The robot setup diagram shows a four-wheeled EV3 robot. The front-left and rear-right wheels are connected to a single motor, and the front-right and rear-left wheels are connected to another single motor. This creates a differential drive configuration where the robot can turn in place.

- Brick Buttons
- Color Sensor
- Gyro Sensor
- Infrared Sensor
- Motor Rotation
- Temperature Sensor
- Timer
- Touch Sensor
- Ultrasonic Sensor
- Energy Meter
- NXT Sound Sensor
- Messaging
- Unlimited
- # Count
- Logic
- Time

Copyright 2017, EV3Lessons (Last Edit: 8/12/17)



SWITCHES

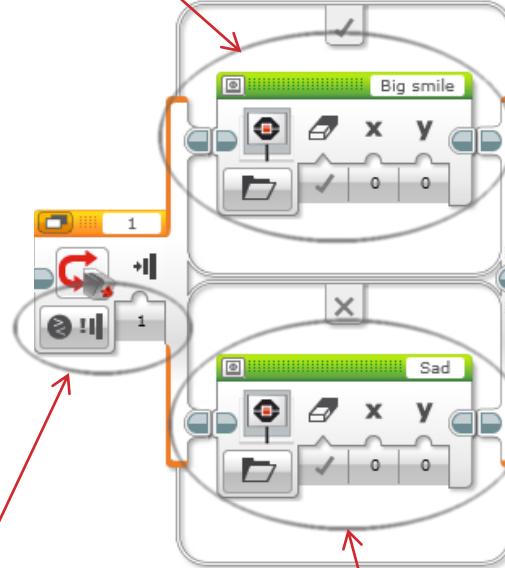


SWITCH BLOCKS



- Asking the robot a question and doing something different based on the answer
 - Example: Does the robot see a line? Or not?
- Basically a YES/NO QUESTION
- Switch blocks are found in the orange/flow tab

Run this code if the answer is yes



The question being asked: is the touch sensor pressed

Run this code if the answer is no

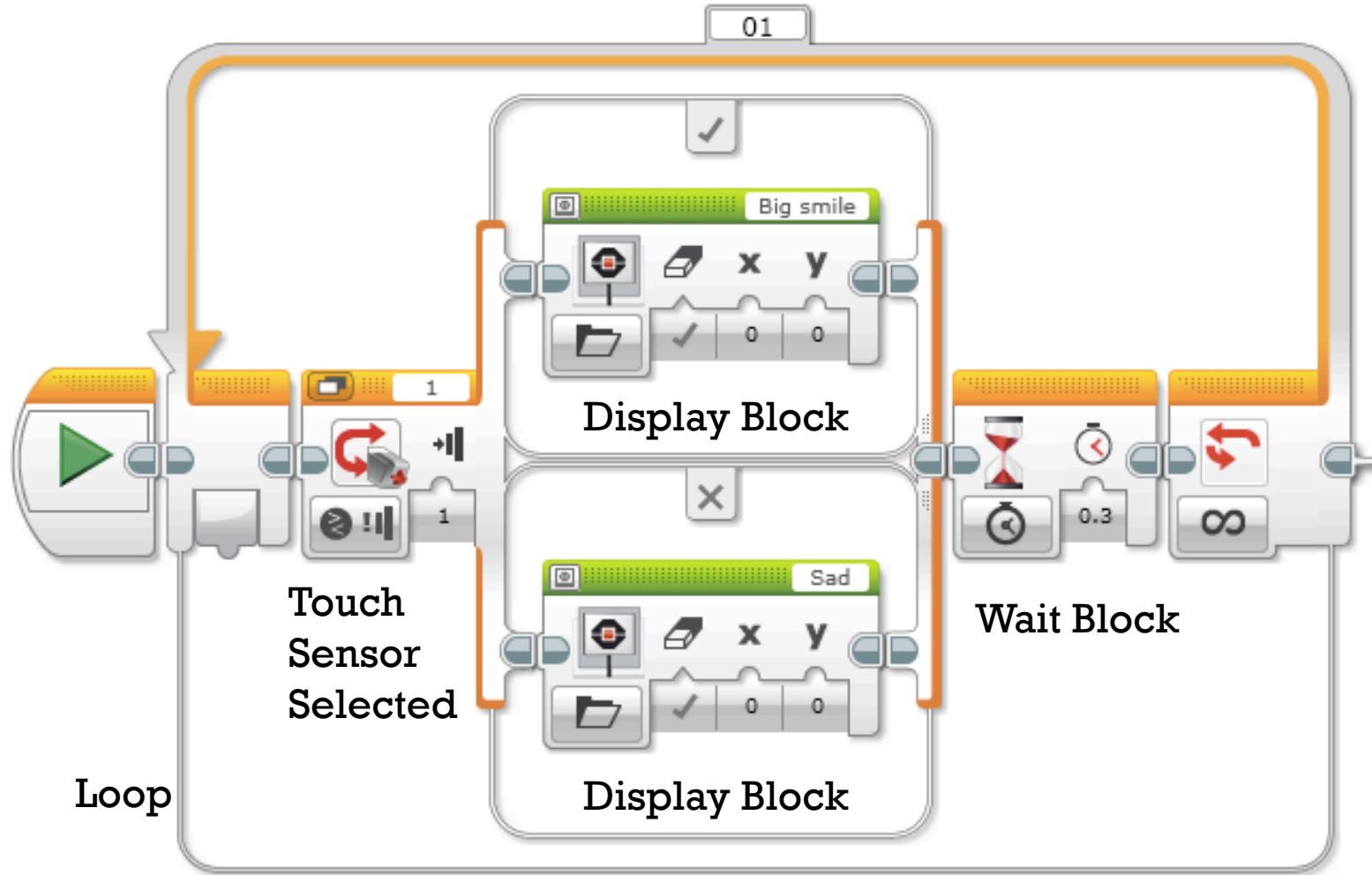
SWITCH BLOCK CHALLENGE 1



- **Challenge:** Write a program that changes the display based on if the touch sensor is pressed or not pressed.
- If pressed, your EV3 is happy! Display a smiley face. If not pressed, the EV3 is sad! Display a sad face.
- **Hint:** You will need to use the display block, loops and switch blocks!



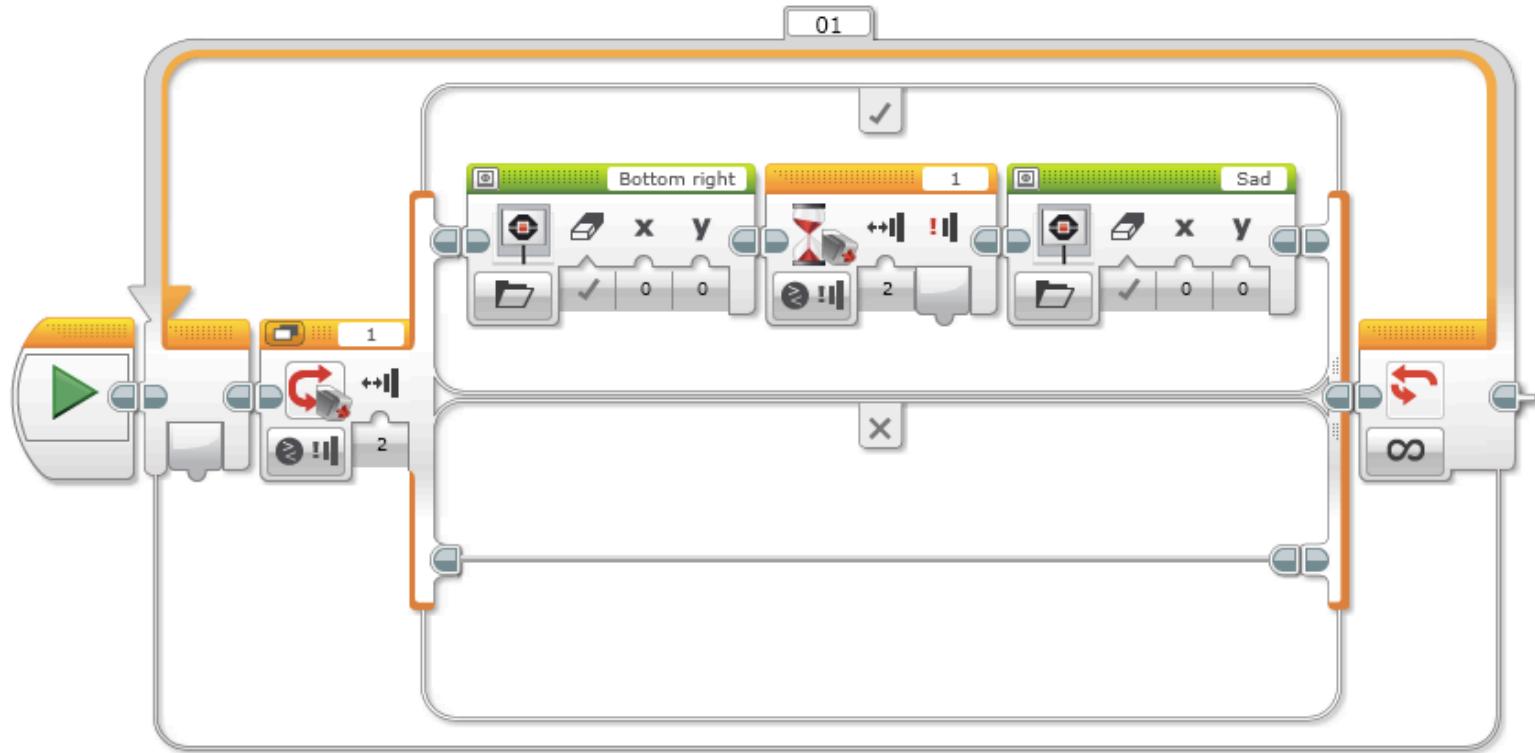
CHALLENGE 1 SOLUTION



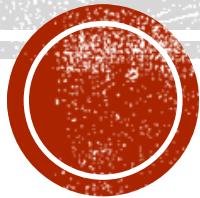
SWITCH BLOCK CHALLENGE 2

- Can you write a program that displays big eyeballs if you touch it once and a sad face if you touch it a second time and toggles back and forth.

CHALLENGE 2 SOLUTION



BASIC LINE FOLLOWER



LESSON OBJECTIVES

1. Learn how humans and robots follow lines
2. Learn how to get a robot to follow a line using Color Mode on the EV3 Color Sensor
3. Learn how to follow a line until a sensor is activated
4. Learn how to follow a line for a particular distance
5. Learn how to combine sensors, loops and switches

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 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!



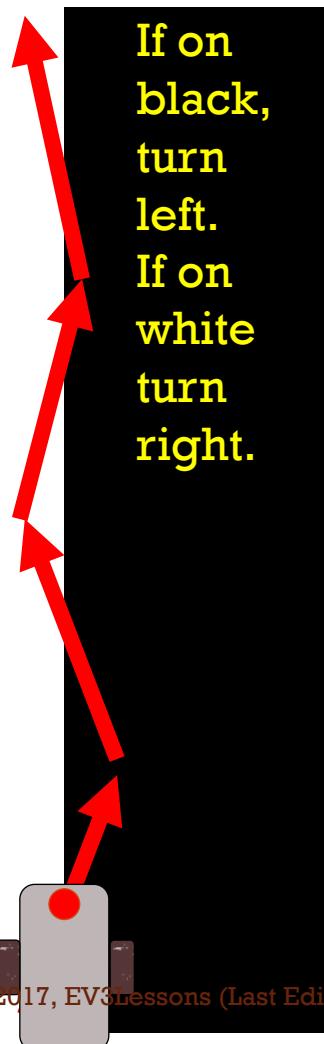
LINE FOLLOWING: ROBOT STYLE

- 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!

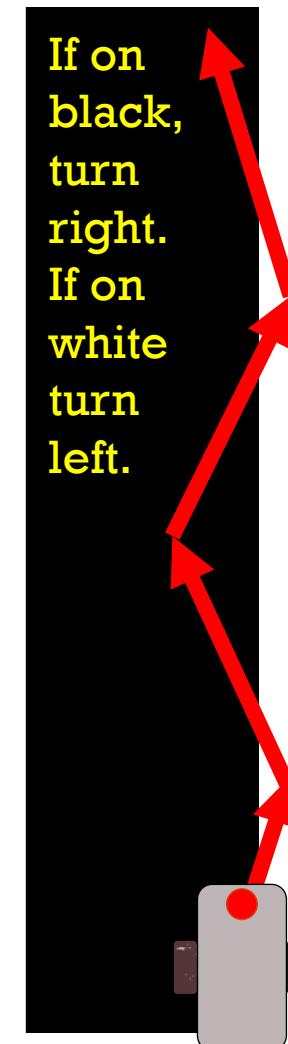


ROBOT LINE FOLLOWING HAPPENS ON THE EDGES

Left side line following



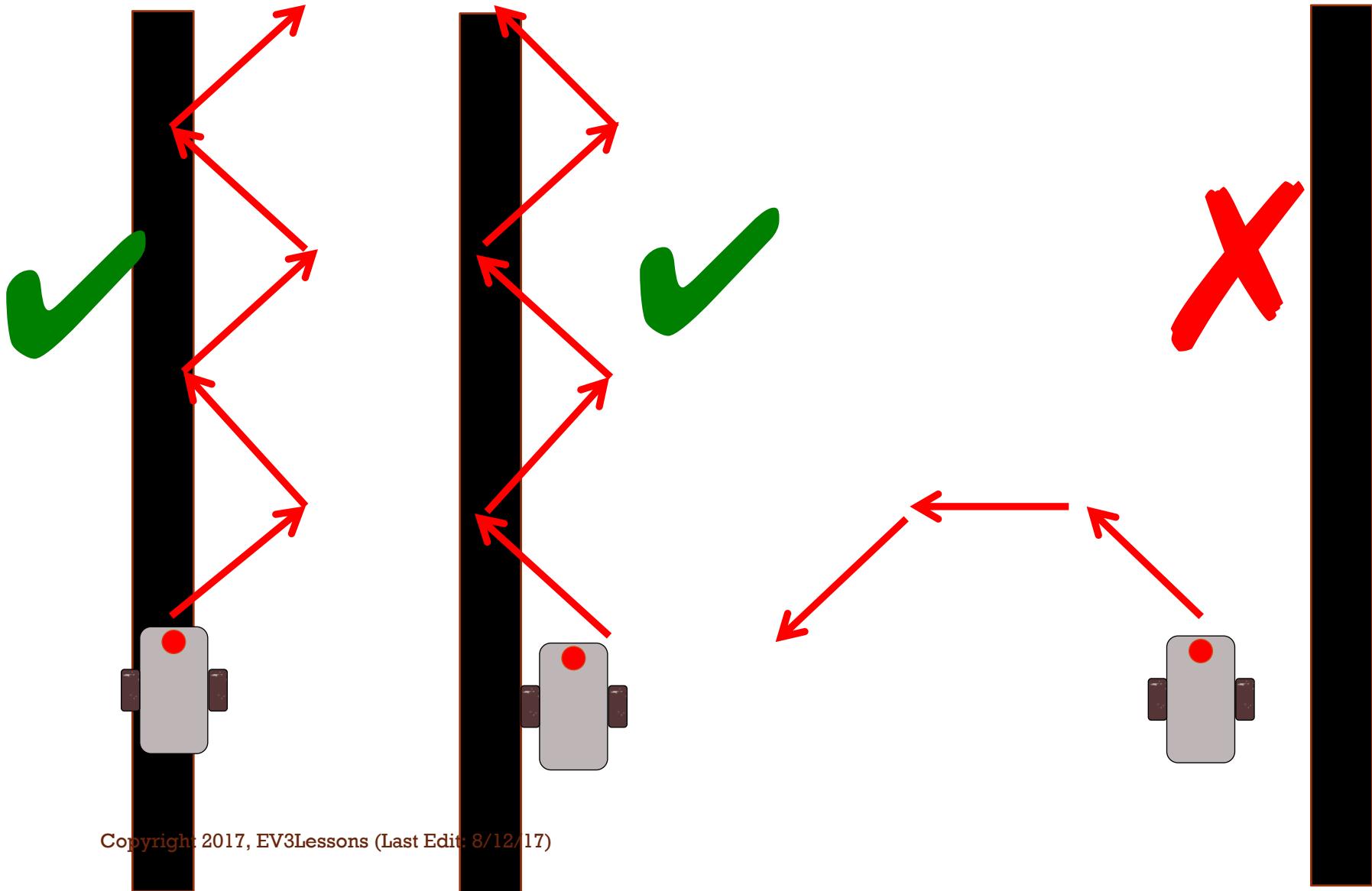
Right side line following



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

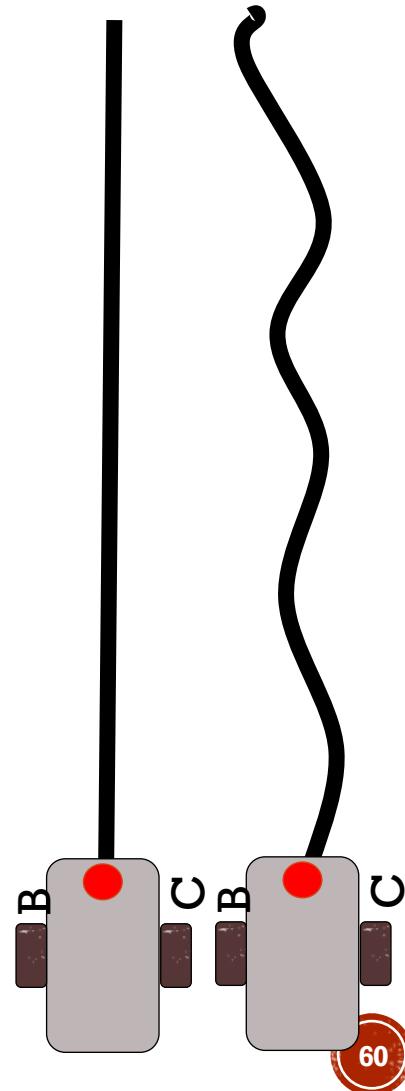
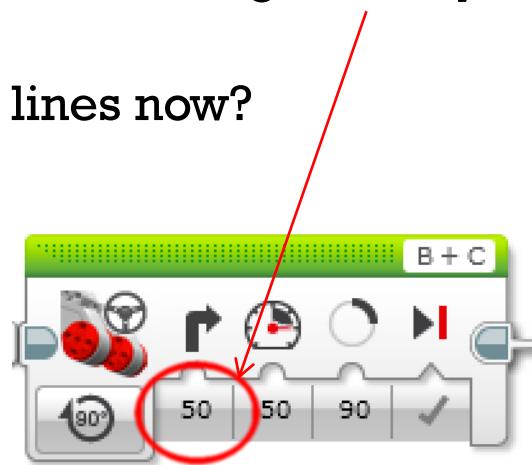
The answer depends on what side of the line you are following!

STARTING THE ROBOT ON THE CORRECT SIDE

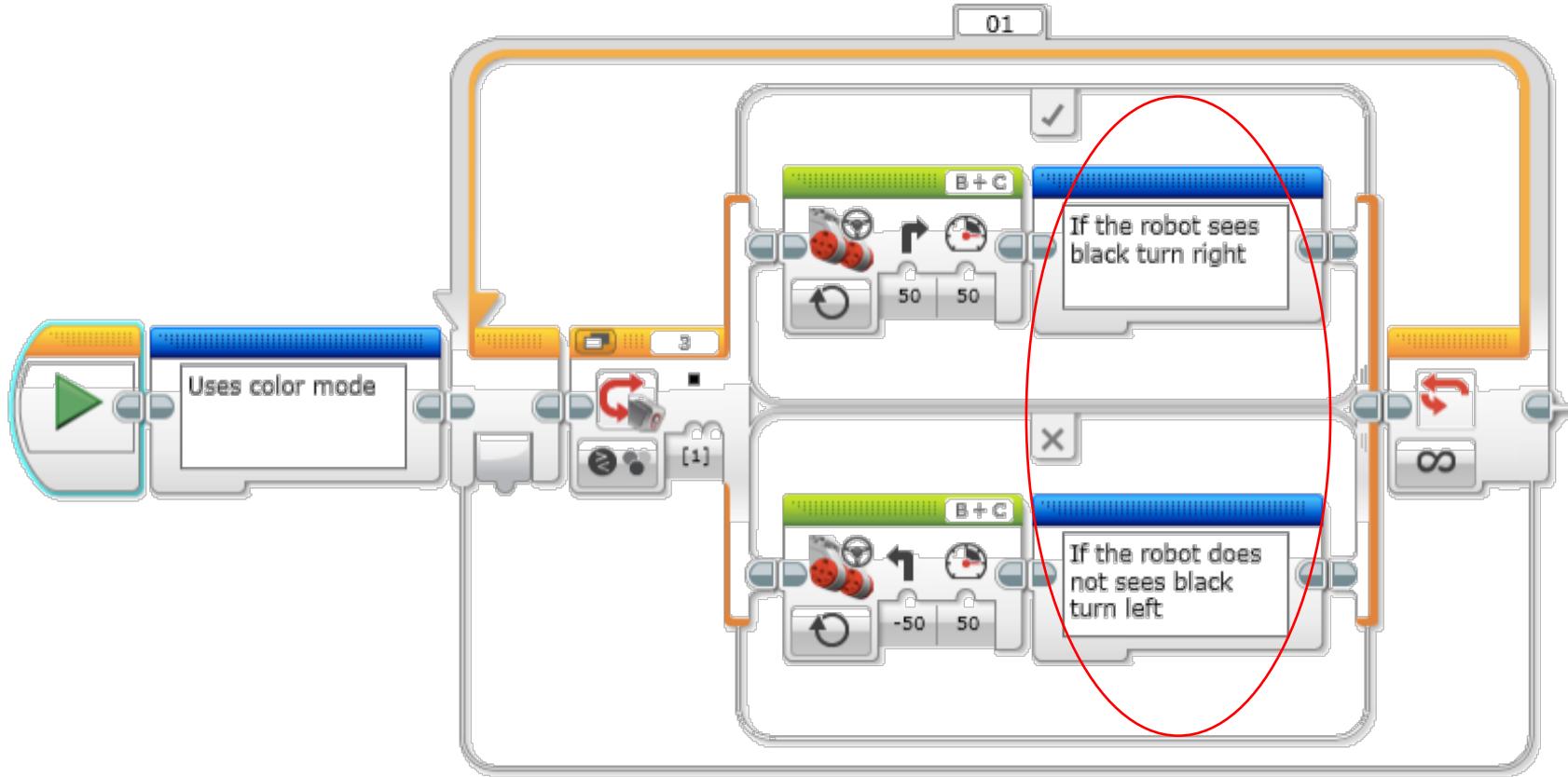


LINE FOLLOWER CHALLENGE 1

- **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?

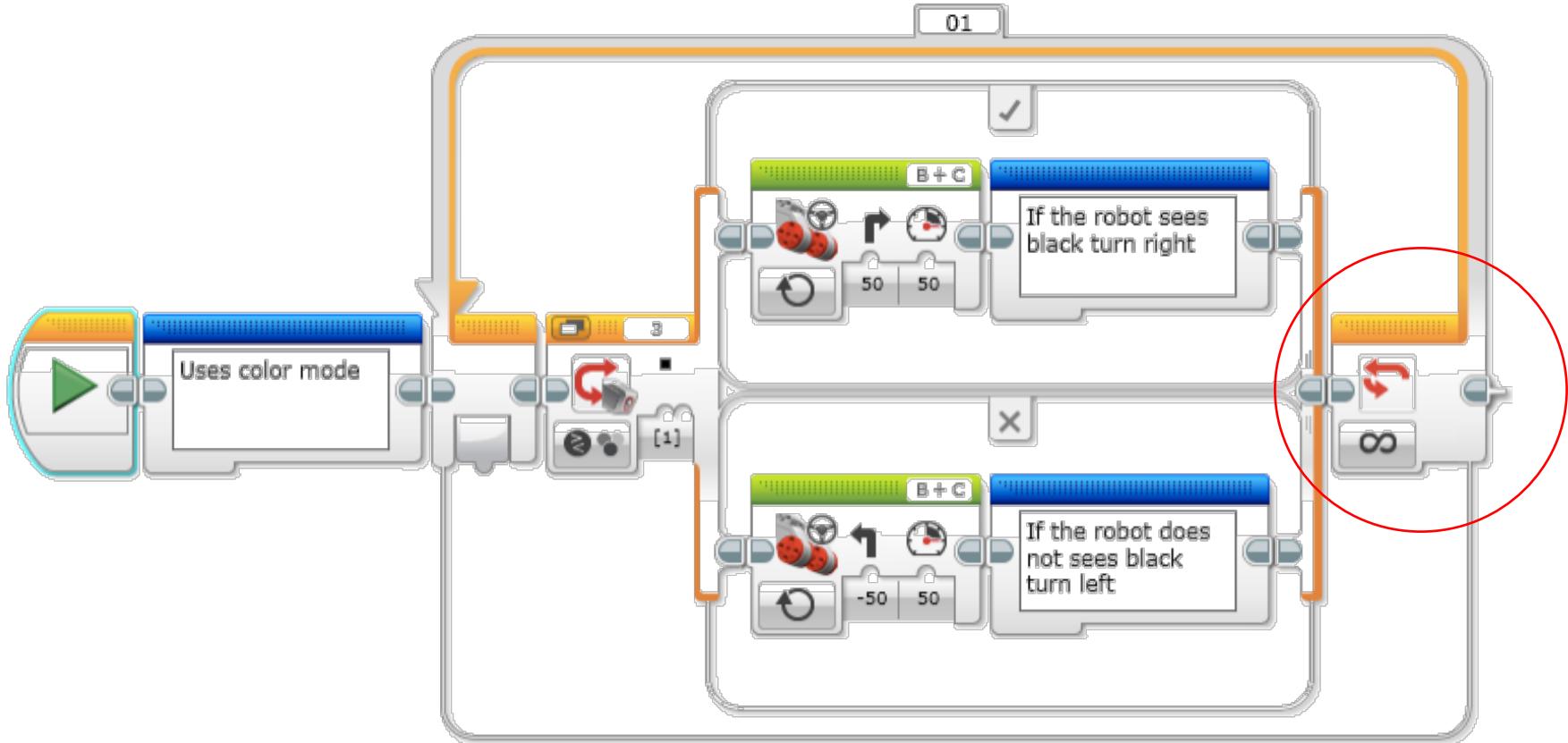


LINE FOLLOWING CHALLENGE SOLUTION



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

CHALLENGE 1 SOLUTION



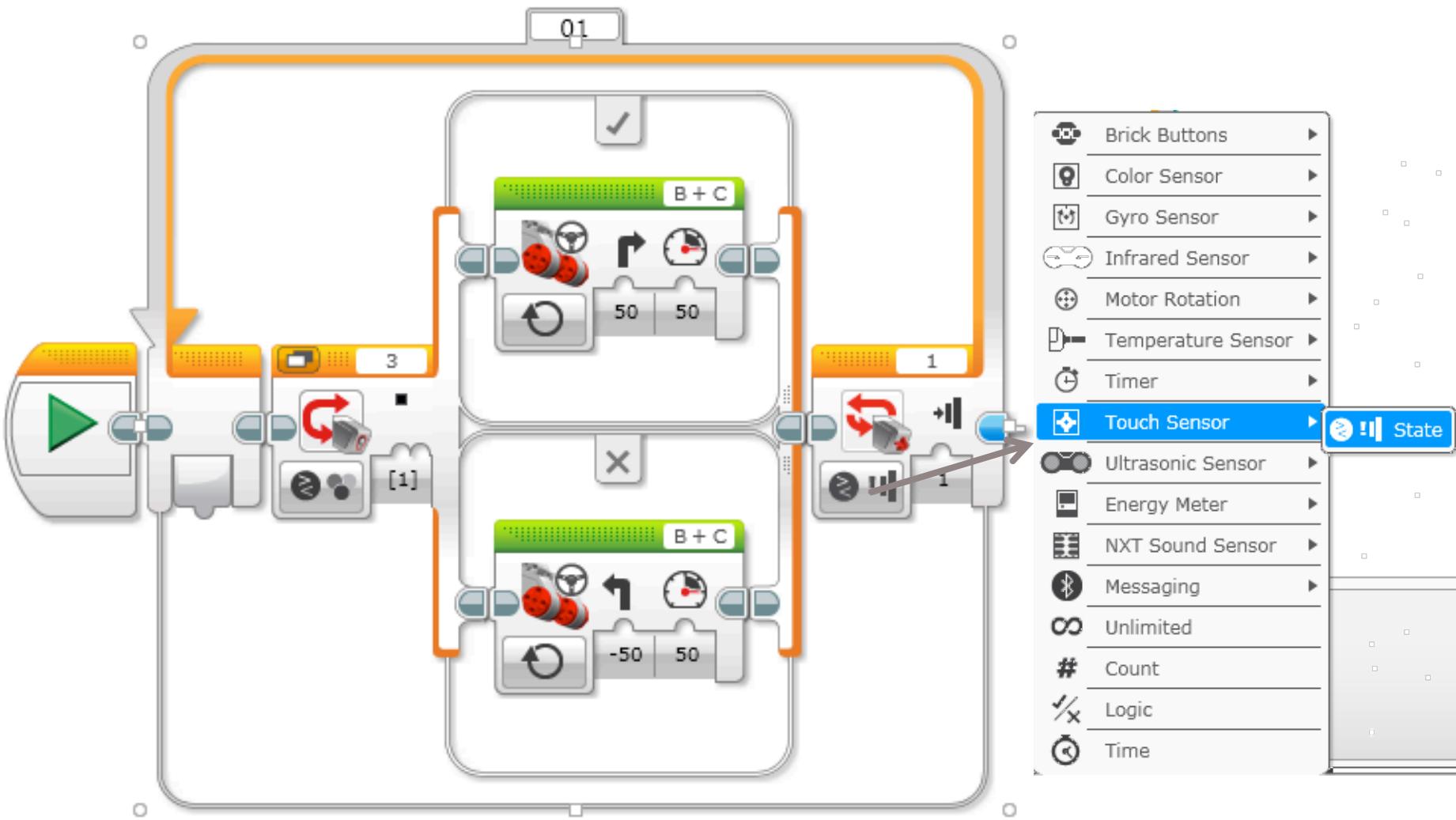
- Q. This line follower goes forever. How do we make this stop?
A. Change the end condition on the loop.

LINE FOLLOWER CHALLENGE 2

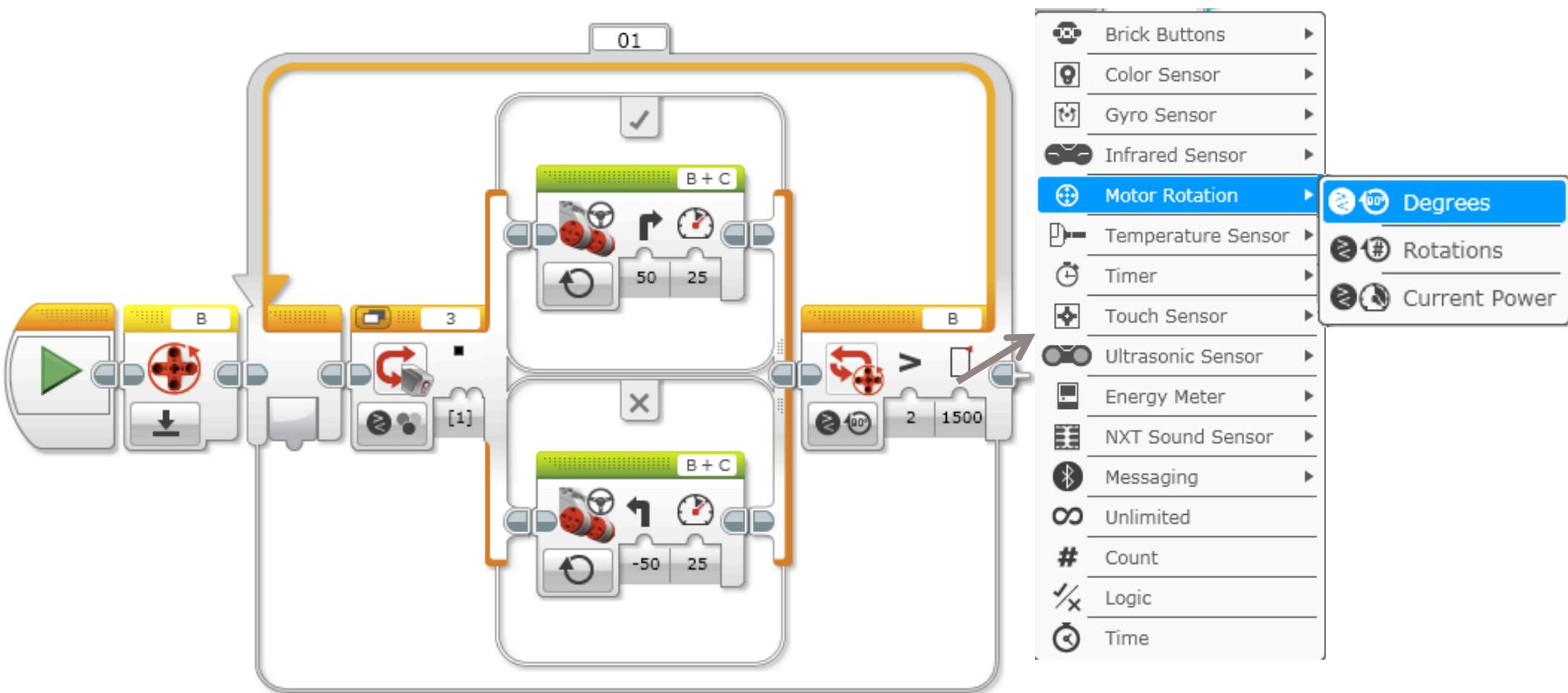
Part 1: Make a line follower that stops when you press the touch sensor

Part 2: Make a line follower that stops after it travels a particular distance

CHALLENGE 2 SOLUTION: SENSOR



CHALLENGE 2 SOLUTION: PARTICULAR DISTANCE



USEFUL LINKS

- EV3Lessons
 - Programming Lessons
 - Coach's Corner - Tips from coaches around the world
 - Team Building Activities
 - Scoring Tool for Hydro Dynamics -
<http://ev3lessons.com/resources/scorer/index.html>
 - Sketch Planner -
<http://ev3lessons.com/resources/drawplan>
- FIRST Steps:
 - <http://info.firstinspires.org/fllfirststepsrequest>
- Hydro Dynamics Challenge Documents (including build instructions, field setup, and rubrics):
 - <http://www.firstlegoleague.org/challenge>

- State-Specific Information
 - How to register
 - Forums
 - Senior Mentor



CREDITS

- This presentation was created and complied by Sanjay and Arvind Seshan (EV3Lessons).
- Thank you to Ibot Braniacs for collaborating on an earlier draft of this presentation.
- You are free to use and modify this presentation for your own workshops. We have indicated slides that need to be customized for your region/state
- The programming lessons are available on EV3Lessons.com
- All photographs were taken by EV3Lessons/Not the Droids You Are Looking for unless indicated and may be freely used with credit if needed.