

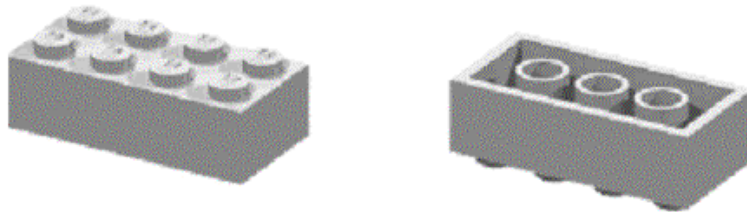
## The Bits and Pieces



# Basic Lego Structures

## Bricks

This is a LEGO building brick. Little has changed since its introduction in 1949. According to LEGO, they have produced 320 billion bricks<sup>1</sup> since that time. That is approximately 52 bricks per person living today.

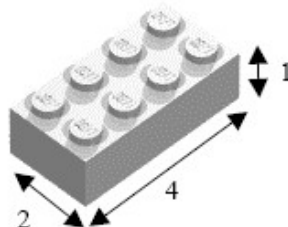


Basic LEGO Brick

LEGO bricks are made out of ABS plastic. They are injection molded to very exacting tolerances (0.002mm)<sup>2</sup>. The top of the brick is covered with cylindrical plastic bumps called studs. The bottom of the brick has cylindrical holes or tubes. When you snap two bricks together, the tubes deform slightly around the studs, locking the two firmly together.

## Dimensions

The common practice is to refer to bricks using their dimensions: width, length, and height (though height is often left off when referring to standard sized bricks). When doing this, the width and length dimensions are given in studs. The piece below is a 2 x 4 brick.

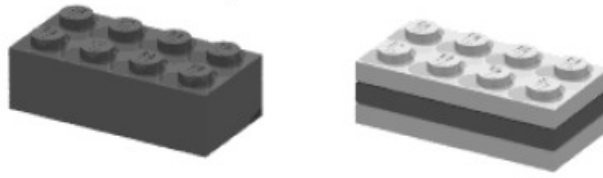


Brick Dimensions

LEGO bricks are based on the metric system. The 2 x 4 brick above is 16mm wide, 32 mm long, and 9.6mm high (ignoring the studs on top). That works out to 1 stud = 8mm.

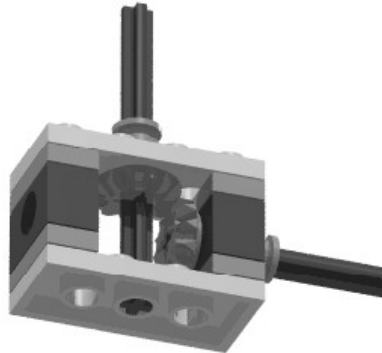
## Plates

Plates are essentially short bricks. They are 1/3 the height of standard bricks-- 3.2mm or 0.4 studs. Plates use the same naming convention as bricks.



**Three Plates = One Brick high**

Some plates have through holes aligned with the backside tubes. They are referred to as Technic plates, or less obscurely, plates with holes. The holes accept axles and connector pins and make the Technic plates much more useful.



**Simple Gearbox Using Technic Plates**

**Construction Note:** Use normal plates when you don't need the through holes. Save the Technic plates for where they are needed.

## Beams

In 1977, LEGO introduced Technic<sup>3</sup>, a series of complex models for older children to build. Central to Technic are the new beams which are 1x bricks with holes in their sides. The holes are spaced at one-stud intervals and centered between the studs on the top of the beam. The beams can be stacked on top of each other just like bricks. In addition, connector pins can be placed in the side holes allowing the beams to be assembled side by side. The number of assembly techniques available using the new parts is staggering.

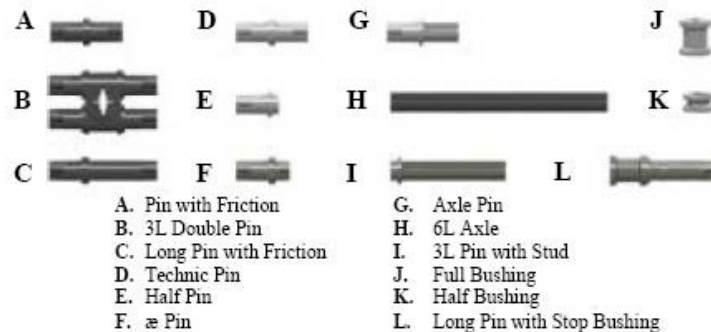


**Technic Beams**

## Axles and Pins

There are a wide variety of pins and axles for connecting Technic beams together. The most commonly used of these is the black Technic pin with friction, or friction pin. The

friction pin has small, raised ridges that make it lock tightly in the holes of a Technic beam providing a very strong connection. A long version of the friction pin can be used to pin three beams together. The double pin works well with the goofy transparent blue connector block and has an axle hole that can sometimes be useful.

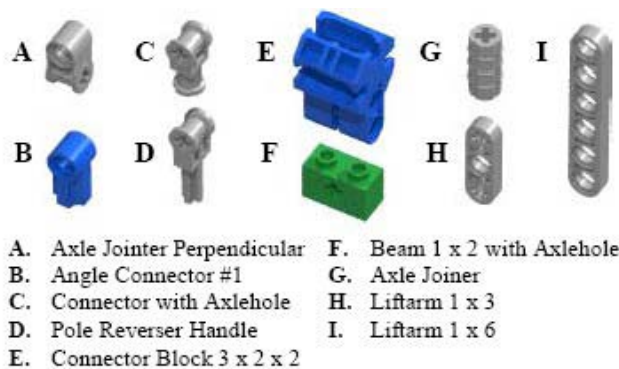


### Pins and Axles

Slightly less common is the gray Technic pin. Similar in appearance to the friction pin, it lacks the ridges and has a slightly loose fit. The Technic pin is a good choice for pivots or hinges. The short post of the  $\Omega$  Technic pin fits nicely in the half deep holes in the side of the programmable brick, and it is often used to attach beams to the side of the programmable brick. The short post of the  $\Omega$  Technic pin is actually the same size as a LEGO stud and can be used to mimic studs coming out of the side of a beam.

Axles are long rods that have a + shaped cross section. They slide easily through the holes in Technic beams, but they fit tightly in the cross-holes found in wheels, gears, bushings, and other Technic elements. Axles are available in even stud lengths starting at 2 and going up to 12. There are also 3 and 5 stud long axles. It is common to use shorthand when referring to axles, describing the axle using its length followed by L. Thus a four stud long axle is a 4L axle.

Other odd ball parts:



Adapted from: Dean Hystad, *Building LEGO Robots for FIRST LEGO League*, Innovations in Science and Technology Education, Version 1.0, Sept 23, 2002.