



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

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Welcome and Introduction



What is FIRST LEGO League?

FIRST Progression of Programs



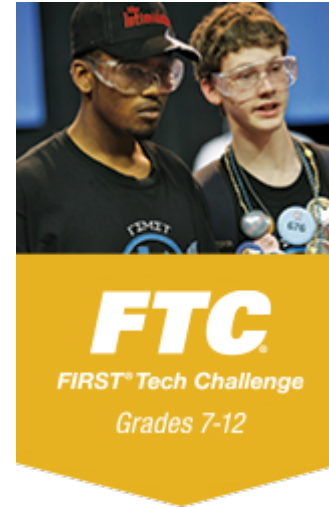
Ages 6-8
4,500 teams
27,000+ players
100+ expos

LEGO elements



Ages 9-14
26,000 teams
267,000 players
1,200+ qualifiers
136 championships

LEGO Mindstorms



Grades 7-12
4,500 teams
44,000 players
300+ meets/events

TETRIX/Matrix kits



Grades 9-12
3,000 teams
75,000 players
100+ meets/events

120 lbs, custom

* based on 2014/2015 projections
<http://www.usfirst.org/aboutus/first-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

Up to 10 team members



Robots built using LEGO Mindstorms and LEGO components only

Game challenge and theme changes every year

2011: Food safety

2014: Education and learning

2012: Senior citizens

2015: Trash and recycling

2013: Natural disasters

2016: Animals and people

North Texas Season Timeline

August 30, 2016: Challenge Release

Game and project rules, mission model build

September 2016: FLL Kickoff Events

UT-Dallas/SEEC (Sep 10)

Fellowship Christian Academy, Dallas (Sep 17)

September-November: Coaches Clinic events

UT-Dallas/SEEC

Fellowship Christian Academy

UME Preparatory School

North Texas Season Timeline

November: Scrimmage events

Nov 5: Fellowship Christian Academy (FCA), Dallas

Nov 19: Grand Saline Middle School

December 3, 10, and 17: Qualifier events

Various locations throughout North Texas

February 4, 2017: Regional Championship

Parish Episcopal School, Dallas

Competition format

FLL competitions have four parts

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



Robot Game

Played on a 4'x8' field

All teams obtain identical field kits, described in Challenge documents released Aug 30

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

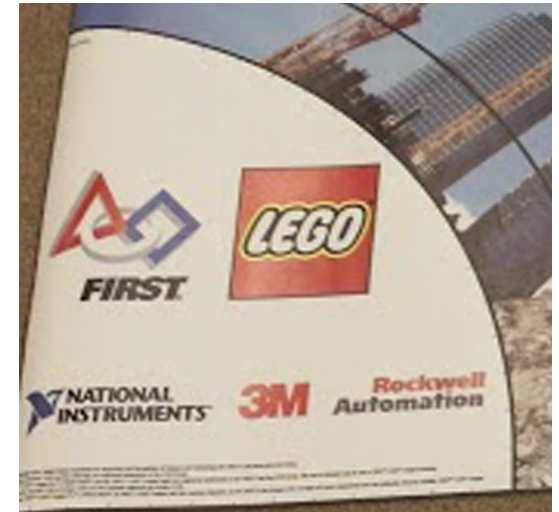
Robot always starts from “Base”

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”

Robot Game: Keys to success

Study the rules carefully!

Consistency and reliability are most important

Use sensors and good strategy to obtain reliability

Analyze missions and scoring

Look for easy, high-scoring missions

Minimize time spent in Base

Reduce possibility for driver error

Participate in scrimmage events

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

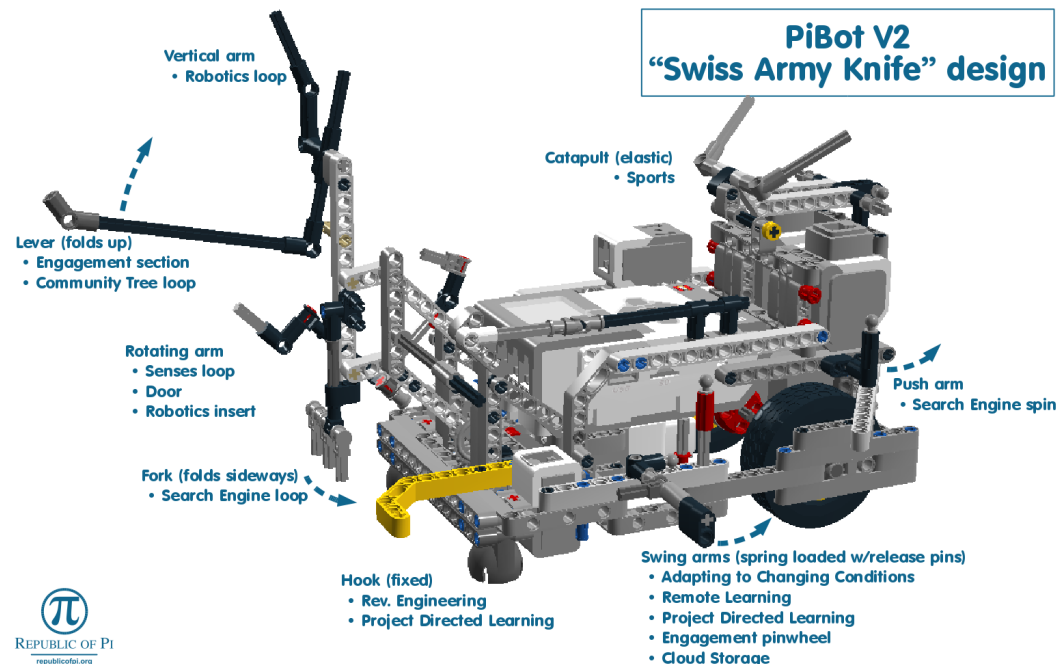
Usually: 5 min for presentation, 5 min for Q&A

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





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 AND would be inconsistent	would not achieve purpose OR would be inconsistent	should achieve purpose repeatedly	should achieve purpose every time
	D				
	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	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	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
D					
Comments:					
Strengths:		Mechanical Design		Programming	
				Strategy & Innovation	

Robot Design: judging tips

Focus on design process used to create robot

During judging, let the team members least involved in robot construction drive the robot

Project

Choose a topic related to Animal/human interaction

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

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
	D				
	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
	D				
	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	
D					
Comments:	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
	D				
Innovative Solution	Team Solution*	Clear explanation of the proposed solution			
	N	difficult to understand	some parts confusing	understandable	easy to understand by all
	D				
	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	existing solution/application	solution/application contains some original element(s)	original solution/application	original solution/application with the potential to add significant value
D					
Comments:	Implementation	Consideration of factors for implementation (cost, ease of manufacturing, etc.)			
	N	minimal factors considered	some factors considered	factors well considered; some question about proposed solution	factors well considered and feasible solution proposed
	D				
Presentation	Sharing*	Degree to which the team shared their Project before the tournament with others who might benefit from the team's efforts			
	N	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
	D				
	Creativity	Imagination used to develop and deliver the presentation			
	N	minimally engaging OR unimaginative	engaging OR imaginative	engaging AND imaginative	very engaging AND exceptionally imaginative
D					
Comments:	Presentation Effectiveness	Message delivery and organization of the presentation			
	N	unclear OR disorganized	partially clear; minimal organization	mostly clear; mostly organized	clear AND well organized
	D				
Strengths:		Research	Innovative Solution	Presentation	

*Required for Award Consideration

Project: Keys to success

Clearly state problem being addressed

Document research and sharing with others

- Bibliography

- Interviews

- Presentations

Perform some critical analysis of solution

- Cost, benefit, feasibility

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

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	
Inspiration	Discovery Balanced emphasis on all three aspects (Robot, Project, Core Values) of FLL; it's not just about winning awards				
	N	emphasis on only one aspect; others neglected	emphasis on two aspects; one aspect neglected	emphasis on all three aspects	balanced emphasis on all three aspects
	D				
	Team Spirit Enthusiastic and fun expression of the team identity				
	N	minimal enthusiasm AND minimal identity	minimal enthusiasm OR minimal identity	team is enthusiastic and fun; clear identity	team engages others in their enthusiasm & fun; clear identity
	D				
Integration	Application of FLL values and skills outside FLL (ability to describe current and potential examples from daily life)				
	N	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
	D				

Comments:

Teamwork	Effectiveness Problem solving and decision making processes help team achieve their goals				
	N	team goals AND team processes unclear	team goals OR team processes unclear	clear team goals and processes	clear processes enable team to accomplish well defined goals
	D				
	Efficiency Resources used relative to what the team accomplishes (time management, distribution of roles and responsibilities)				
	N	limited time management AND unclear roles	limited time management OR unclear roles	excellent time management and role definition allows team to accomplish most goals	excellent time management and role definition allows teams to accomplish all goals
	D				
Kids Do the Work	Appropriate balance between team responsibility and coach guidance				
	N	limited team responsibility AND excessive coach guidance	limited team responsibility OR excessive coach guidance	Good balance between team responsibility and coach guidance	team independence with minimal coach guidance
	D				

Comments:

Gracious Professionalism®	Inclusion Consideration and appreciation for the contributions (ideas and skills) of all team members, with balanced involvement				
	N	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	balanced team involvement AND appreciation for contributions of all team members
	D				
	Respect Team members act and speak with integrity so others feel valued-- especially when solving problems or resolving conflicts				
	N	not evident with majority of team members	evident with majority of team members	almost always evident with all team members	always evident, even in the most difficult situations
	D				
Coopertition®	Team competes in the spirit of friendly competition and cooperates with others				
	N	not evident with majority of team members	evident with majority of team members	almost always evident with all team members	always evident, even in difficult situations--and team actively helps other teams
	D				

Comments:

Strengths:	Inspiration	Teamwork	Gracious Professionalism®
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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

Qualifier Awards

Judged awards:

1st place Champion's
2nd place Champion's
Core Values
Robot Design
Project
Judges Award
Local Award



Robot Performance:

1st Place Robot Performance
2nd Place Robot Performance

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 400 teams



Global Challenge Release

30 August 2016

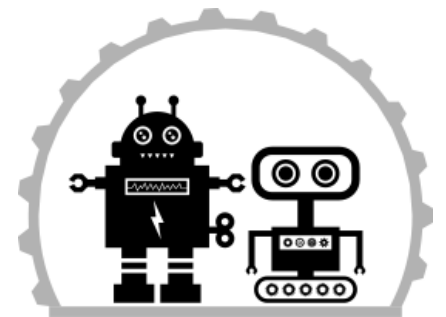
12 PM EDT

Purchase a Field setup kit
(mat and mission model LEGOs)

Challenge document released August 30

Obtain Mindstorms EV3 kit

Join Roboplex.org and mailing list



Getting started: Early season team activities

Review the challenge documents (Aug 30)

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”

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



Local contacts and online resources

roboplex.org : Robotics for the Metroplex

NorthTexasFLL Google Group

firstlegoleague.org

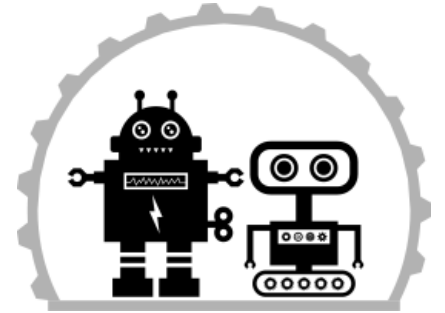
Perot Museum

Joe Varnell, FIRST Senior Mentor

jvarnell@usfirst.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"

Beams

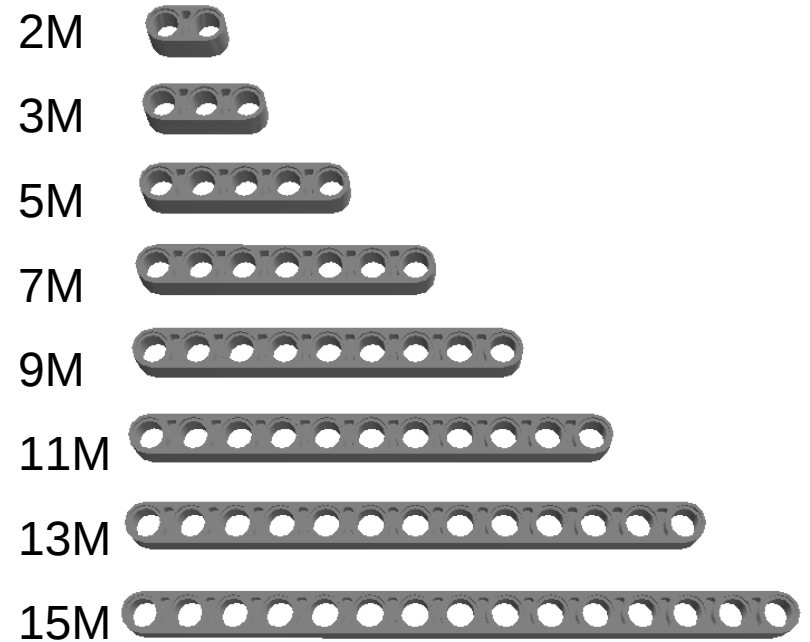
Beams are the basic building pieces for most LEGO robots

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”



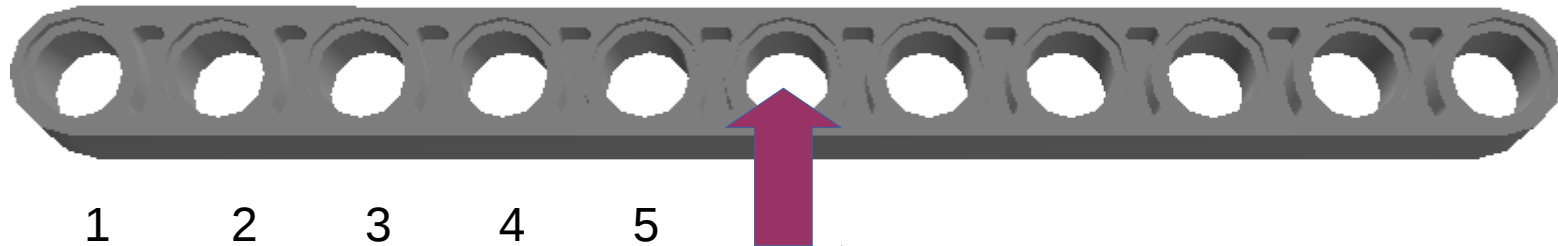
Quickly determining beam size

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



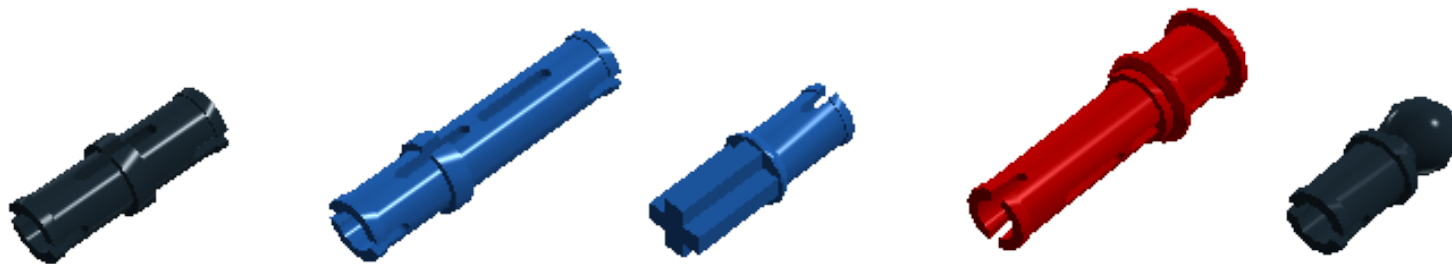
Pegs

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

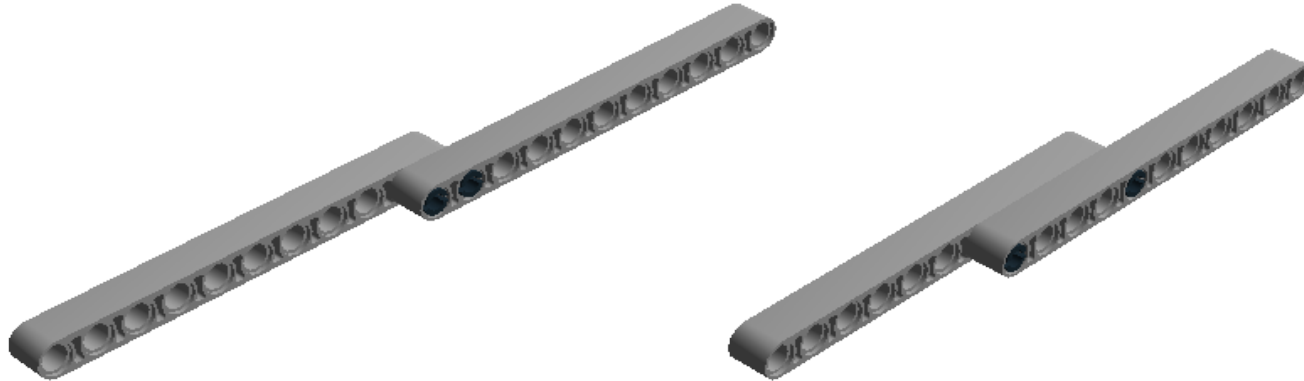


Connecting beams

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!

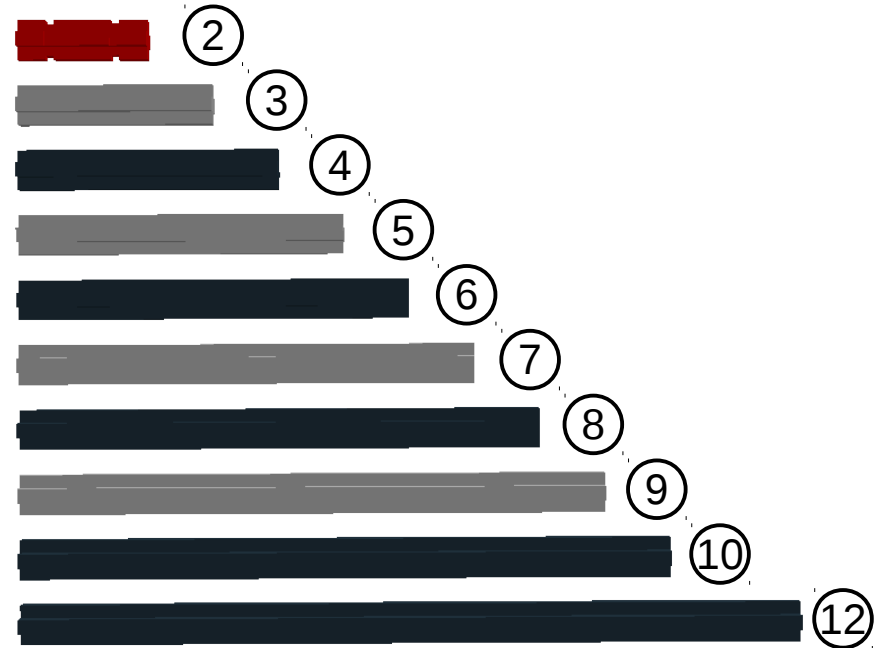
Axles

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



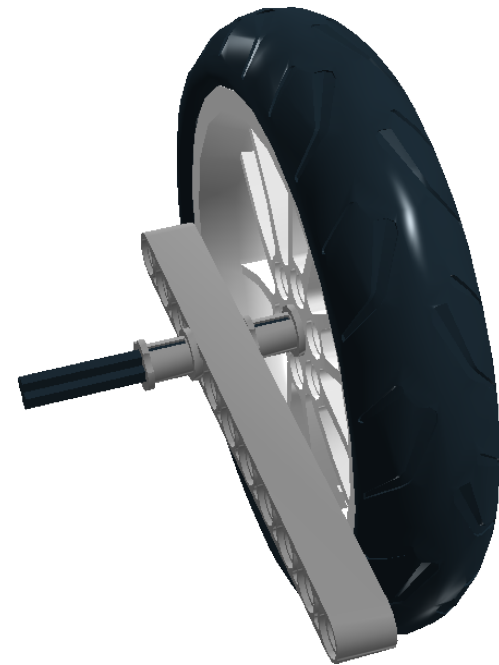
Bushings

Used to hold axles on beams

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

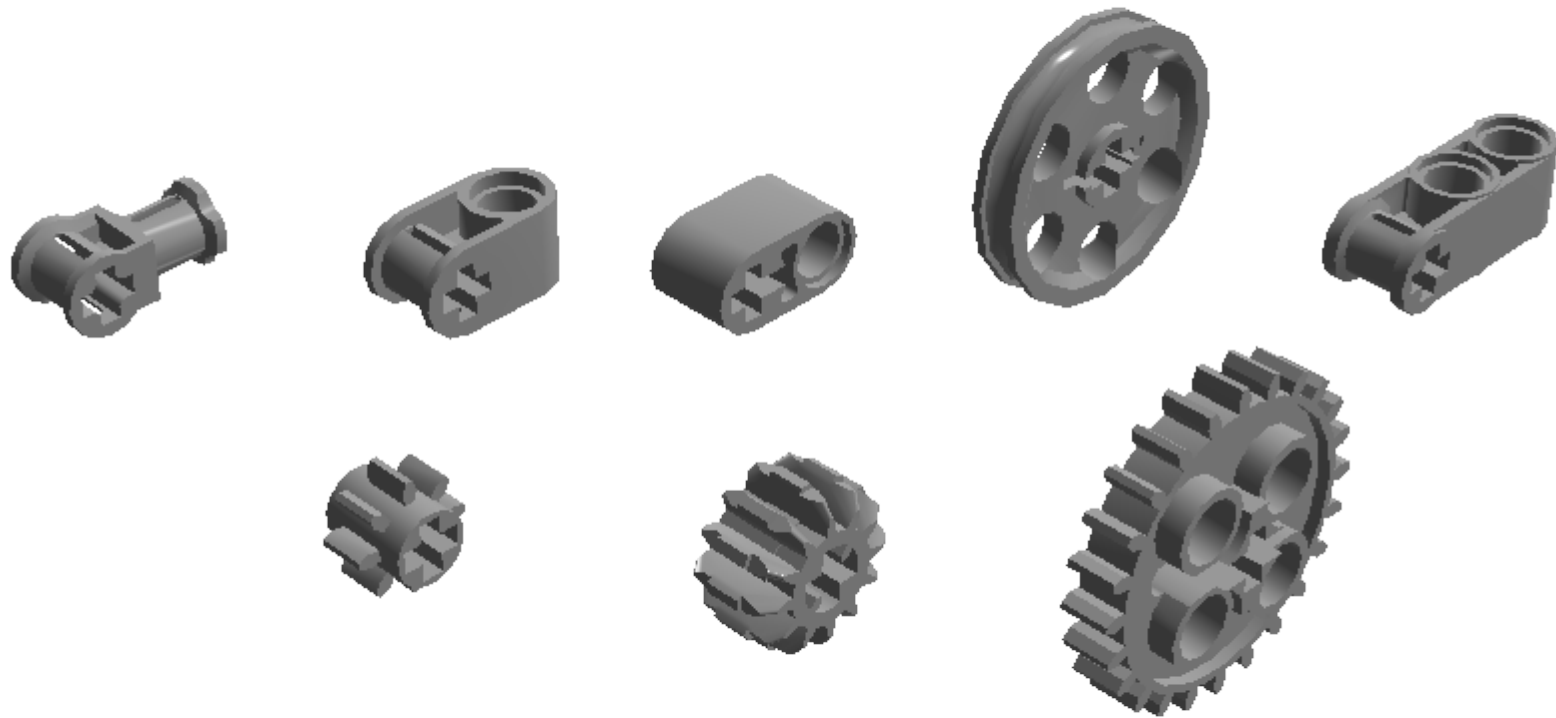
32123 Half-bushing

6590 Bushing



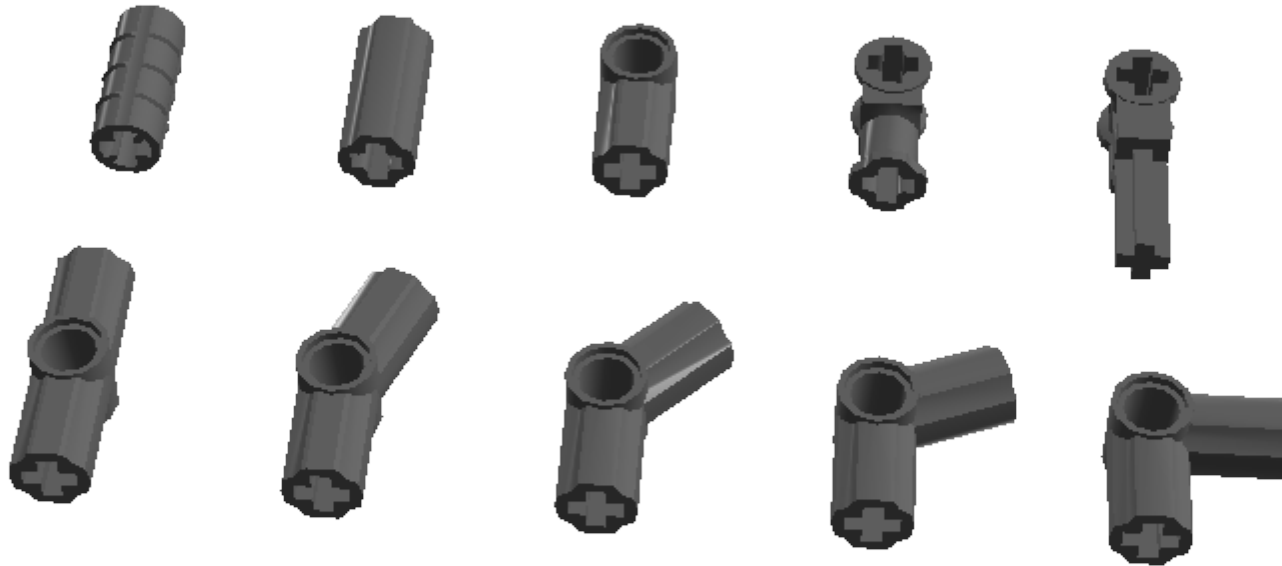
Bushings

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

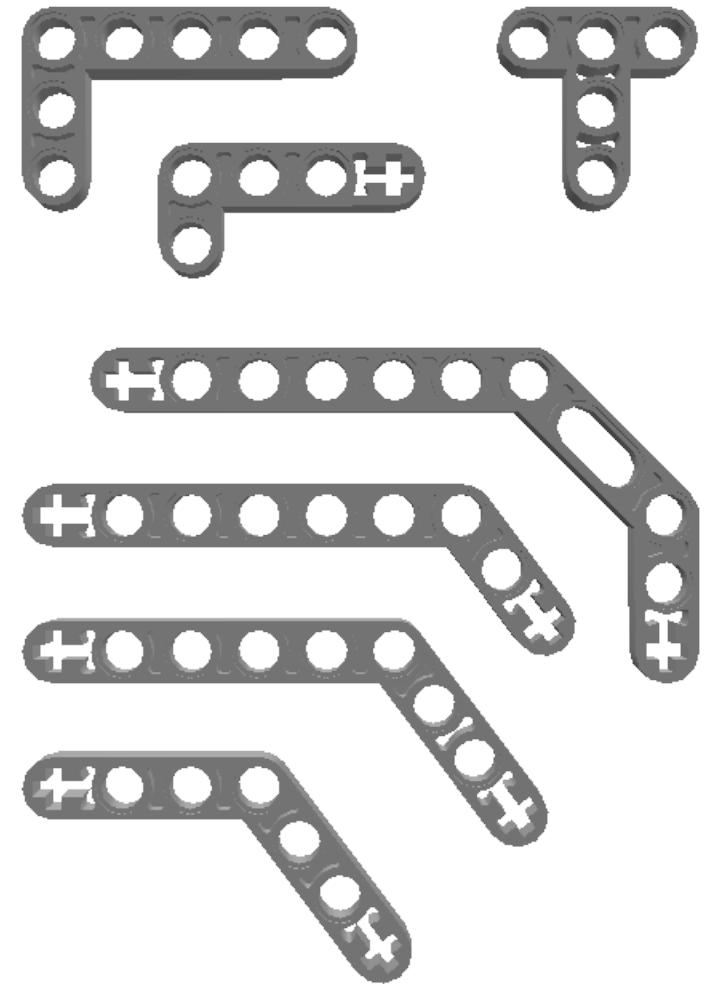
60484: 3x3 T beam

32009: 3x7 double-angle beam

32271: 3x7 angle beam

6629: 4x6 angle beam

32348: 4x4 angle beam



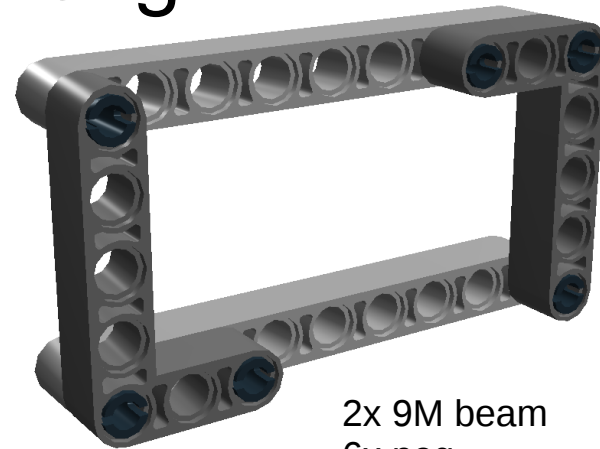
Structural strength

Weak



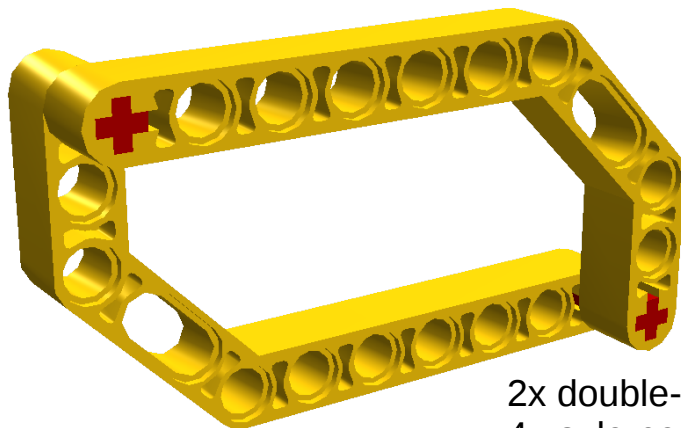
2x 5M beam
2x 9M beam
4x peg

Strong



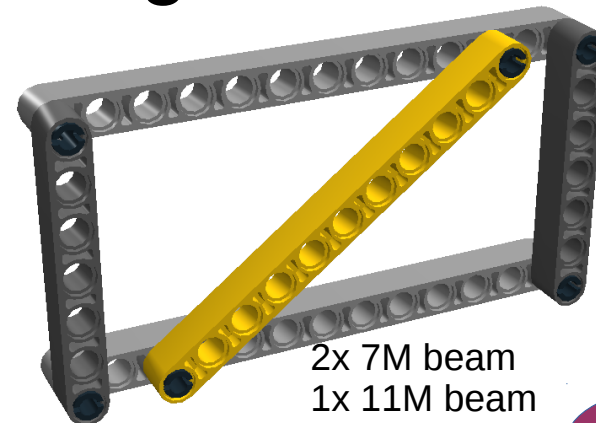
2x 9M beam
6x peg

Strong



2x double-angle beam
4x axle peg

Strong



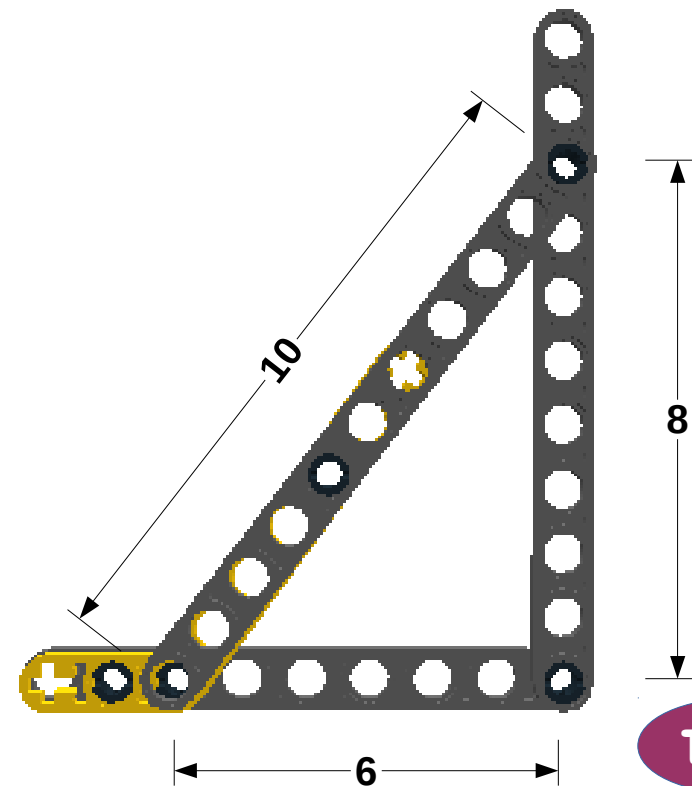
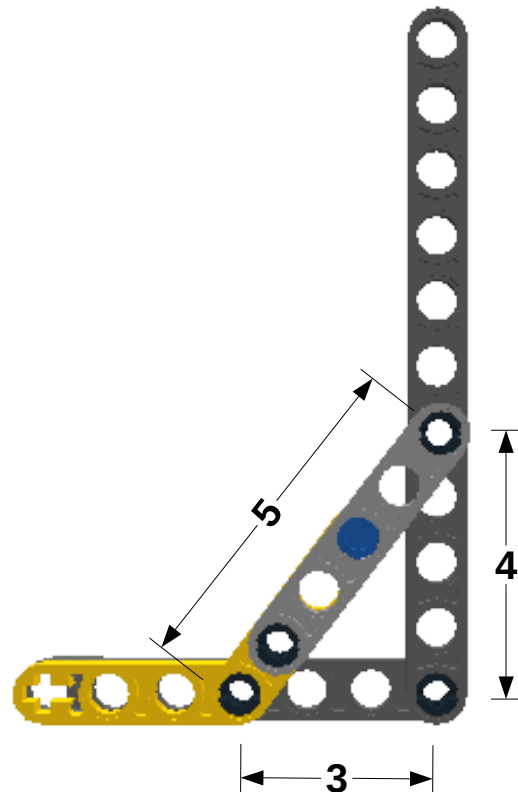
2x 7M beam
1x 11M beam
2x 13M beam
6x peg

Try these!

3:4:5 triangles

Angled bracing is very strong

Use 3:4:5 spacing to ensure right angles and proper alignment



Try it!

Useful LEGO pieces - frames and panels

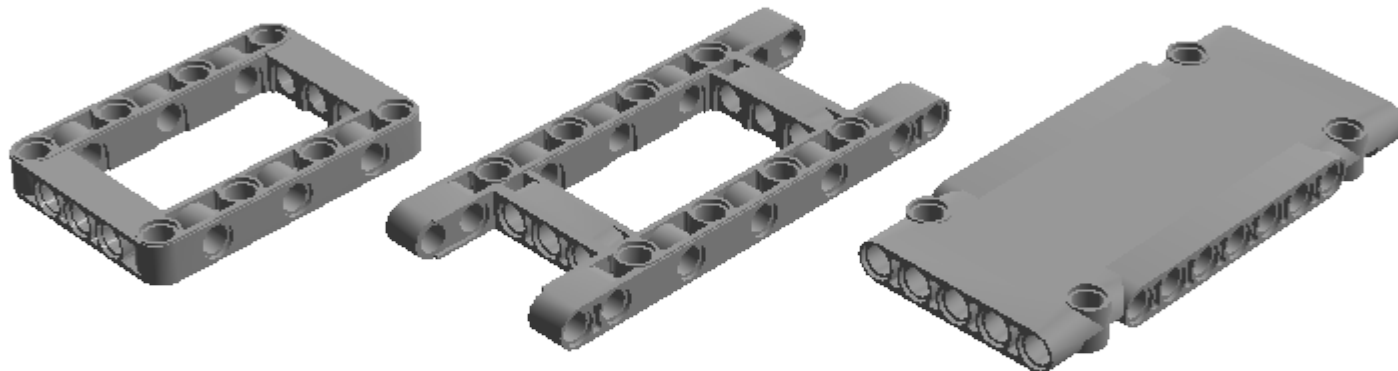
These pieces are excellent for building large structures and boxes

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



Useful LEGO pieces - cross blocks and beams

These allow connections in multiple directions

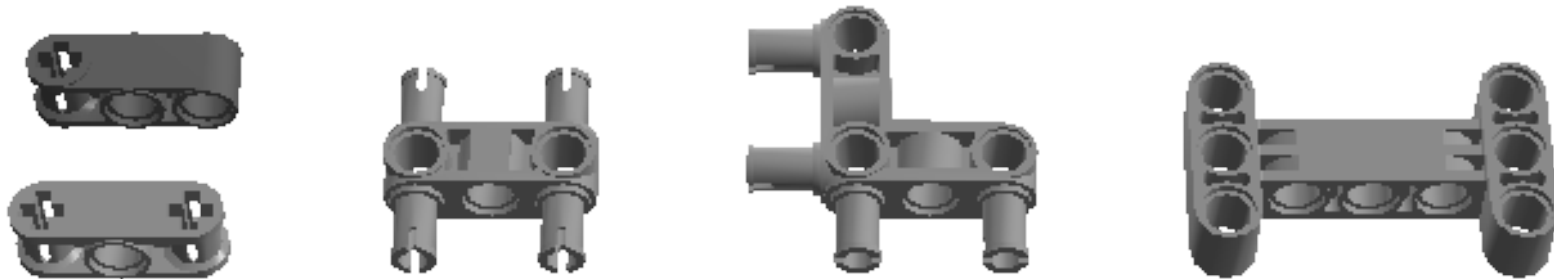
42003: Cross block 3M

32184: Double cross block

48989: Beam 3M with 4 snaps ("H-peg")

55615: Angular beam 90 degrees with 4 snaps ("L-peg")

14720: Beam I-Frame 3x5 90 degrees



Useful LEGO pieces - cross blocks

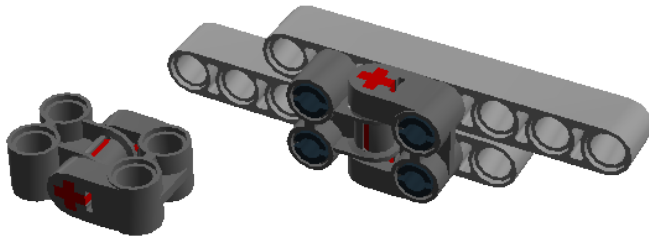
These cross blocks have a wide variety of uses

32291: Cross block 2x1 ("Mickey")

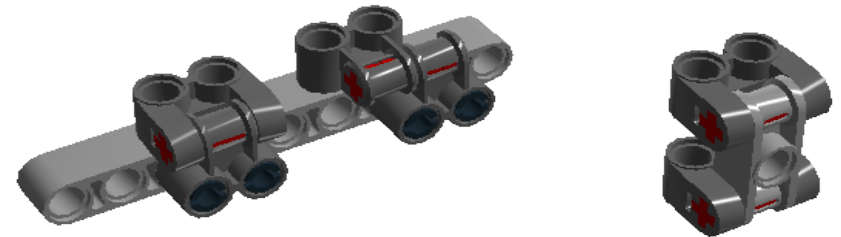
41678: Cross block fork 2x2 ("Minnie")



Connect two parallel beams



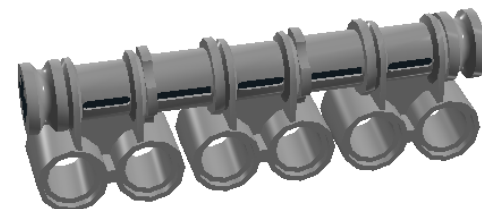
Create holes at right angles



Mount axles in different directions

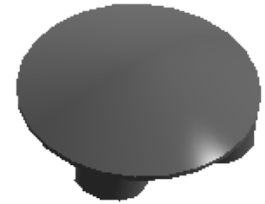


Create "beams" with even # of holes

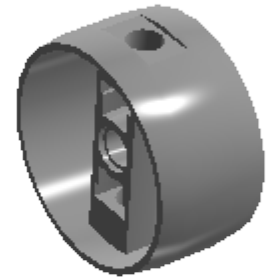
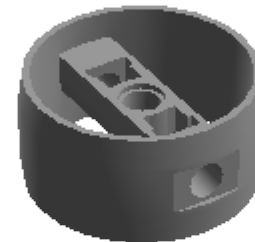


Useful LEGO pieces - misc

2654: Slide shoe round 2x2
(good for skids)



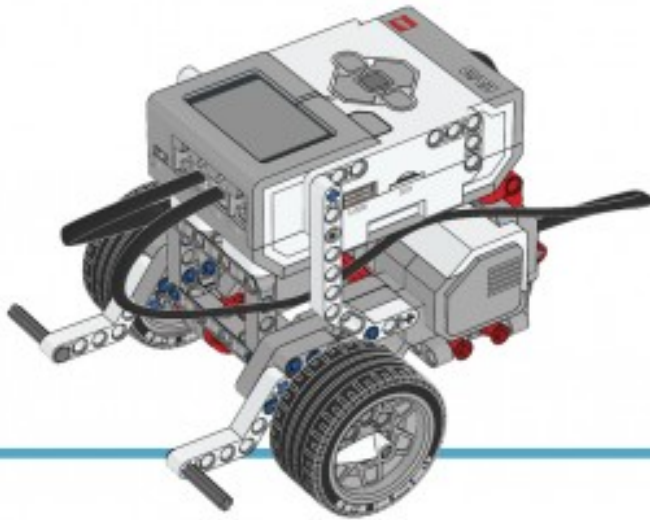
41531: Turbine 31.01 x 2
(wheels that also slide)



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





Questions and Discussion