FLL Workshop – Session 1
Introduction to FLL, Mindstorms, and Robot Construction

Patrick R. Michaud
pmichaud@pobox.com

University of Texas at Dallas
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Welcome and Introduction

FIRST Progression of Programs

Ages 6-8	Ages 9-14	Grades 7-12	Grades 9-12
16,000+ teams 86,000+ players	35,200 teams 280,000+ players	5,900 teams 59,000+ players	3,650 teams 91,000+ players
LEGO WeDo	LEGO Mindstorms	REV/TETRIX kits	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, 2019)

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
2019: City Shaper

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

Other regions: Team meets with a separate panel of judges for each category

- 10 minute sessions with each panel
  common: 5 minute presentation, 5 minute interview

North Texas: "Combined judging panels"

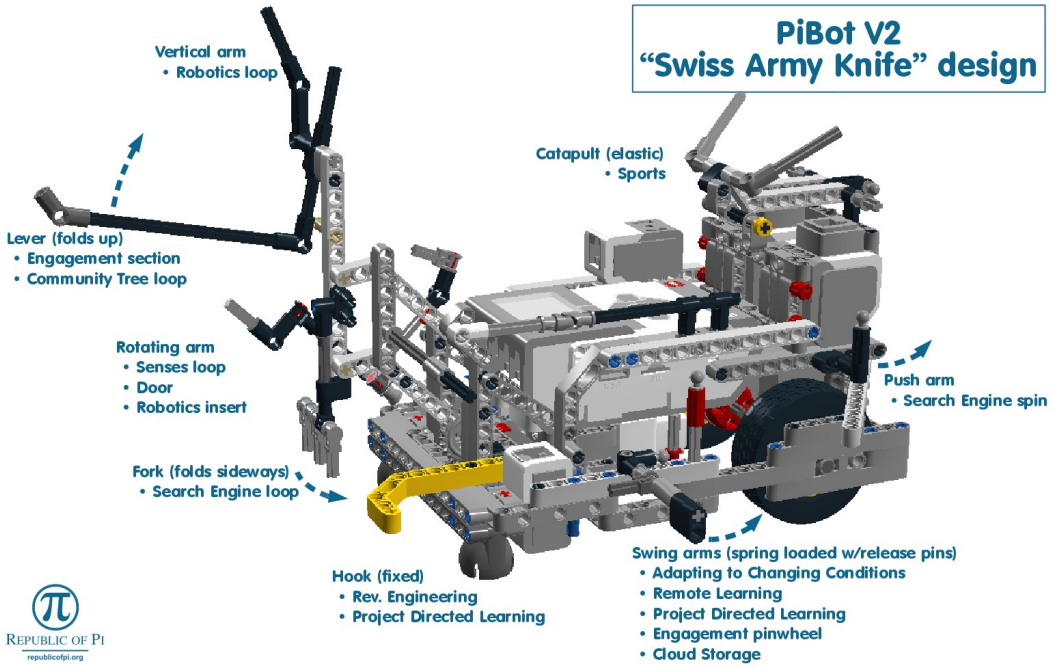
- 20-30 minutes with a panel of judges

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:

- Discovery: We explore new skills and ideas
- Innovation: We use creativity and persistence to solve problems
- Impact: We apply what we learn to improve our world
- Inclusion: We respect each other and embrace our differences
- Teamwork: We are stronger when we work together
- Fun: We enjoy and celebrate what we do!

Core Values judging

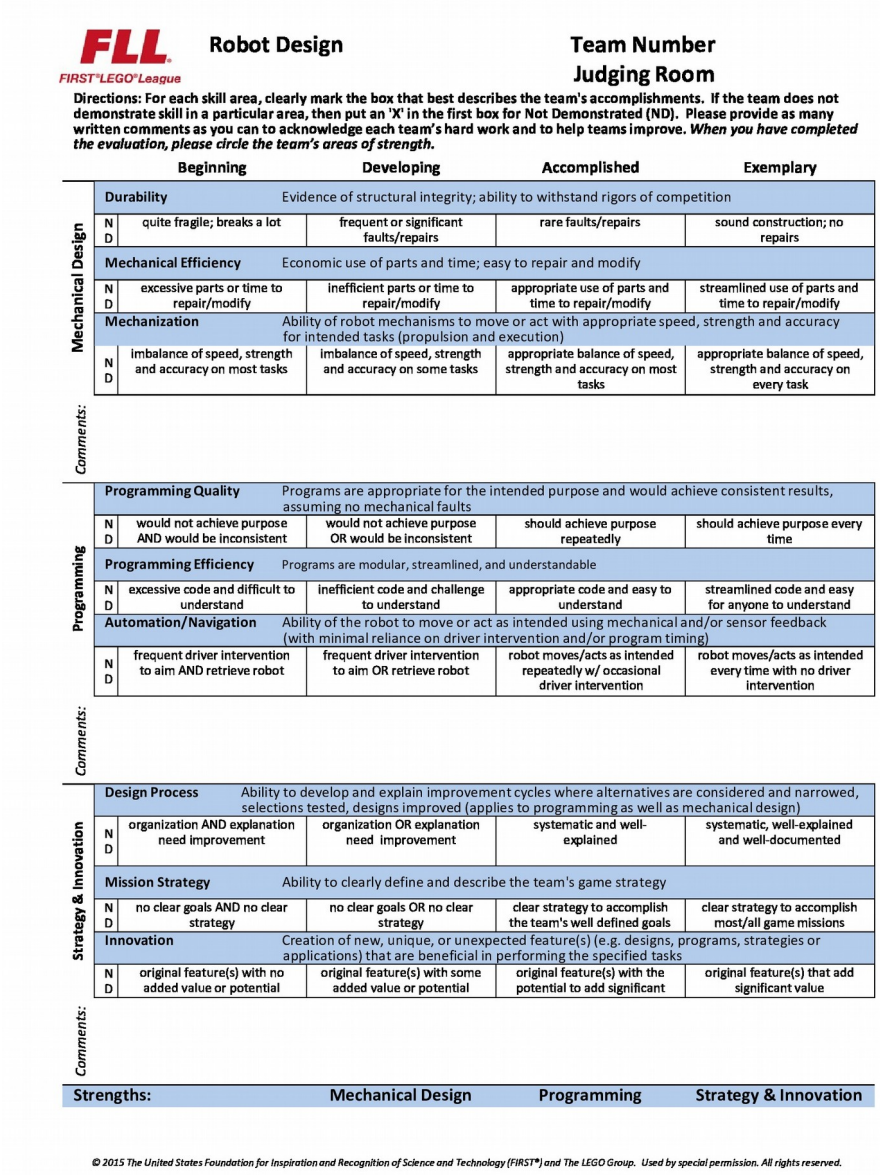
Team is given a short activity to perform to demonstrate how they function as a team

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



FIRST® LEGO® League

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			
	ND	quite fragile; breaks a lot	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			
	ND	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
	Mechanization	Ability of robot mechanisms to move or act with appropriate speed, strength and accuracy for intended tasks (propulsion and execution)			
	ND	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
Comments:					
Programming	**Programming Quality**	Programs are appropriate for the intended purpose and would achieve consistent results, assuming no mechanical faults			
	ND	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
	Programming Efficiency	Programs are modular, streamlined, and understandable			
	ND	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)			
	ND	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:					
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)			
	ND	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			
	ND	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
	Innovation	Creation of new, unique, or unexpected feature(s) (e.g. designs, programs, strategies or applications) that are beneficial in performing the specified tasks			
	ND	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**

FIRST® LEGO® League

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			
	ND	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			
	ND	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			
	ND	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			
	ND	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			
	ND	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			
	ND	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.)			
	ND	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			
	ND	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			
	ND	minimally engaging OR unimaginative	engaging OR imaginative	engaging AND imaginative	very engaging AND exceptionally imaginative
	Presentation Effectiveness	Message delivery and organization of the presentation			
	ND	unclear OR disorganized	partially clear; minimal organization	mostly clear; mostly organized	clear AND well organized
Comments:					

Strengths: **Research** **Innovative Solution** **Presentation**

*Required for Award Consideration

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 TIMS: http://firstlegoleague.org/
North Texas: Limited to ~440 teams
Managed by Perot Museum

Receive field setup kit
(mat and mission model LEGOs)

Obtain Mindstorms EV3 kit

Challenge document released Aug 1

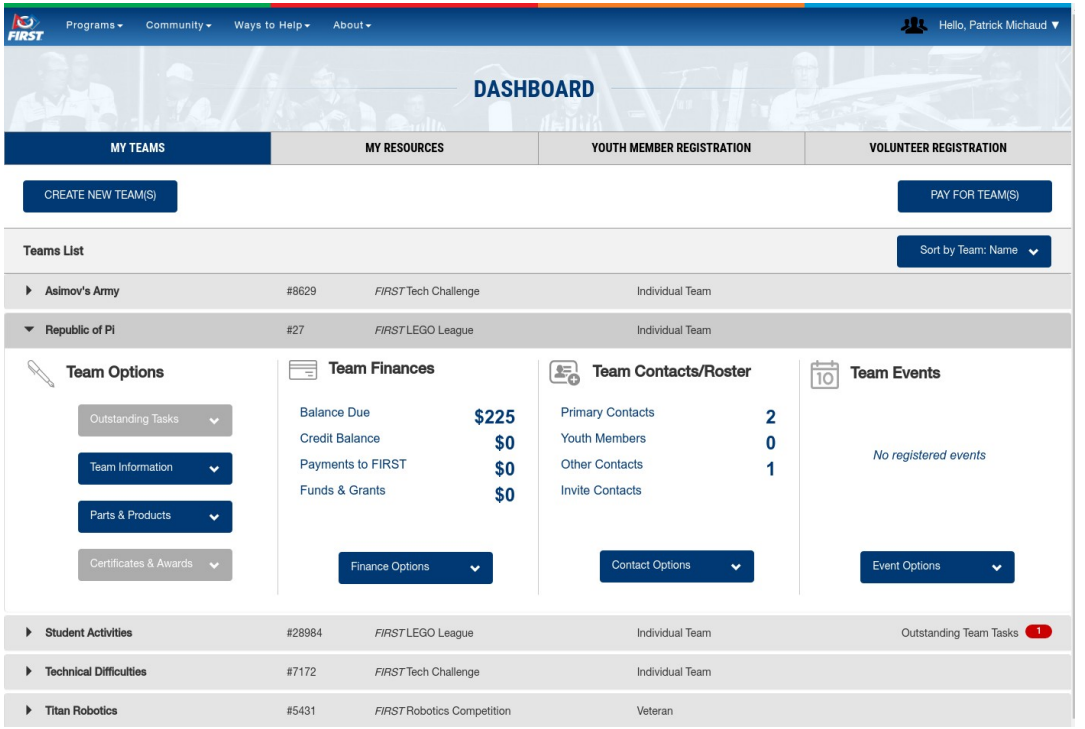
Join Roboplex.org and mailing list

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)

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
- August 3: North Texas FLL Kickoff @ Perot Museum

September: FLL Kickoff Events

- UT-Dallas sponsored (Sep 7, Location TBD)
- Other kickoff events TBD

September-November: Coaches Clinic events

- UT-Dallas/SEEC
- Fellowship Christian Academy
- Benbrook Public Library

North Texas Season Timeline

October-November: Scrimmage events

Various locations, dates, and registration options

November-December: Official Qualifier events

Various locations throughout North Texas
Registration via Perot Museum

January 25: 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

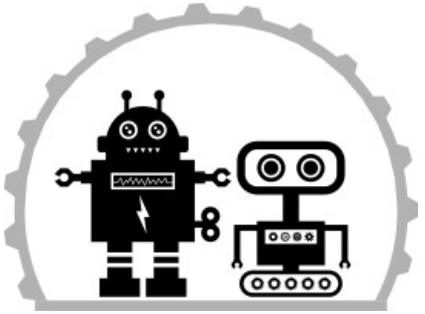
Rules / strategy	Programming
Project / research	Communication / sharing
Robot construction	Marketing

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)

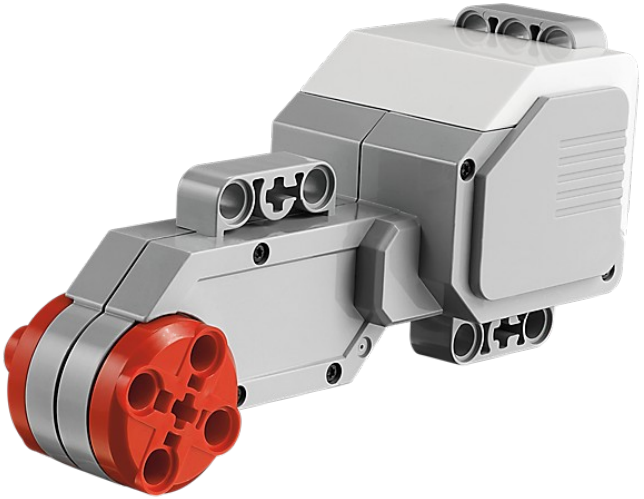
Four sensor ports (1-4)

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

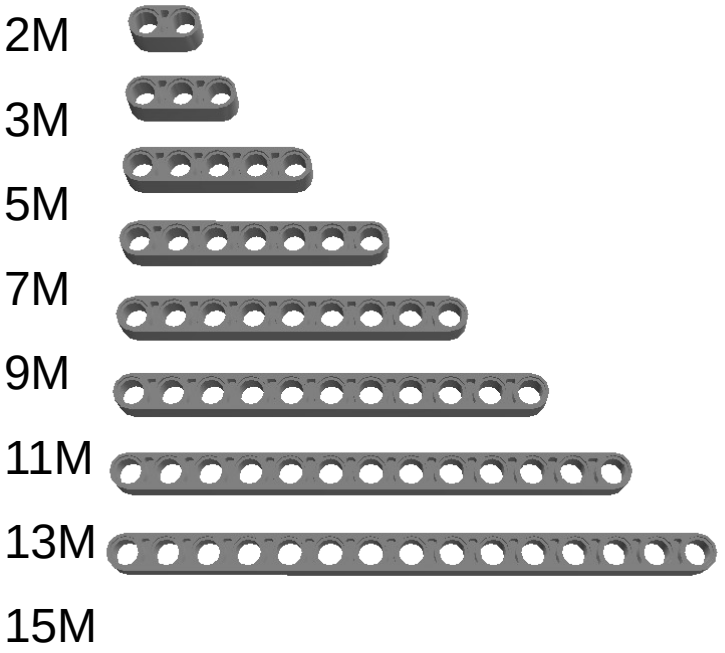
senses color and light

Ultrasonic sensor

distance to surface

Beams

Beams are the basic building pieces for most LEGO robots



Length of beam determined by number of holes

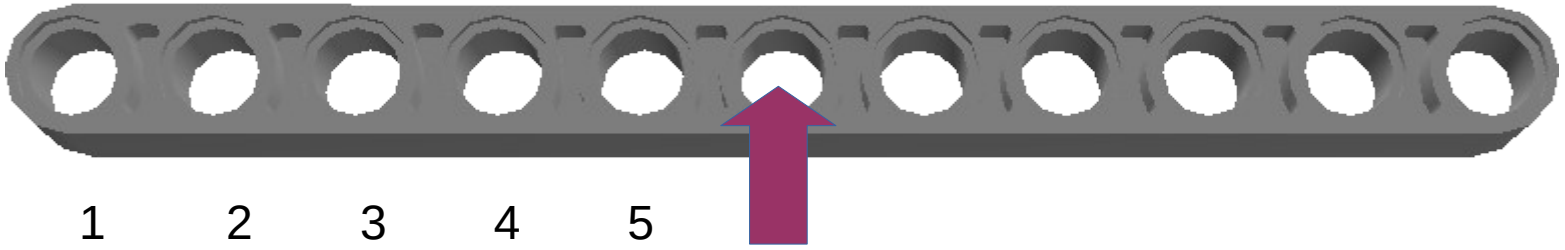
- Often called “M” or “L” units
- Center-to-center distance is 8mm

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



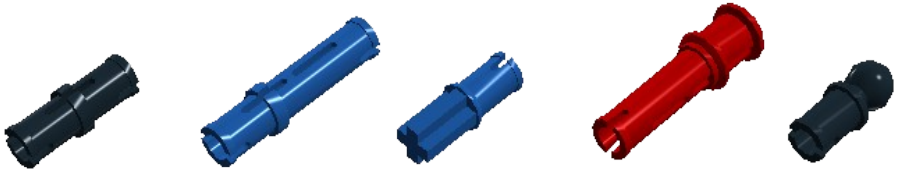
Pegs

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

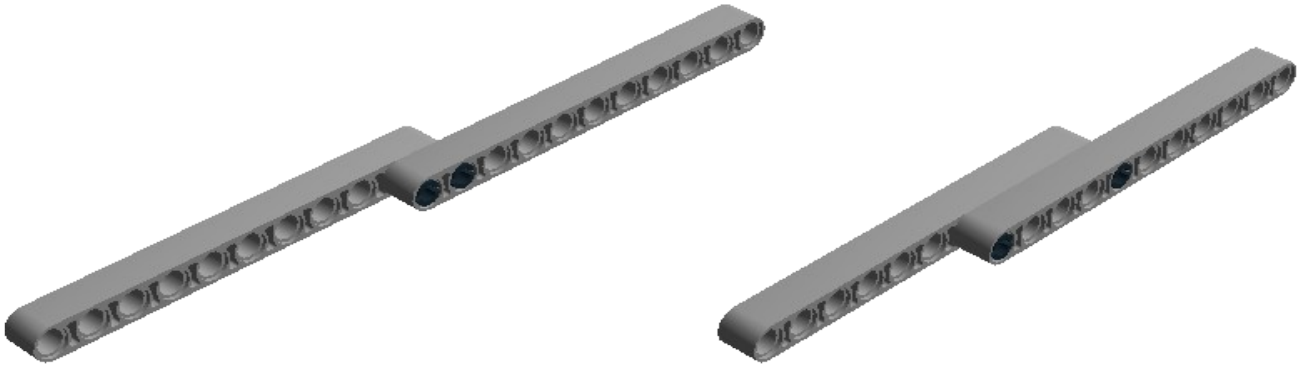
- Connector peg
- 3M connector peg
- Connector peg cross axle

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

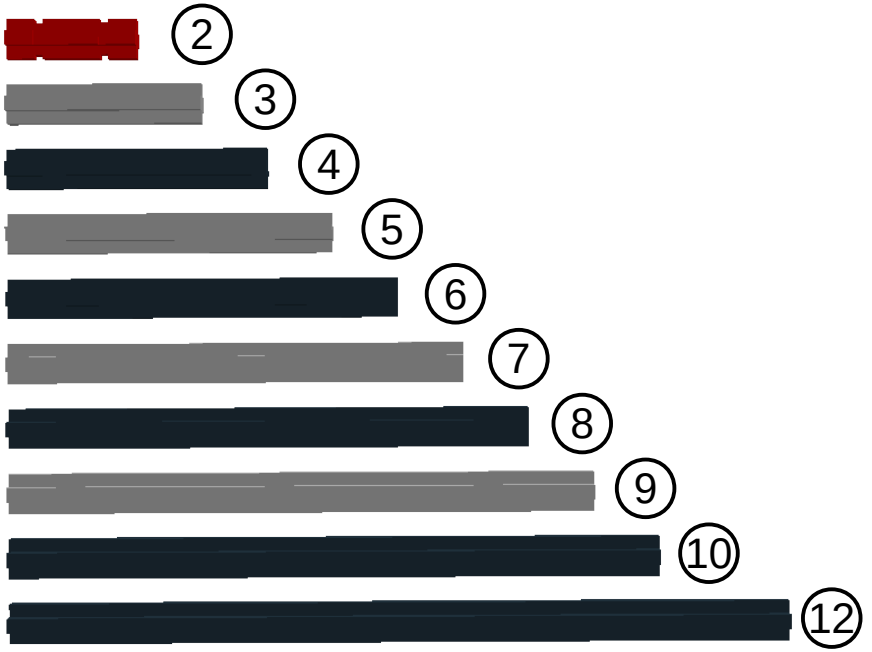
Try it!

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

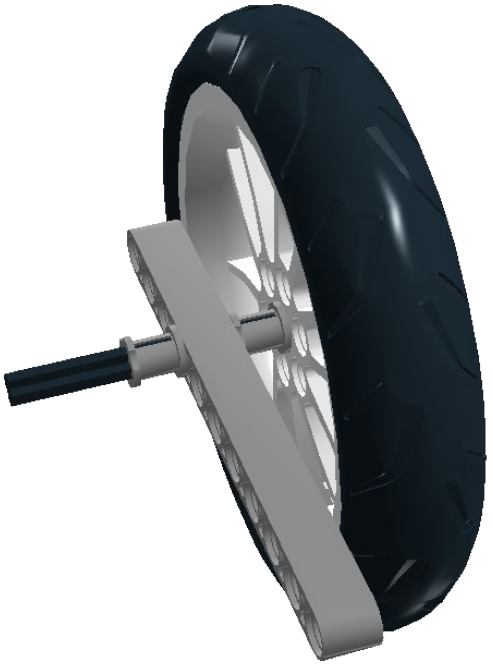
Bushings

Used to hold axles on beams

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

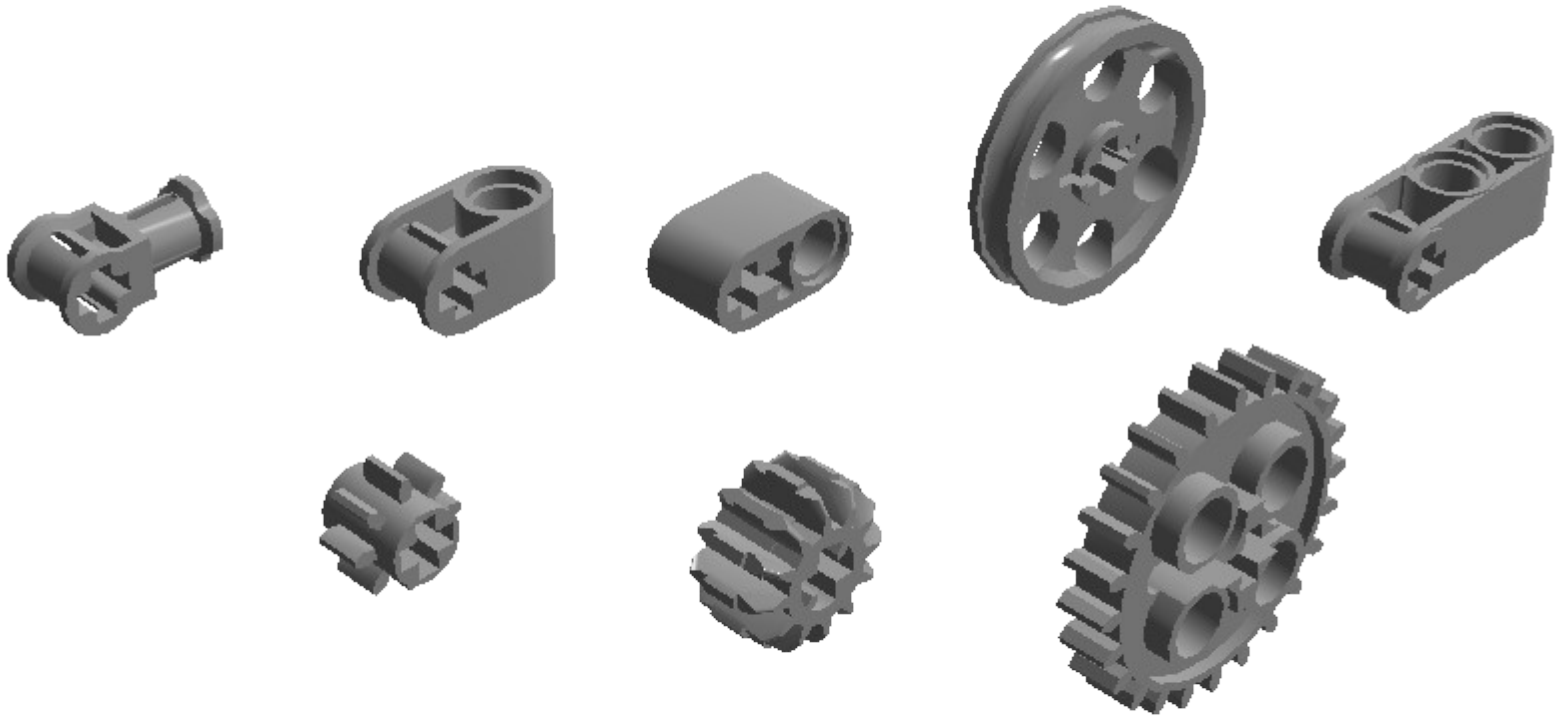
32123 Half-bushing

6590 Bushing



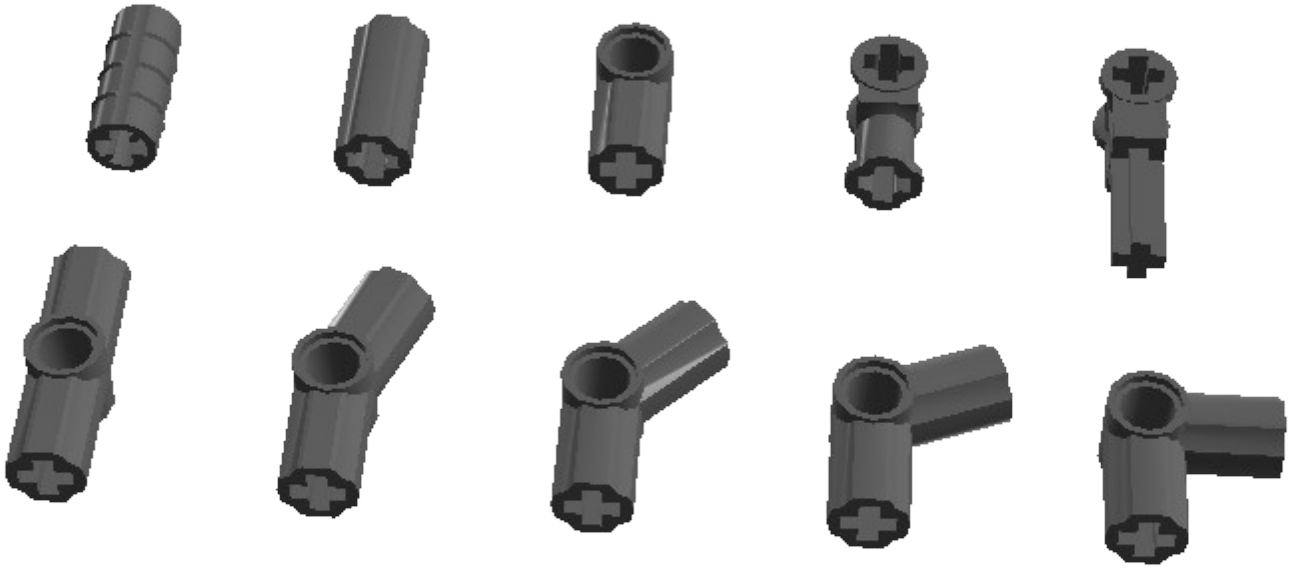
Bushings

Other elements can also be used as bushings or spacers



Axle connectors

Axles can be joined using a wide variety of connectors

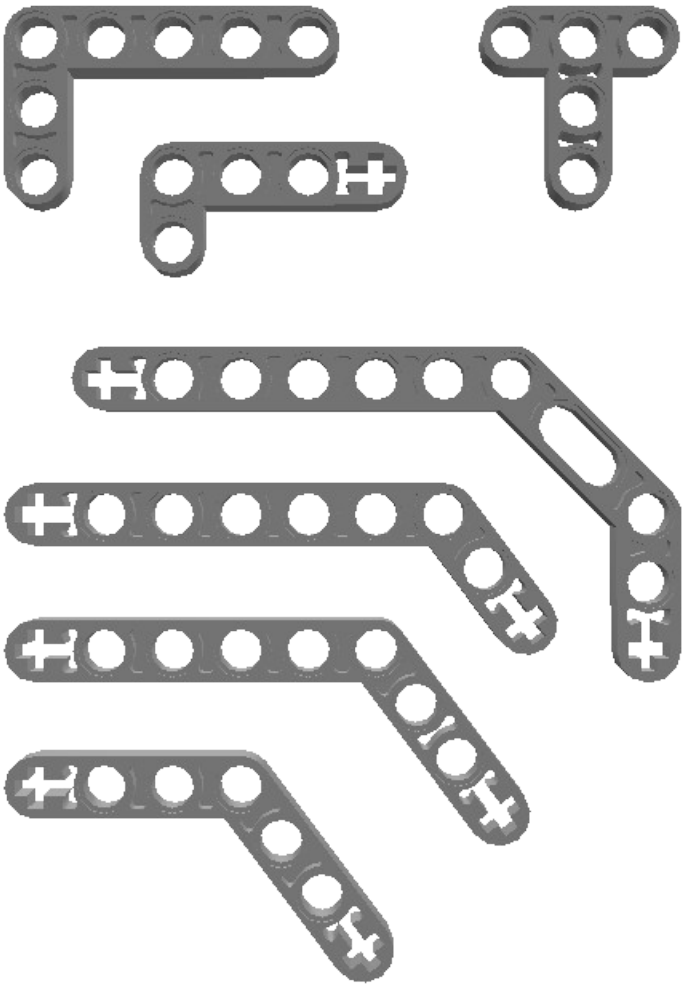


Angle beams

Allow beams to be connected at rigid angles

Excellent for structure

Some beams have cross holes



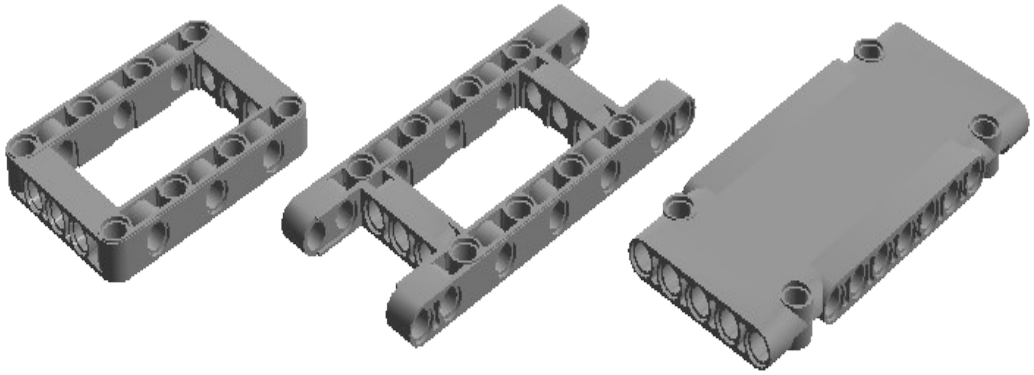
32526: 3x5 L beam
32140: 2x4 L beam
60484: 3x3 T beam
32009: 3x7 double-angle beam
32271: 3x7 angle beam
6629: 4x6 angle beam
32348: 4x4 angle beam

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

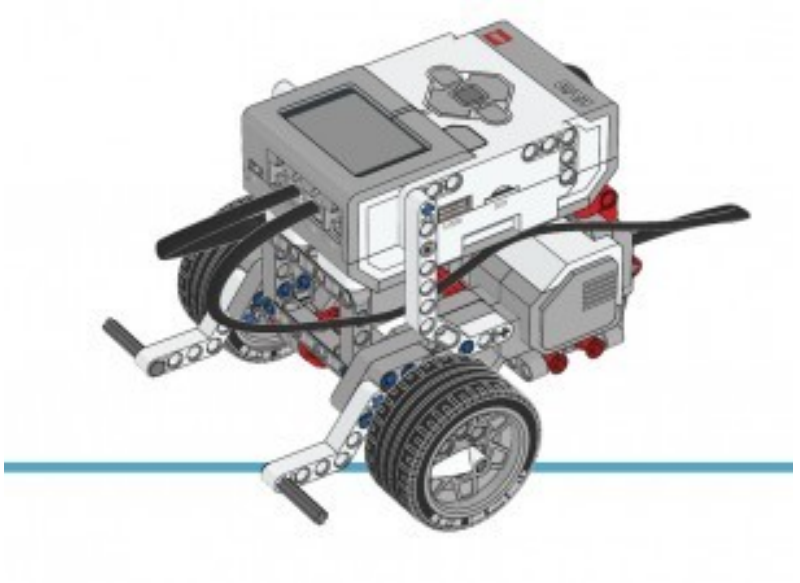
This robot is a good start for learning about LEGO parts, sensors, and programming

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