

# **FIRST<sup>®</sup> LEGO<sup>®</sup> League** **TUTORIALS**

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## **Wheels**

By Sanjay and Arvind Seshan



## **ROBOT DESIGN LESSON**

# LOTS TO CHOOSE FROM

- LEGO is the largest tire manufacturer in the world!
- LEGO has wheels of all sizes and also treads



# TIP: MEASURING THE SIZE OF A TIRE

## 1) Look for the size of the tire on the tire itself

The first number is the diameter to of the tire in mm.  
The second is the width of the tire in mm.

## 2) Look up the tire on a LEGO catalogue (e.g. Brickowl.com and Bricklink.com), or using the LEGO wheels chart by Sarel (see page 11)



# KNOWING YOUR WHEEL SIZE HELPS CONVERT DISTANCE TO DEGREES

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## Wheel Converter: Automatic Distance to Degrees Calculator

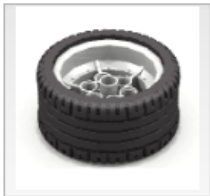
This tool can be used to easily convert your wheel/tire size information into useful data to be used by your First Lego League team.

**STEP 1: Enter Wheel Dimensions**


Input your wheel diameter in millimeters \*-OR-\* You can click one of the tires commonly used by FLL teams below.




Large Motorcycle Wheel - 94.2×20




EV3 basic tire - 56×28



Motorcycle tire - 81.6×15



Balloon tire - 56×26



Small tire - 43.2×22

**STEP 2: Enter Distance Robot Needs to Move**

Input the distance you would like the robot to move in either inches or centimeters:

centimeters

inches

**STEP 3: Hit the Button to Calculate!**

CALCULATE

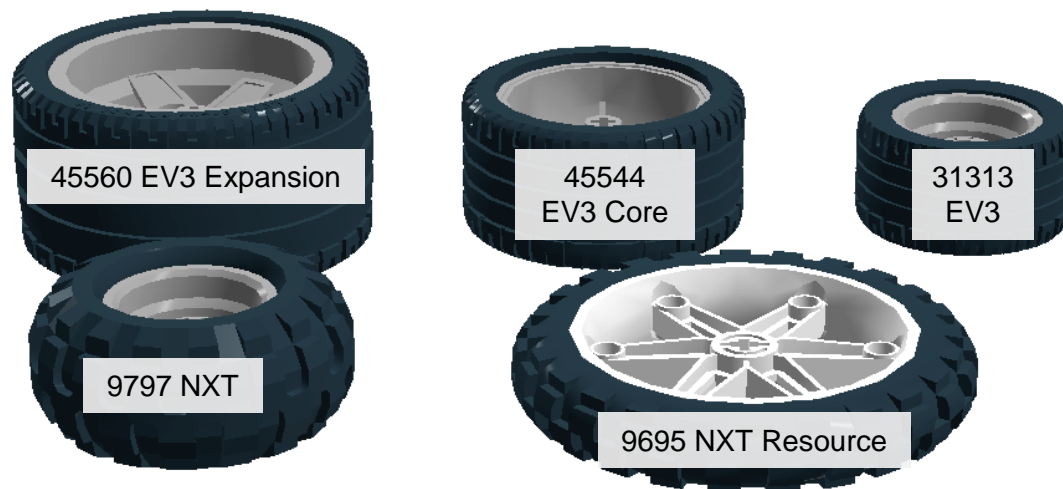
<http://ev3lessons.com/resources/wheelconverter/>

# “BEST” WHEELS FOR FIRST LEGO LEAGUE

There are many options for wheels on your competition robot. There is no “best” wheel.

- 1) Some wheels are better than others, but there is no one wheel that is perfect for every task or every surface your robot will run on.
- 2) Every wheel has a pro and a con
- 3) Do not make decisions on what wheel to use based on someone else’s experience

Create a set of tests to see if the wheels can hold the weight of the robot, drive straight and are fast enough for your tasks (see next page)



Common  
wheels found in  
MINDSTORMS  
sets

# THINGS TO CONSIDER: SIZE, SPEED, ACCURACY, STABILITY...

- Large wheels make a robot taller and so might give you both greater ground clearance as well as a higher center of gravity
  - This might be positive as you might be able to drive over obstacles, but might also make your robot unstable
- Large wheels allow your robot to travel further for each rotation, therefore, making your robot faster.
  - Speed can be a positive thing in a timed robotics contest, but your robot may not travel as accurately
- Smaller wheels are slower but can be more accurate than large wheels
- Wider wheels allow for more contact with the ground which might increase stability, but can also cause more friction.

See next page for sample tests

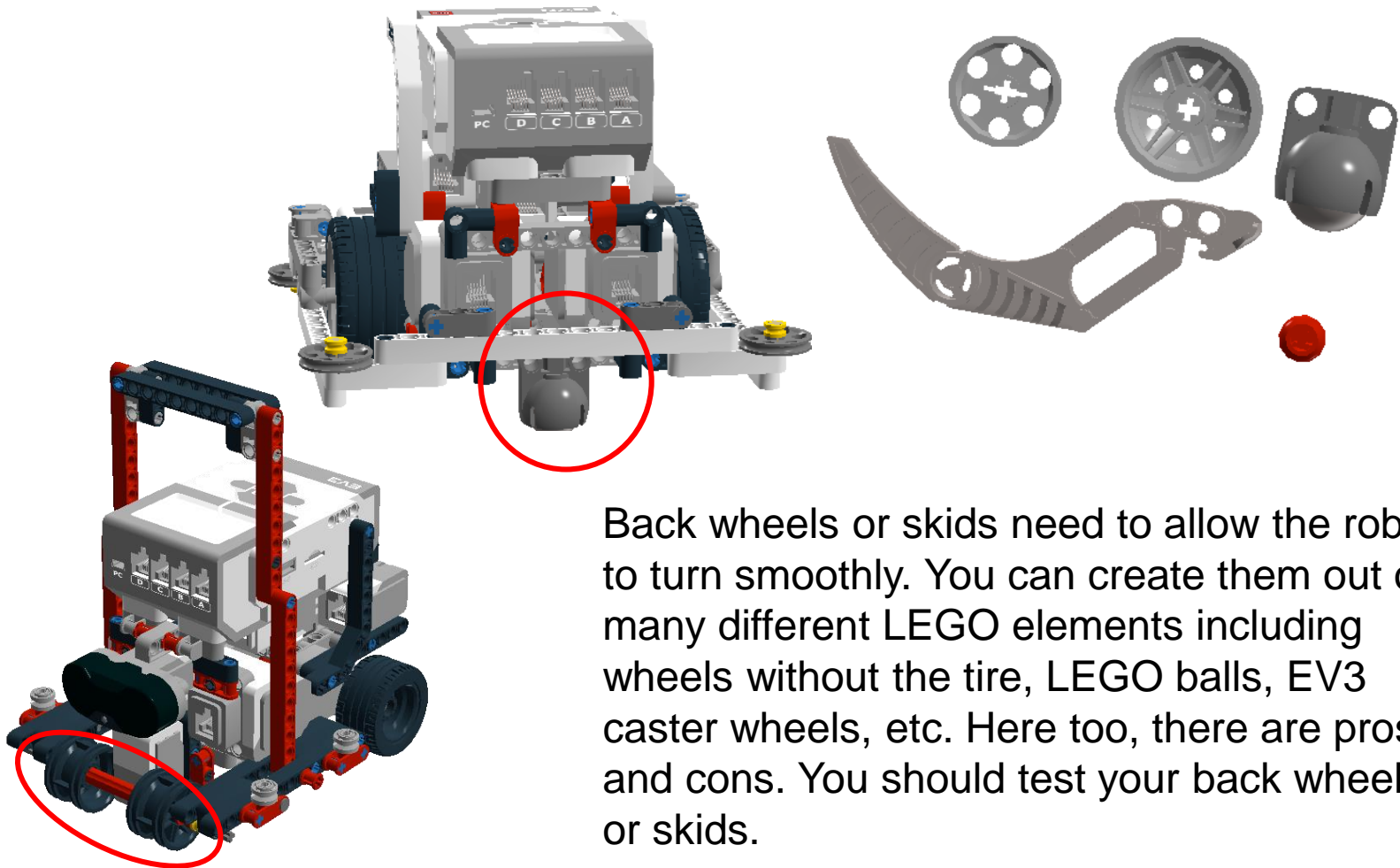


# SAMPLE WORKSHEET

Tests	Results
Wheel used	<i>(List the wheel type and size)</i>
Accuracy Test: Move straight 20-30 inches	<i>(Does the robot veer?)</i>
Turn Test: Four 90 degree turns in a row	<i>(Are the turns accurate?)</i>
Traction Test: Push an object	<i>(Does the robot skid?)</i>
Speed Test: Time to go 70 inches, Turn 360 degrees	<i>(Is your robot fast?)</i>
Tire observations	<i>(Does the tire stay on the rim or come off easily?)</i>
Height and width of robot (when using these tires)	<i>(Does the tire make the robot narrower, wider, taller, or shorter?)</i>

You will have to weigh the plusses and minuses of each wheel for your robot.

# BACK WHEELS: SKIDS, CASTER WHEELS....



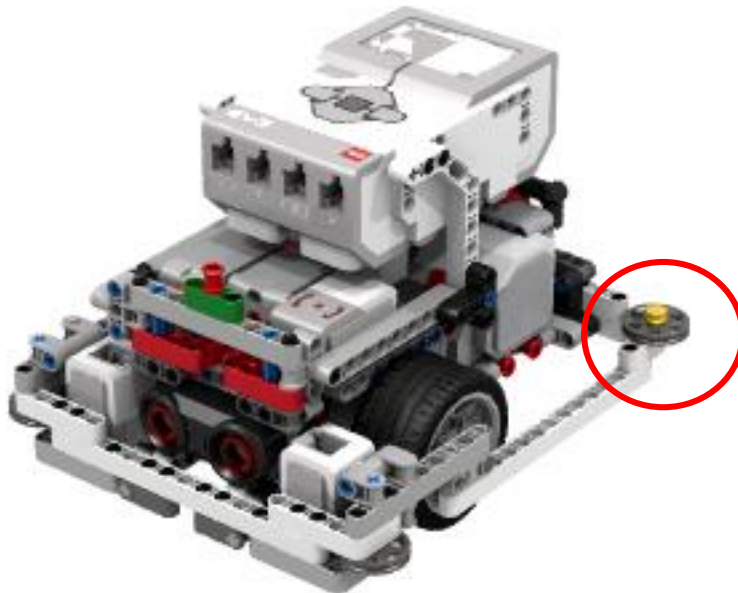
Back wheels or skids need to allow the robot to turn smoothly. You can create them out of many different LEGO elements including wheels without the tire, LEGO balls, EV3 caster wheels, etc. Here too, there are pros and cons. You should test your back wheels or skids.



# WHEELS FOR OTHER USES

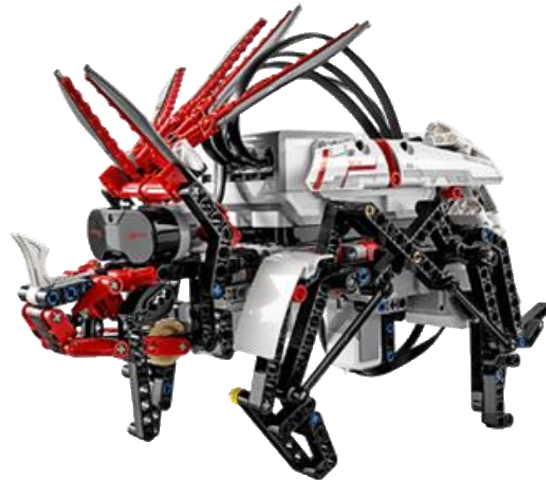
Riding wheels can help your robot drive along walls.

**FLL Tip:** Make sure that they are installed at the correct height for your table (at home or at competition). You might have either 2X4 or 2X3 wood as walls.








# ROBOTS WITH NO WHEELS

You don't always need wheels to build a robot that moves!



Images from LEGO and LEGO Education

# USEFUL TOOL: LEGO WHEELS CHART

LEGO™ Wheels Chart					
<p>Move your cursor over any item to see subparts: rim and tire (does not apply to single-piece wheels). When subparts are shown, move your cursor over a rim to see the tires it fits, or over a tire to see the rims it fits. Click any image to open respective Bricklink's catalog page in a new tab in your browser</p> <p>You can sort the chart by clicking fields from 'Total diameter' to 'Weight'.</p> <p>Total items: 50. Last updated: July 19th 2016.</p>					
Wheel:	Total diameter:	Tire width:	Rim diameter:	Rim width:	Weight:
	14 mm 0.55" 1.75 studs	6 mm 0.24" 0.75 studs	11 mm 0.43" 1.38 studs	8 mm 0.31" 1 studs	0.75g
	17 mm 0.67" 2.13 studs	6 mm 0.24" 0.75 studs	11 mm 0.43" 1.38 studs	8 mm 0.31" 1 studs	1.1g
	20 mm 0.79" 2.5 studs	no tire	20 mm 0.79" 2.5 studs	?	3g
	23 mm 0.91" 2.88 studs	no tire	23 mm 0.91" 2.88 studs	23 mm 0.91" 2.88 studs	4g
	24 mm 0.94" 3 studs	13.5 mm 0.53" 1.69 studs	17.5 mm 0.69" 2.19 studs	16 mm 0.63" 2 studs	3g
	24 mm 0.94" 3 studs	7 mm 0.28" 0.88 studs	17 mm 0.67" 2.13 studs	7 mm 0.28" 0.88 studs	3g
	30 mm 1.18" 3.75 studs	3 mm 0.12" 0.38 studs	24 mm 0.94" 3 studs	3 mm 0.12" 0.38 studs	2g

<http://wheels.sariel.pl/>

# CREDITS

- This tutorial was created by Sanjay Seshan and Arvind Seshan
- More lessons at [www.ev3lessons.com](http://www.ev3lessons.com) and [www.flltutorials.com](http://www.flltutorials.com)
- LEGO Wheels Chart from <http://wheels.sariel.pl/>



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