



FLL Workshop – Session 1

Introduction to FLL, Mindstorms, and Robot Construction

Patrick R. Michaud
pmichaud@pobox.com

University of Texas at Dallas
Summer 2018



Welcome and Introduction

FIRST Progression of Programs



Ages 6-8

16,000+ teams
86,000+ players

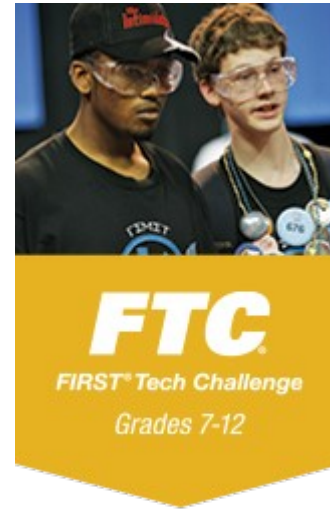
LEGO WeDo



Ages 9-14

35,200 teams
280,000+ players

LEGO Mindstorms



Grades 7-12

5,900 teams
59,000+ players

REV/TETRIX kits



Grades 9-12

3,650 teams
91,000+ players

120 lbs, custom

<http://firstinspires.org/about-at-a-glance>

FIRST LEGO League

Teams use engineering, problem solving, teamwork, and “Gracious Professionalism” to solve real-world problems



Teams present solutions at competitions using LEGO robots

FLL competitions occur at regional, state, national, and international levels

FIRST LEGO League

Ages 9-14 (as of Jan 1, 2018)

Up to 10 team members



Robots built using LEGO Mindstorms and LEGO components only

Game challenge and theme changes every year

2011: Food safety

2012: Senior citizens

2013: Natural disasters

2014: Education and learning

2015: Trash and recycling

2016: "Animal Allies"

2017: Hydro-dynamics

2018: Into Orbit

Who is here?

1. Name
2. School / affiliation
3. What do you want to get from this workshop?

Competition format

FLL competitions have four parts

1. Robot game
2. Robot design (judged)
3. Project (judged)
4. Core values (judged)



Challenge Guide

Challenge document
released August 1

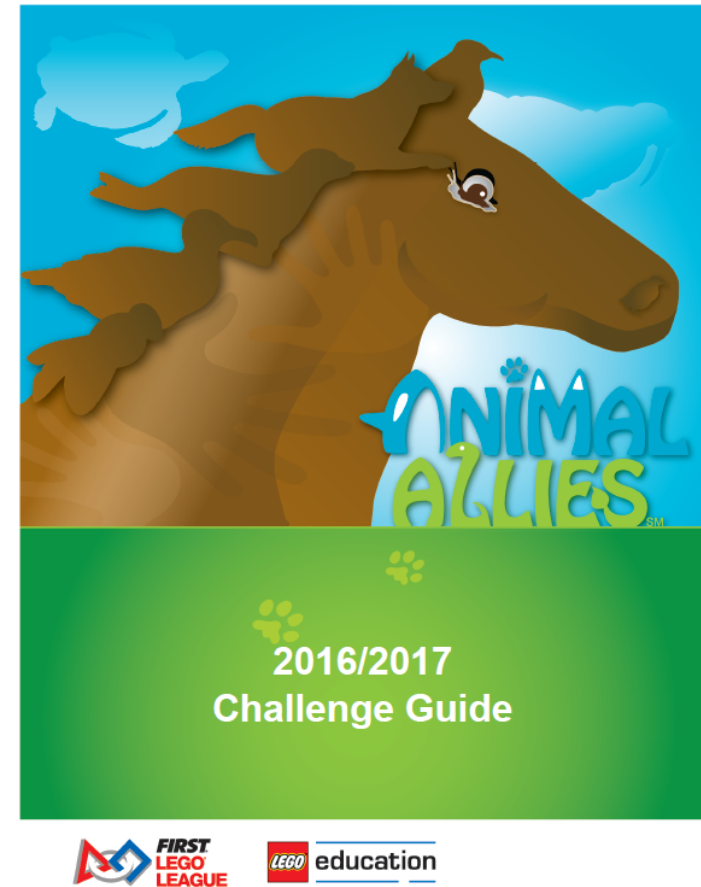
Sections:

Core Values

Project

Robot Game Rules

Robot Game Missions



This document identifies everything team needs
to do for competition. Read it carefully!

Robot Game

Played on a 4'x8' field

All teams obtain identical field kits, described in Challenge documents released Aug 1

Game consists of multiple “missions”, each worth varying numbers of points

Teams design, build, and program autonomous robot to solve missions

Robot solves as many missions as possible in 2:30

Robot Game

Robot always starts from “Base”

If a robot has to be rescued outside of Base, team receives a “touch penalty” (reduces score)

Robot can solve multiple missions on each trip out of Base

When robot returns to Base, drivers can add/remove attachments or change robot

Study rules CAREFULLY!



Robot Game

At competition, 3 or 4 rounds are played

Team's score is based on highest scoring round

Tables are organized in pairs with two teams competing across from each other, but matches are not “head-to-head”

Judged categories

Robot Design, Project, Core Values

Team meets with a separate panel of judges for each category

10 minutes with each panel of judges

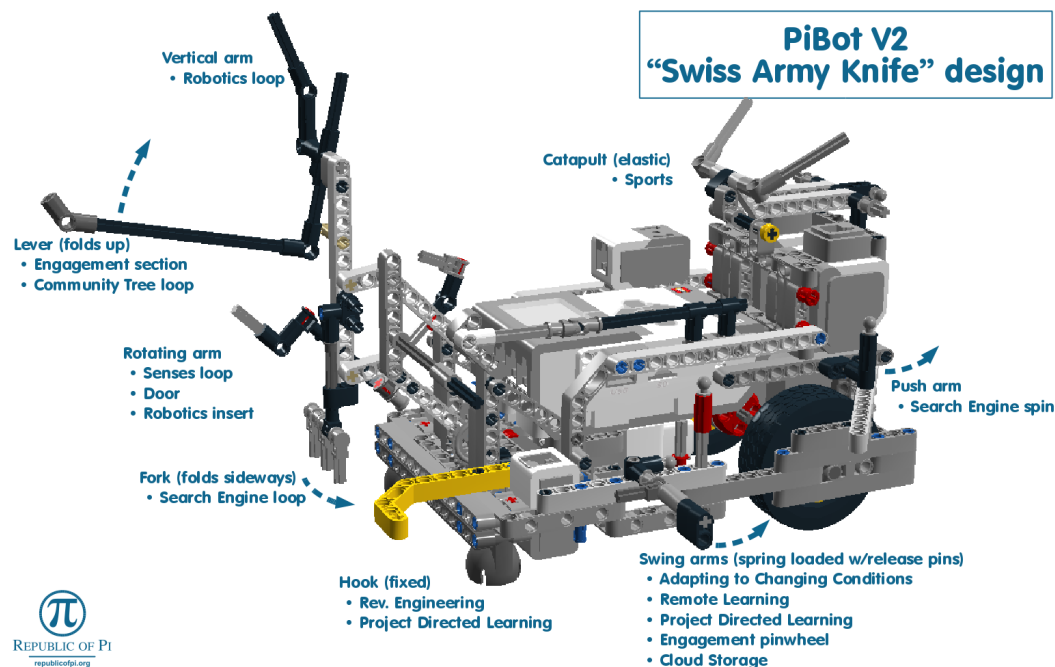
Usually: 5 min for presentation, 5 min for Q&A

Judges fill out rubrics for each team in each category

Robot Design

Judging of mechanical and programming design of team's robot

Panel of judges will interview the team and want to see demonstrations of robot capabilities



Project

Choose a topic related to season's theme

Research the topic

Create an innovative solution that helps

Share the solution with others

At competition, present research and solution to a panel of judges

Core Values

Central component of FIRST LEGO League:

- We are a team.
- We do the work to find solutions with guidance from our coaches and mentors.
- We know our coaches and mentors don't have all the answers; we learn together.
- We honor the spirit of friendly competition.
- What we discover is more important than what we win.
- We share our experiences with others.
- We display Gracious Professionalism® and Coopertition® in everything we do.
- We have FUN!

Core Values judging

Team is given a short activity to perform to demonstrate how they function as a team

Judges interview team on how they are integrating FLL Core Values into their activities

Core Values includes interaction with other teams, professionals, and community

Judging Rubrics

Available from <https://www.firstinspires.org/resource-library/fll/judging-rubrics>



Robot Design

Team Number Judging Room

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.

		Beginning	Developing	Accomplished	Exemplary
Mechanical Design	Durability		Evidence of structural integrity; ability to withstand rigors of competition		
	N	quite fragile; breaks a lot	frequent or significant faults/repairs	rare faults/repairs	sound construction; no repairs
	D				
	Mechanical Efficiency		Economic use of parts and time; easy to repair and modify		
	N	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
	D				
Mechanization	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
	D				

Comments:

Programming	Programming Quality		Programs are appropriate for the intended purpose and would achieve consistent results, assuming no mechanical faults		
	N	would not achieve purpose	would not achieve purpose	should achieve purpose	should achieve purpose every
	D	AND would be inconsistent	OR would be inconsistent	repeatedly	time
	Programming Efficiency		Programs are modular, streamlined, and understandable		
	N	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
	D				
	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	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
	D				

Comments:

Strategy & Innovation	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	organization AND explanation need improvement	organization OR explanation need improvement	systematic and well-explained	systematic, well-explained and well-documented
	D				
	Mission Strategy		Ability to clearly define and describe the team's game strategy		
	N	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
	D				
	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	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

Comments:

Strengths:	Mechanical Design	Programming	Strategy & Innovation
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Project

Team Number Judging Room

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.

	Beginning		Developing		Accomplished		Exemplary		
Research	Problem Identification *		Clear definition of the problem being studied						
	N	unclear; few details		partially clear; details missing		mostly clear; detailed		clear; very detailed	
	Sources of Information		Types (e.g. books, magazines, websites, reports and other resources) and number of quality sources cited, including professionals in the field						
	N	one type of information cited; minimal sources		two types of information cited; several sources		three types of information cited; many sources, including professionals		four(+) types of information cited; extensive sources, incl. professionals	
	Problem Analysis		Depth to which the problem was studied and analyzed by the team						
	N	minimal study; no team analysis		minimal study; some team analysis		sufficient study and analysis by team		extensive study and analysis by team	
	Review Existing Solutions		Extent to which existing solutions were analyzed by the team, Including an effort to verify the originality of the team's solution						
	N	minimal review; no team analysis		minimal review; some team analysis		sufficient review and analysis by team		extensive review and analysis by team	

Comments:

Innovative Solution	Team Solution *		Clear explanation of the proposed solution		
	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	original solution/application with the potential to add significant value
	Implementation		Consideration of factors for implementation (cost, ease of manufacturing, etc.)		
	N D	minimal factors considered	some factors considered	factors well considered; some question about proposed solution	factors well considered and feasible solution proposed

Comments:

Presentation	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 with one individual	shared with one group	shared with one individual or group who may benefit	shared with multiple individuals or groups who may benefit
	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

Comments:

Strengths:	Research	Innovative Solution	Presentation
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*Required for Award Consideration

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Awards and advancement

Teams must participate in all four areas to be eligible for an award or advancement

Judges use rubrics to determine which teams receive awards

Robot Performance awards based solely on Robot Game scores

Judged awards are based on multiple criteria

Teams can win only one judged award

Advancing to regional championship

Top teams advance to regional championship

Team must be in top 40% of Robot Game scores and rank highly in all other categories

Number of teams advancing depends on size of qualifier, number of qualifiers, and size of regional championship

Winning an award doesn't guarantee advancement

FIRST LEGO League...

Where do I start?!?

Key materials

Register a team

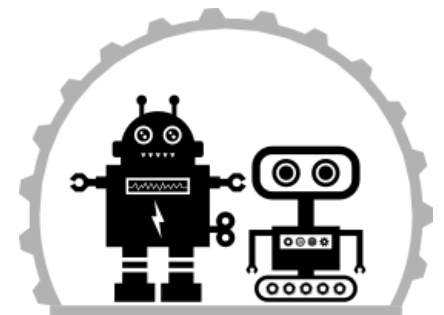
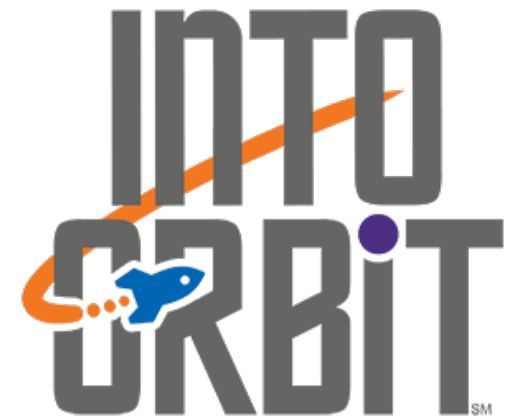
FLL TMS: <http://firstlegoleague.org/>
North Texas: Limited to ~400 teams
Managed by Perot Museum

Receive field setup kit
(mat and mission model LEGOs)

Obtain Mindstorms EV3 kit

Challenge document released Aug 1

Join Roboplex.org and mailing list



Team Registration - FIRST

Create an account
at firstinspires.org

“Create new teams”

Invite a 2nd coach
(required)

Pay for team registration, receive team number

Don't need to specify team roster until first event
(e.g. qualifier)

The screenshot shows the FIRST Inspire dashboard for a user named Patrick Michaud. The dashboard has a top navigation bar with links for Programs, Community, Ways to Help, and About. Below this is a 'DASHBOARD' header. The main content area is divided into four tabs: MY TEAMS, MY RESOURCES, YOUTH MEMBER REGISTRATION, and VOLUNTEER REGISTRATION. Under the MY TEAMS tab, there are buttons for 'CREATE NEW TEAM(S)' and 'PAY FOR TEAM(S)'. Below these buttons is a 'Teams List' section with a 'Sort by Team: Name' dropdown. The list shows several teams, including 'Asimov's Army' and 'Republic of PI'. For the 'Republic of PI' team, there is a detailed view showing 'Team Options' (Outstanding Tasks, Team Information, Parts & Products, Certificates & Awards), 'Team Finances' (Balance Due: \$225, Credit Balance: \$0, Payments to FIRST: \$0, Funds & Grants: \$0), 'Team Contacts/Roster' (Primary Contacts: 2, Youth Members: 0, Other Contacts: 1, Invite Contacts), and 'Team Events' (No registered events). At the bottom, there is a 'Student Activities' section with a list of activities including 'Technical Difficulties' and 'Titan Robotics'.

LEGO Mindstorms EV3 Education Kit

LEGO Mindstorms EV3 “brick”

Rechargeable battery, charger

Technic LEGO components

Beams, axles, wheels,
pegs, gears, etc.

EV3 electronics

Motors, color sensor, gyro sensor, ultrasonic sensor,
cables

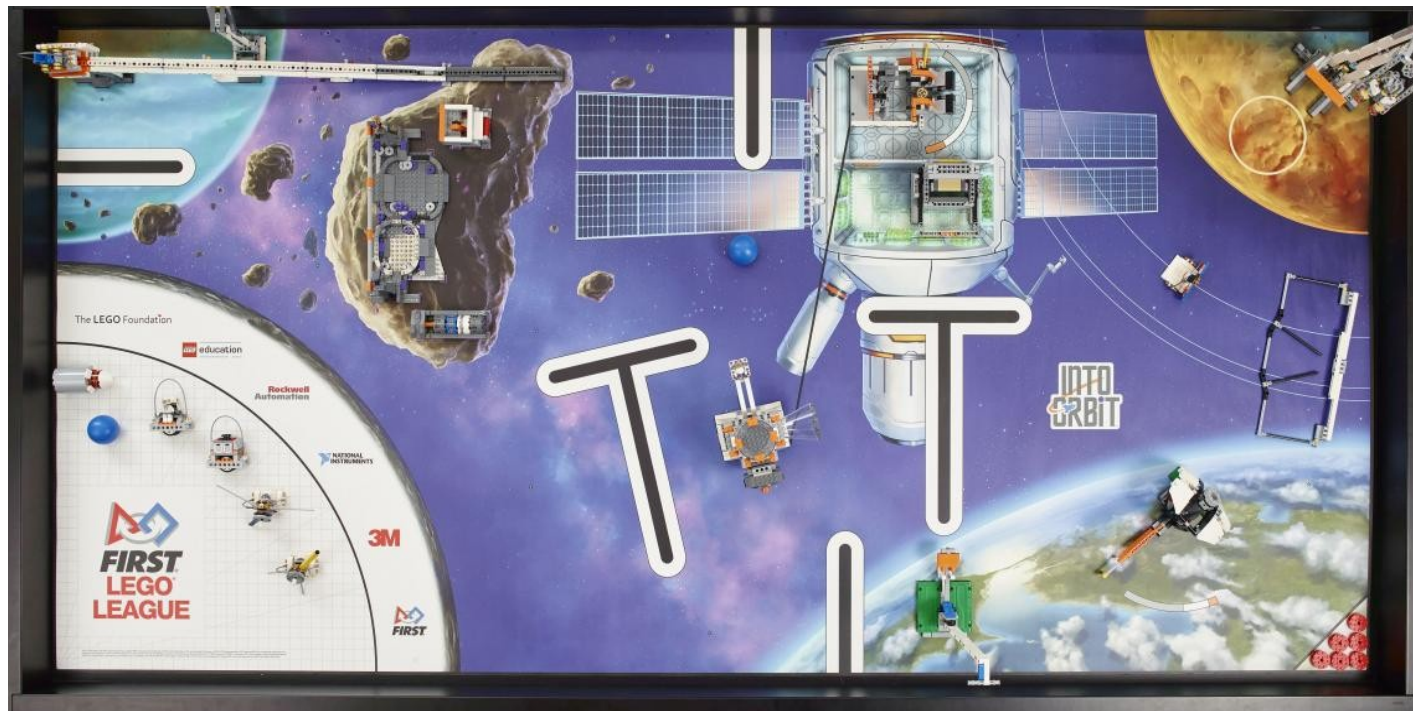


FLL Field Setup Kit

Included as part of team registration

Includes field mat, LEGOs for Mission Models

Models divided into bags for easy assembly



North Texas Season Timeline

August: Challenge Release

Game and project rules, mission model build

September: FLL Kickoff Events

UT-Dallas sponsored (Sep 8, Williams HS Plano)

Other kickoff events TBD

September-November: Coaches Clinic events

UT-Dallas/SEEC

Fellowship Christian Academy

Benbrook Public Library(?)

North Texas Season Timeline

November: Scrimmage events

Various locations, dates, and registration options

December: Official Qualifier events

Various locations throughout North Texas
Registration via Perot Museum

January: Second-round qualifier events

February: Regional Championship

Parish Episcopal School, Dallas

Getting started: Early season team activities

Review the challenge documents

Build the mission models

Learn about building with LEGO Mindstorms

Learn about Mindstorms programming

Begin project research, identify resources and contact experts

Things to do/remember

Have the team set a goal for the season

Commit to attending a qualifier, don't back out even if the team seems “not ready”

Participate in a scrimmage

Don't feel like you have to know everything beforehand

The team members will figure things out

It's really a partnership

Be a “coach”

Being a FLL Coach or Mentor

Kids come first;
Kids do the work

Coaches:

- Inspire and guide
- Teach new skills
- Handle logistics
- Ask questions
- Remind team of rules

Team members:

- Decide on strategy
- Build and program
- Research
- Choose problem/solution
- Present

Organizing the team

Teams may have up to 10 members

Designate “role leaders”:

Captain

Rules / strategy Programming

Project / research Communication / sharing

Robot construction Marketing

Every team has different dynamics; try to find what works best for the team

“Team” means “specialists”

Local contacts and online resources

roboplex.org : Robotics for the Metroplex

NorthTexasFLL Google Group

firstlegoleague.org

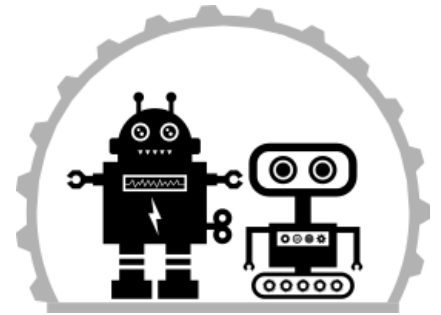
Perot Museum FLL pages

Joe Varnell, FIRST Senior Mentor

jvarnell@firstinspires.org

Patrick R. Michaud, Veteran Coach

pmichaud@pobox.com





LEGO basics

Coaching tip

Have all team members identify and use pieces by name

Correct: "beam", "L-beam", "axle", "axle peg"

Incorrect: "stick", "thingy", "that"

EV3 brick

“Brains” of the robot

Mindstorms EV3 programming environment

Four motor ports (A-D)

Four sensor ports (1-4)

Highly recommended:
Rechargeable battery
+ charger

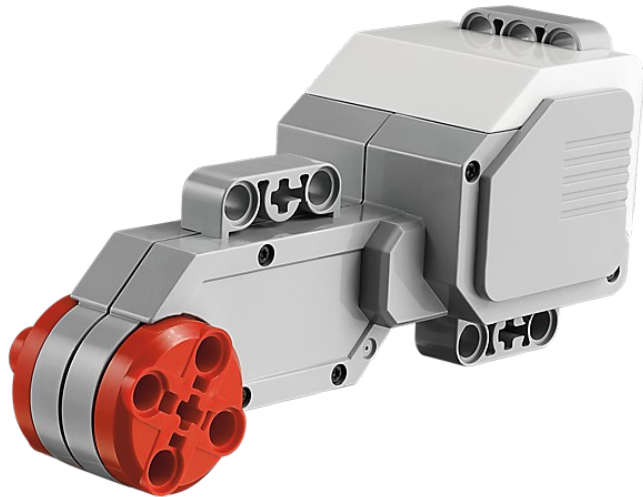


EV3 motors

Large motor

Good for driving wheels

Higher torque / power



Medium motor

Good for arms & attachments

Smaller size

Lower torque / power



EV3 sensors

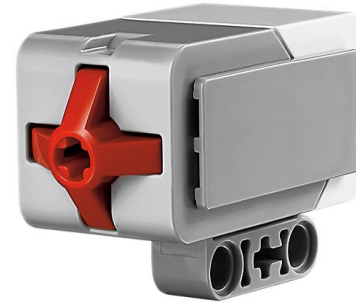
Gyro sensor

detects robot turns



Touch sensor

detects button press



Color sensor

senses color and light



Ultrasonic sensor

distance to surface



Beams

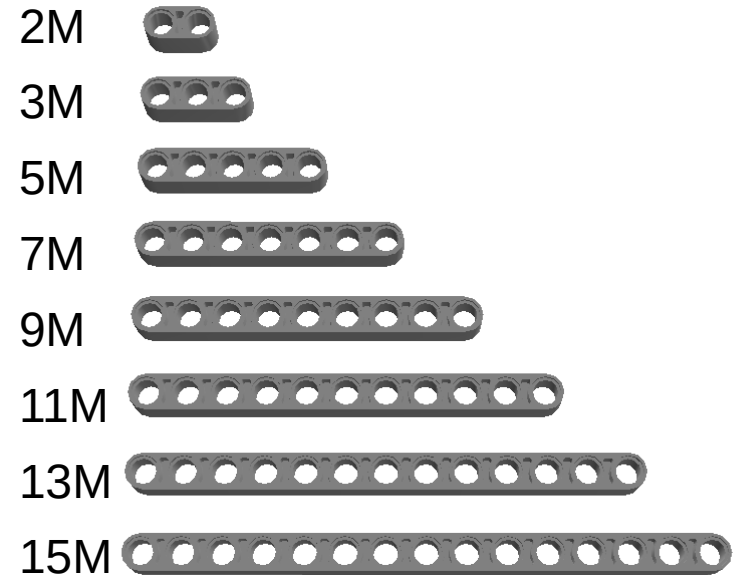
Beams are the basic building pieces for most LEGO robots

Length of beam determined by number of holes

Often called “M” or “L” units

Center-to-center distance is 8mm

Beams can be “thin” or “thick”



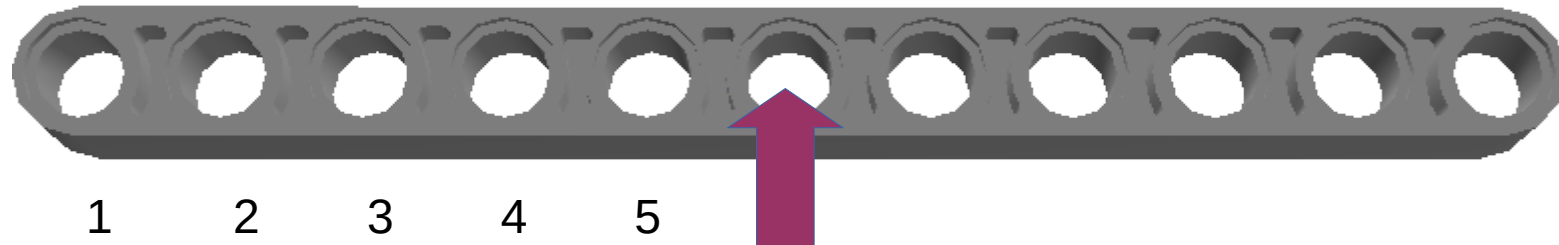
Quickly determining beam size

To quickly determine the size of a beam

Place a finger over the center hole

Count the holes on one side

Double that and add one



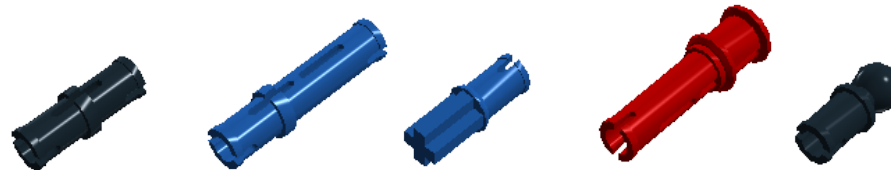
Pegs

Used to connect beams and other components

Fit inside beam holes

Friction pegs do not turn freely in holes

- Connector peg with friction (“peg”)
- 3M connector peg with friction (“long peg”)
- Connector peg with cross-axle (“axle peg”)
- Connector peg with cross-hole (“bushing peg”)
- Ball with friction snap (“ball peg”)



Pegs

Non-friction pegs will turn in beam holes

Connector peg

3M connector peg

Connector peg cross axle

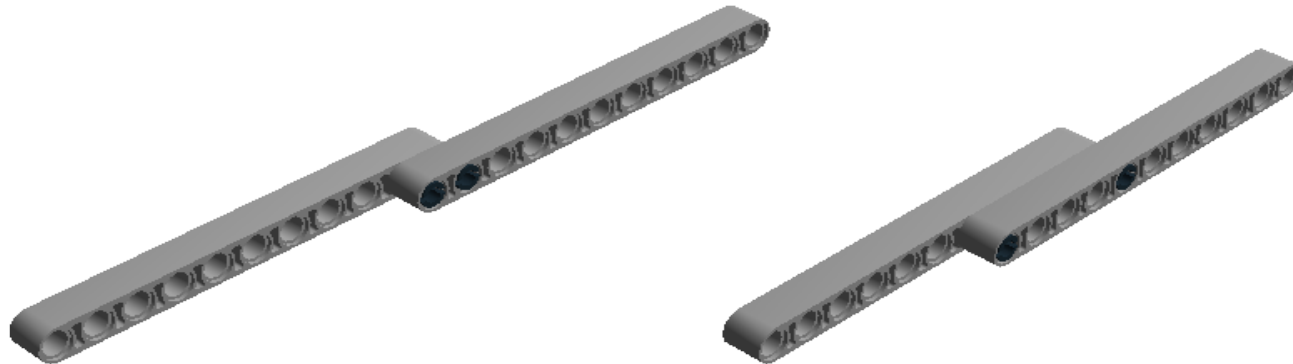


Connecting beams

Use pegs to connect beams

At least two pegs are needed to make a rigid structure

Greater distance between pegs reduces flex



More pegs increases hold between beams

Try it!

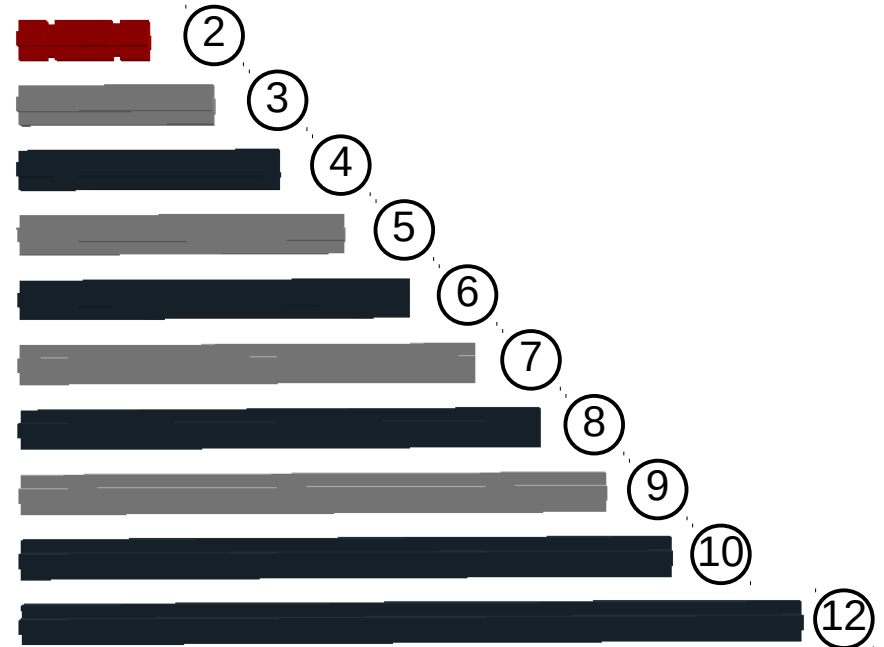
Axles

Transmits power between wheels, gears, and attachments

Length also measured in “M” units

Grey axles are typically odd lengths, black axles are typically even lengths

Axles will rotate and slide in beam holes unless constrained



Wheels

Many types of wheels and tires available

Wheel consists of “rim” and “tire”

Tire measurements printed on sidewall

Cross hole attaches to axles

56908 Rim wide 43.2 x 26

41897 Tyre Low Wide 56 x 28

32020c01 Wheel 62.4 x 20, with Black Tire 62.4 x 20



Bushings

Used to hold axles on beams

Also used as spacers to prevent tires from hitting beams or other elements

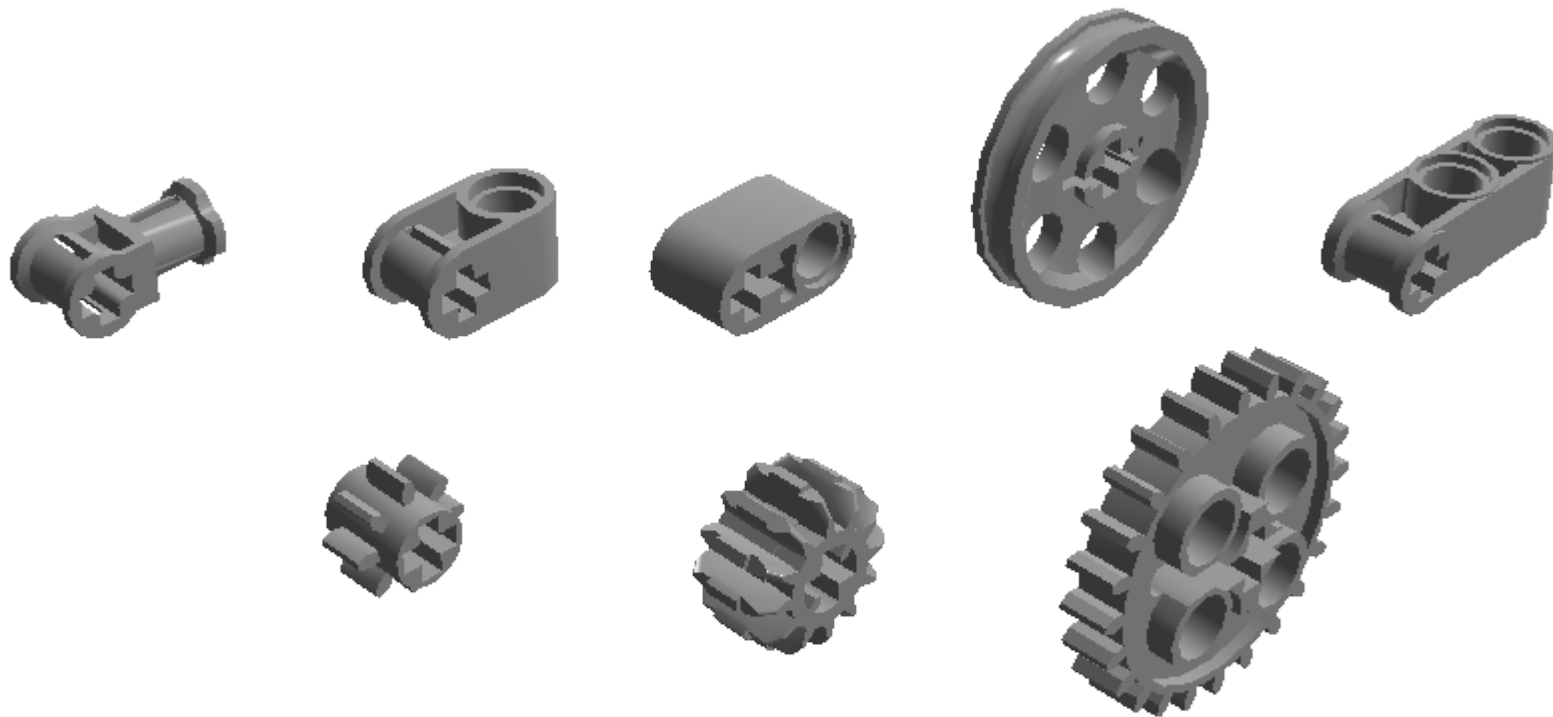
32123 Half-bushing

6590 Bushing



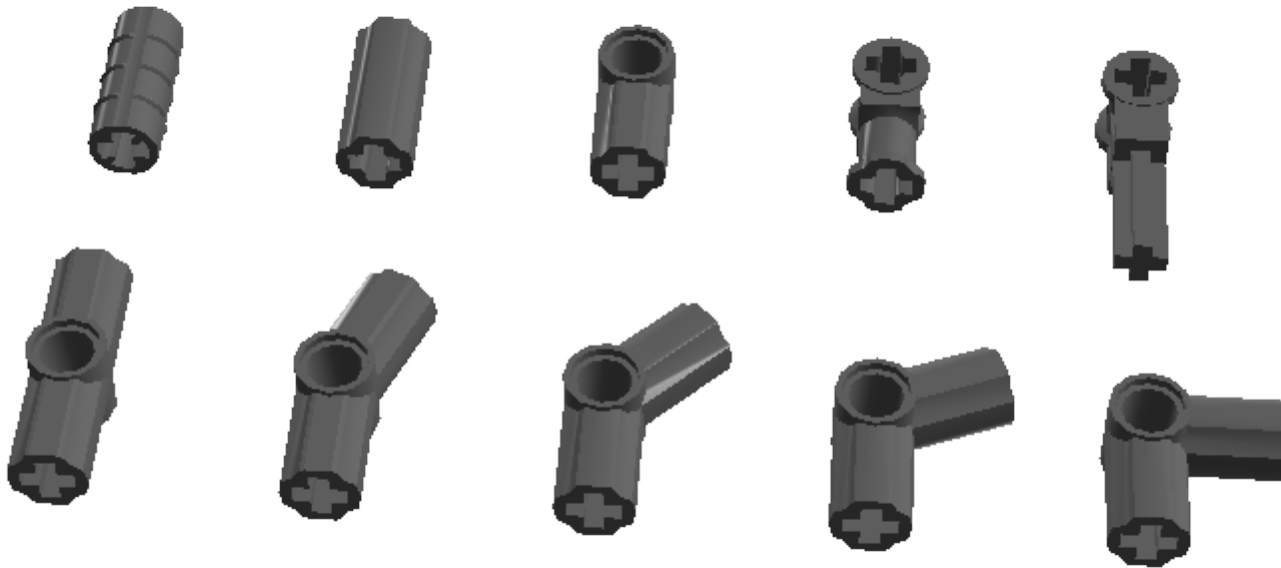
Bushings

Other elements can also be used as bushings or spacers



Axle connectors

Axles can be joined using a wide variety of connectors



Angle beams

Allow beams to be connected at rigid angles

Excellent for structure

Some beams have cross holes

32526: 3x5 L beam

32140: 2x4 L beam

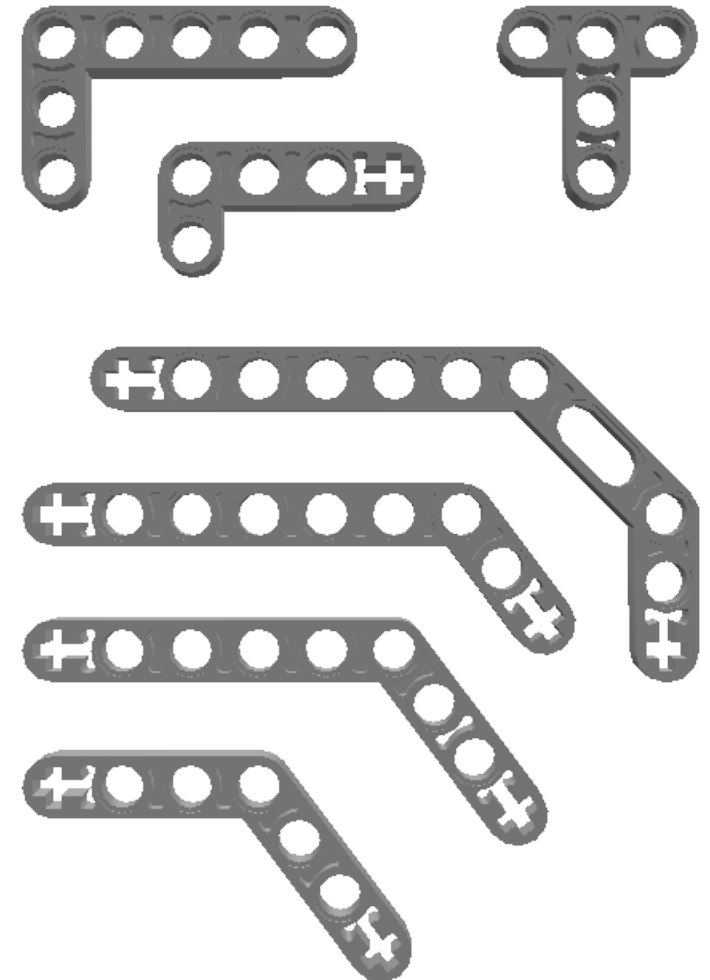
60484: 3x3 T beam

32009: 3x7 double-angle beam

32271: 3x7 angle beam

6629: 4x6 angle beam

32348: 4x4 angle beam



Useful LEGO pieces - frames and panels

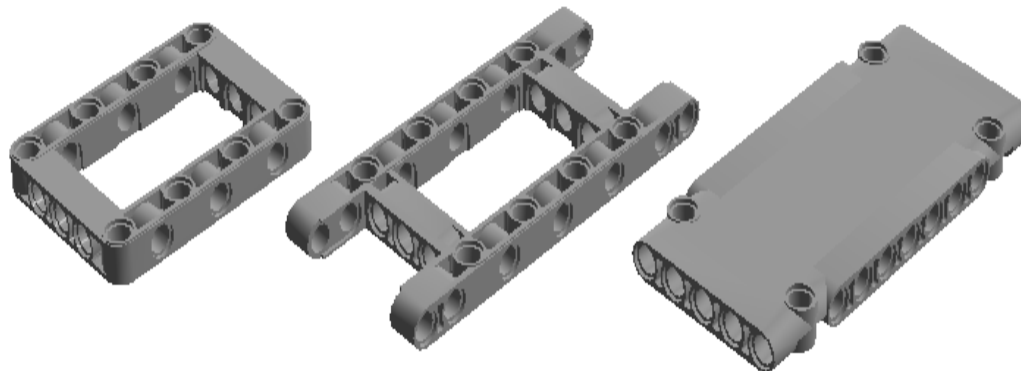
These pieces are excellent for building large structures and boxes

Holes in all three axes for multiple mounting options

64179: Beam frame 5x7 (“box frame”)

64170: Beam H frame 5x11 (“H frame”)

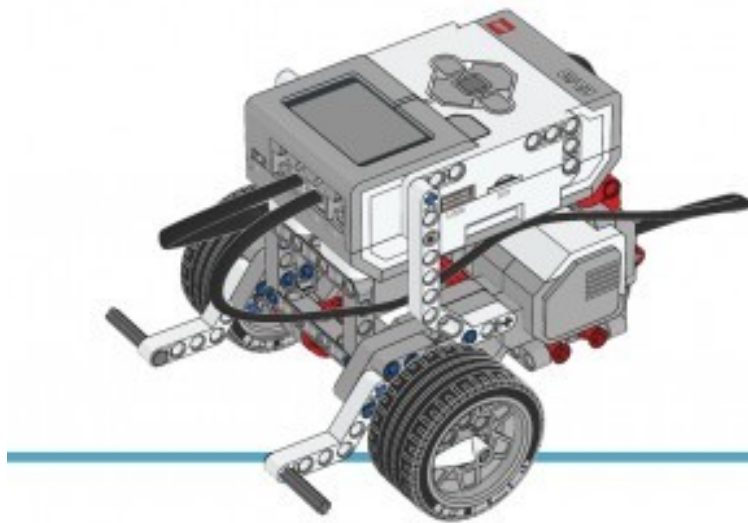
64782: Flat Panel



Recommended first build

EV3 Education Kits come with instructions for building a simple “educator vehicle” robot

This robot is a good start for learning about LEGO parts, sensors, and programming



First build – Day 1

Verify battery works in robot!

Build the Educator Vehicle

Chassis: pages 7-38

Gyro: pages 48-53

Touch: pages 77-80

Color: pages 69-72

Optional:

Arm: pages 54-68

Ultrasonic: pages 42-47

