

LEGO

This article is about the construction toy. For the company, see The Lego Group. For other uses, see Lego (disambiguation).

LEGO (Danish pronunciation: [lɑjˀɡøˀ?]; stylized **LEGO**) is a line of plastic construction toys that are manufactured by The Lego Group, a privately held company based in Billund, Denmark. The company's flagship product, Lego, consists of colourful interlocking plastic bricks accompanying an array of gears, figurines called minifigures, and various other parts. Lego pieces can be assembled and connected in many ways, to construct objects; vehicles, buildings, and working robots. Anything constructed can then be taken apart again, and the pieces used to make other objects.^{[1][2]}

The Lego Group began manufacturing the interlocking toy bricks in 1949. Since then a global Lego subculture has developed. Supporting movies, games, competitions, and six Legoland amusement parks have been developed under the brand. As of July 2015, 600 billion Lego parts had been produced.^[3]

In February 2015, Lego replaced Ferrari as Brand Finance's "world's most powerful brand".^[4]

1 History

Main articles: History of Lego and Lego timeline

The Lego Group began in the workshop of Ole Kirk



Lego bricks

Christiansen (1891–1958), a carpenter from Billund, Denmark, who began making wooden toys in 1932.^{[5][6]} In 1934, his company came to be called "LEGO", derived from the Danish phrase *leg godt*, which means "play



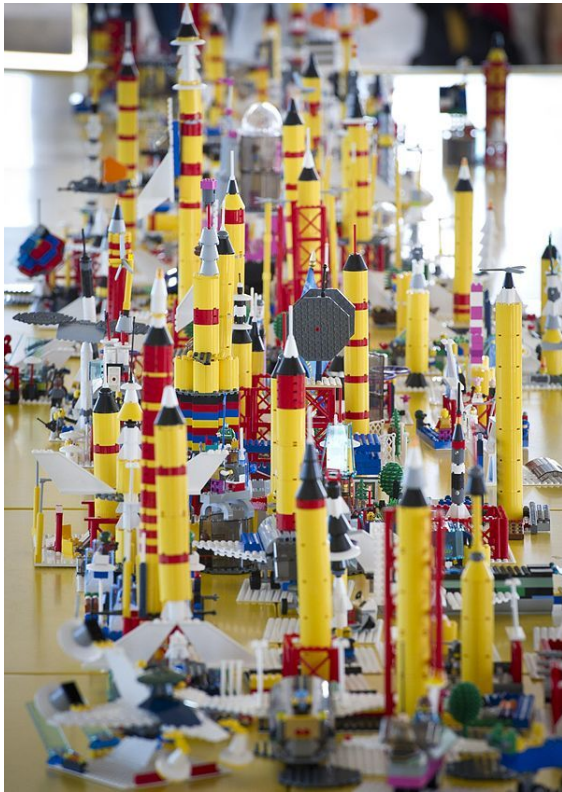
Lego Duplo

well". In 1947, Lego expanded to begin producing plastic toys.^[7] In 1949 Lego began producing, among other new products, an early version of the now familiar interlocking bricks, calling them "Automatic Binding Bricks". These bricks were based in part on the Kiddicraft Self-Locking Bricks, which were patented in the United Kingdom in 1939^[8] and released in 1947. Lego modified the design of the Kiddicraft brick after examining a sample that they received from the supplier of an injection-molding machine that Lego purchased.^[9] The bricks, originally manufactured from cellulose acetate,^[10] were a development of the traditional stackable wooden blocks of the time.^[7]

The Lego Group's motto is *det bedste er ikke for godt* which means roughly "only the best is the best" (more literally "the best is never too good").^[6] This motto, which is still used today, was created by Ole Kirk to encourage his employees never to skimp on quality, a value he believed in strongly.^[6] By 1951 plastic toys accounted for half of the Lego Company's output, even though the Danish trade magazine *Legetøjs-Tidende* ("Toy-Times"), visiting

the Lego factory in Billund in the early 1950s, felt that plastic would never be able to replace traditional wooden toys.^[11] Although a common sentiment, Lego toys seem to have become a significant exception to the dislike of plastic in children's toys, due in part to the high standards set by Ole Kirk.^[12]

By 1954, Christiansen's son, Godtfred, had become the junior managing director of the Lego Group.^[11] It was his conversation with an overseas buyer that led to the idea of a toy system. Godtfred saw the immense potential in Lego bricks to become a system for creative play, but the bricks still had some problems from a technical standpoint: their locking ability was limited and they were not versatile.^[1] In 1958, the modern brick design was developed; however, it took another five years to find the right material for it, ABS (acrylonitrile butadiene styrene) polymer.^{[9][10]} The modern Lego brick design was patented on 28 January 1958.^[13]



Lego building at NASA's Kennedy Space Center

The Lego Group's Duplo product line was introduced in 1969 and is a range of simple blocks which measure twice the width, height and depth of standard Lego blocks and are aimed towards younger children.^{[11][14]}

In 1978, Lego produced the first minifigures, which have since become a staple in most sets.^[15]

In May 2011, Space Shuttle Endeavour mission STS-134 brought 13 Lego kits to the International Space Station, where astronauts built models to see how they would react in microgravity, as a part of the Lego Bricks in Space

program. The results will be shared with schools as part of an educational project.^{[16][17]}

In May 2013, the largest model ever created was displayed in New York and was made of over 5 million bricks; a 1:1 scale model of an X-wing fighter.^[18] Other records include a 112-foot (34 m) tower^[19] and a 4 km (2.5 mi) railway.^{[20][21][22]}

In February 2015, Lego replaced Ferrari as the "world's most powerful brand."^{[4][23]}

1.1 In popular culture

Main article: [Lego in popular culture](#)

Lego's popularity is demonstrated by its wide representation and usage in many forms of cultural works, including books, films and art work. It has even been used in the classroom as a teaching tool.^[24] In the USA, Lego Education North America is a joint venture between Pitsco, Inc. and the educational division of the Lego Group.^[25]

In 1998, Lego bricks were one of the original inductees into the National Toy Hall of Fame at The Strong in Rochester, New York.^[26]

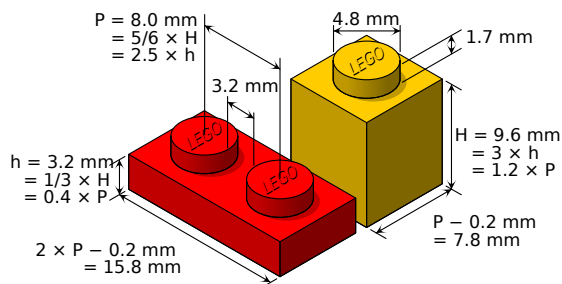
2 Design



A model of Trafalgar Square, London, in Legoland Windsor

Lego pieces of all varieties constitute a universal system. Despite variation in the design and the purposes of individual pieces over the years, each piece remains compatible in some way with existing pieces. Lego bricks from 1958 still interlock with those made in the current time, and Lego sets for young children are compatible with those made for teenagers. Six pieces of 2x4 bricks can be combined in 915,103,765 ways.^[27]

Each Lego piece must be manufactured to an exacting degree of precision. When two pieces are engaged they must fit firmly, yet be easily disassembled. The machines that manufacture Lego bricks have tolerances as small as 10 micrometres.^[28]



Dimensions of some standard Lego bricks and plates^{[29][30]}

Primary concept and development work takes place at the Billund headquarters, where the company employs approximately 120 designers. The company also has smaller design offices in the UK, Spain, Germany, and Japan which are tasked with developing products aimed specifically at these markets. The average development period for a new product is around twelve months, split into three stages. The first stage is to identify market trends and developments, including contact by the designers directly with the market; some are stationed in toy shops close to holidays, while others interview children. The second stage is the design and development of the product based upon the results of the first stage. As of September 2008 the design teams use 3D modeling software to generate CAD drawings from initial design sketches. The designs are then prototyped using an in-house stereolithography machine. These prototypes are presented to the entire project team for comment and for testing by parents and children during the “validation” process. Designs may then be altered in accordance with the results from the focus groups. Virtual models of completed Lego products are built concurrently with the writing of the user instructions. Completed CAD models are also used in the wider organisation, for marketing and packaging.^[31]



In the early 1960s, Lego made accurately scaled Matchbox sized vehicles like the Citroen DS sedan. These were notable for their completely metal wheels.

Lego Digital Designer is an official piece of Lego software for Mac OS X and Windows which allows users to create their own digital Lego designs.^[32] The program once allowed customers to order their custom designs^[33] with a service to ship physical models from Digital Designer to consumers; the service ended in 2012.^[34]

3 Manufacturing

Since 1963, Lego pieces have been manufactured from a strong, resilient plastic known as acrylonitrile butadiene styrene (ABS).^{[10][28]} As of September 2008, Lego engineers use the NX CAD/CAM/CAE PLM software suite to model the elements. The software allows the parts to be optimized by way of mould flow and stress analysis. Prototype moulds are sometimes built before the design is committed to mass production. The ABS plastic is heated to 232 °C (450 °F) until it reaches a dough-like consistency. It is then injected into the moulds at pressures between 25 and 150 tonnes, and takes approximately 15 seconds to cool. The moulds are permitted a tolerance of up to two micrometres, to ensure the bricks remain connected.^[31] Human inspectors check the output of the moulds, to eliminate significant variations in color or thickness. According to the Lego Group, about eighteen bricks out of every million fail to meet the standard required.^[35] Lego factories recycle all but about 1 percent of their plastic waste from the manufacturing process. If the plastic cannot be re-used in Lego bricks, it is processed and sold on to industries that can make use of it.^{[36][37]}



A Lego factory in Kladno, Czech Republic, one of several sites in the world where Lego toys are manufactured

Manufacturing of Lego bricks occurs at a number of locations around the world. Moulding is done in Billund, Denmark; Nyíregyháza, Hungary; Monterrey, Mexico and latest in Jiaying, China. Brick decorations and packaging is done at plants in Denmark, Hungary, Mexico and Kladno in the Czech Republic. The Lego Group estimates that in the course of five decades it has produced some 400 billion Lego blocks.^[38] Annual production of Lego bricks averages approximately 36 billion per year, or about 1140 elements per second. According to an article in *BusinessWeek* in 2006, Lego could be considered the world's No. 1 tire manufacturer; the factory produces about 306 million small rubber tires a year.^[39] The claim was reiterated in 2012.^[40]

In December 2012, the BBC's *More or Less* radio program asked the Open University's engineering depart-

ment to determine “how many Lego bricks, stacked one on top of the other, it would take for the weight to destroy the bottom brick?”^[41] Using a hydraulic testing machine, the engineering department determined the average maximum force a 2×2 Lego brick can stand is 4,240 newtons; since an average 2×2 Lego brick has a mass of 1.152 grams (0.0406 oz), according to their calculations it would take a stack of 375,000 bricks to cause the bottom brick to collapse, which represents a stack 3,591 metres (11,781 ft) in height.^[41]

Private tests have shown several thousand assembly-disassembly cycles before the bricks begin to wear out,^[42] although Lego tests show fewer cycles.^[43]

4 Lego set themes

Further information: List of Lego themes

Since the 1950s, the Lego Group has released thousands



A Lego set released in 2013, “Gold Getaway”, based on the Lego Castle theme



Lego sets of the Lego City theme.

of sets with a variety of themes, including space, robots, pirates, trains, Vikings, castle, dinosaurs, undersea exploration, and wild west. Some of the classic themes that continue to the present day include Lego City (a line of sets depicting city life introduced in 1973) and Lego Technic (a line with more unique pieces; rotating gears introduced in 1977).^[44]

Over the years, Lego has licensed themes from numerous

cartoon and film franchises and even some from video games. These include *Batman*, *Indiana Jones*, *Star Wars*, and *Minecraft*. Although some of the licensed themes, Lego Star Wars and Lego Indiana Jones, had highly successful sales, Lego has expressed a desire to rely more upon their own characters and classic themes, and less upon licensed themes related to movie releases.^[45]

For the 2012 Summer Olympics in London Lego released a special Lego Minifigures serie and for the 2016 Summer Olympics and 2016 Summer Paralympics in Rio, Lego released a kit with the Olympic and Paralympic mascots Vinicius and Tom.^[46]

One of the largest Lego sets commercially produced was a minifig-scaled edition of the Star Wars Millennium Falcon. Designed by Jens Kronvold Fredericksen, it was released in 2007 and contained 5,195 pieces. It was surpassed however by a 5,922-piece Taj Mahal.^[47]

4.1 Robotics themes

Main articles: Lego Mindstorms, Lego Mindstorms NXT, Lego Mindstorms NXT 2.0, and Lego Mindstorms EV3

Lego has also initiated a robotics line of toys called ‘Mindstorms’ in 1999, and has continued to expand and update this range ever since. The roots of the product originate from a programmable brick developed at the MIT Media Lab, and the name is taken from a paper by Seymour Papert, a computer scientist and educator who developed the educational theory of constructionism, and whose research was at times funded by the Lego Group.^[48]

The programmable Lego brick which is at the heart of these robotics sets has undergone several updates and redesigns, with the latest being called the ‘EV3’ brick, being sold under the name of Lego Mindstorms EV3. The set includes sensors that detect touch, light, sound and ultrasonic waves, with several others being sold separately, including an RFID reader.^[49]

The intelligent brick can be programmed using official software available for Windows and Mac computers, and is downloaded onto the brick via Bluetooth or a USB cable. There are also several unofficial programs and compatible programming languages that have been made to work with the brick, and many books have been written to support this community.^[49]

There are several robotics competitions which use the Lego robotics sets. The earliest is Botball, a national U.S. middle- and high-school competition stemming from the MIT 6.270 Lego robotics tournament. Other Lego robotics competitions include Junior FIRST LEGO League (Jr.FLL) for students ages 6–9, FIRST Lego League (FLL) for students ages 9–16 (age 9–14 in the United States, Canada, and Mexico), and FIRST Tech

Challenge (FTC) for high school students. Jr.FLL FLL, and FTC offer real-world engineering challenges to participants. FLL uses Lego-based robots to complete tasks. Jr.FLL participants build models out of Lego elements. FTC uses the NXT Intelligent brick and its pieces along with another building platform called TETRIX. In its 2010 season, there were 16,070 FLL teams in over 55 countries. In its 2010 season, there were 2,147 Jr.FLL teams with 12,882 total student participants in the United States and Canada. The international RoboCup Junior football competition involves extensive use of Lego Mindstorms equipment which is often pushed to its extreme limits.^[50]

The capabilities of the Mindstorms range have now been harnessed for use in Iko Creative Prosthetic System, a prosthetic limbs system designed for children. Designs for these Lego prosthetics allow everything from mechanical diggers to laser-firing spaceships to be screwed on to the end of a child's limb. Iko is the work of the Chicago-based Colombian designer Carlos Arturo Torres, and is a modular system that allows children to customise their own prosthetics with the ease of clicking together plastic bricks. Designed with Lego's Future Lab, the Danish toy company's experimental research department, and Cirec, a Colombian foundation for physical rehabilitation, the modular prosthetic incorporates myoelectric sensors that register the activity of the muscle in the stump and send a signal to control movement in the attachment. A processing unit in the body of the prosthetic contains an engine compatible with Lego Mindstorms, the company's robotics line, which lets the wearer build an extensive range of customised, programmable limbs.^{[51][52]}

5 Clones of Lego

Main article: Lego clone

The definitive shape of the Lego bricks, with the inner tubes, was patented by the Lego Group in 1958.^{[13][53]} Several competitors have attempted to take advantage of Lego's popularity by producing blocks of similar dimensions, and advertising them as being compatible with Lego bricks. In 2002, Lego sued the CoCo Toy Company in Beijing for copyright infringement over its "Coko bricks" product. CoCo was ordered to cease manufacture of the products, publish a formal apology and pay damages.^[54] Lego sued the English company Best-Lock Construction Toys in German courts in 2004^[55] and 2009;^[56] however, the Federal Patent Court of Germany denied Lego trademark protection for the shape of its bricks for the latter case.^[57] In 2005, the Lego Company sued Canadian company Mega Bloks for trademark violation, but the Supreme Court of Canada upheld Mega Bloks' rights to sell their product.^[58] In 2010, the European Court of Justice ruled that the eight-peg design of the original Lego brick "merely performs a technical

function [and] cannot be registered as a trademark."^[59]

6 Related services

6.1 Official website

Main article: Lego.com

First launched in 1996, the Lego website has developed over the years, and provides many extra services beyond an online store and a product catalogue. There are also moderated message boards that were founded in 2001. Since then, the message boards received a complete overhaul and the design was neatened and provided many new tools and various improvements on design features from 2001.^[60] The site also includes instruction booklets for all Lego sets dating back to 2002.^[61]

My Lego Network is a social networking site that involves items, blueprints, ranks, badges which are earned for completing certain tasks, trading and trophies called masterpieces which allow users to progress to go to the next rank. The website has a built in inbox which allows users to send pre written messages to one another. The Lego Network includes automated non-player characters within called "Networkers", who are able to do things which normal users cannot do, sending custom messages, and selling masterpieces and blueprints. The site also has modules which are set up on the user's page that give the user items, or that display picture compositions. Before *My Lego Network*, there were Lego Club Pages, which essentially held the same purpose, although the design lacked complex interaction.^[62]

6.2 Theme parks

Main article: Legoland

Merlin Entertainments operates seven Legoland amusement parks, the original in Billund, Denmark, the second in Windsor, England, the third in Günzburg, Germany, the fourth in Carlsbad, California, the fifth in Winter Haven, Florida, the sixth in Nusajaya, Malaysia^[63] and the seventh (latest) in Dubai, United Arab Emirates.^[64] On 13 July 2005, the control of 70% of the Legoland parks was sold for \$460 million to the Blackstone Group of New York while the remaining 30% is still held by Lego Group.^[65] There are also eight Legoland Discovery Centres, two in Germany, four in the United States, one in Japan and one in the United Kingdom. Two Legoland Discovery Centres opened in 2013: one at the Westchester Ridge Hill shopping complex in Yonkers, NY and one at the Vaughan Mills in Vaughan, Ontario, Canada. Another has opened at the Meadowlands complex in East Rutherford, New Jersey in 2014.^[66]

6.3 Retail stores



A Lego store in Canada



Lester mascot at the world's largest Lego store in Leicester Square, London, United Kingdom.

LEGO operates 125 retail stores (80 in the United States, 13 in the United Kingdom, 11 in Germany, 10 in Canada, 6 in France, 2 in Austria, 1 in Belgium, 1 in Sweden and 1 in Denmark).^[67] There are stores at the Downtown Disney shopping complexes at Disneyland and Walt Disney World Resorts as well as in Mall of America in

Bloomington, Minnesota. The opening of each store is celebrated with weekend-long event in which a Master Model Builder creates, with the help of volunteers—most of whom are children—a larger-than-life LEGO statue, which is then displayed at the new store for several weeks.^[68]

6.4 Business consultancy

Main article: [LEGO Serious Play](#)

Since around 2000, the LEGO Group has been promoting “LEGO Serious Play”, a form of business consultancy fostering creative thinking, in which team members build metaphors of their organizational identities and experiences using LEGO bricks. Participants work through imaginary scenarios using visual three-dimensional LEGO constructions, imaginatively exploring possibilities in a serious form of play.^[69]

7 Related products

7.1 Video games

Main article: [List of LEGO video games](#)

LEGO branched out into the video game market in 1997, beginning games with *LEGO Island* and *LEGO Creator*. Popular titles include the 1999 game *LEGO Racers* and the 2001 game *LEGO Racers 2*. More recent licensed games include *LEGO Star Wars*, *LEGO Indiana Jones*, *LEGO Batman*, and many more including the very well-received *LEGO Marvel Super Heroes* game, featuring New York City as the overworld and including Marvel characters from the Avengers, the Fantastic Four, the X-Men, and more.^{[70][71]} More recently, LEGO has created a game based on *The LEGO Movie*, due to its popularity.^[72]

7.2 Board games

Main article: [LEGO board games](#)

LEGO Games launched in 2009, was a series of LEGO-themed board games designed by Cephos Howard and Reiner Knizia^{[73][74]} in which the players usually build the playing board out of LEGO bricks and then play with LEGO-style players. Examples of the games include “Minotaurus”, in which players roll dice to move characters within a brick-built labyrinth, “Creationary”, in which players must build something which appears on a card, or “Ramses Pyramid”, in which players collect gems and climb up a customizable pyramid. Like many board games, the games use dice. However, in *LEGO Games*, the dice are LEGO, with LEGO squares with symbols on LEGO studs

on the dice, surrounded by rubber. The games vary from simple to complex, some are similar to “traditional” board games, while others are completely different.^[75]

7.3 Films and television

Main articles: [List of Lego films](#) and [The Lego Movie](#)

For a time, Lego turned down approaches from Hollywood to make a feature-length film based on the toy. However, a number of straight-to-DVD computer animated Bionicle and Hero Factory movies were produced, and *Lego: The Adventures of Clutch Powers* was released on DVD in February 2010, a computer-animated film made by Tinseltown Toons.^[76]

In June 2013, it was reported that Warner Bros. was developing a feature film adaptation of Lego Ninjago. Brothers Dan Hageman and Kevin Hageman were attached to write the adaptation, while Dan Lin and Roy Lee, along with Phil Lord and Chris Miller, were announced as producers.^[77] A computer-generated animated series based on *Lego Ninjago: Masters of Spinjitzu* began in 2011, and another based on *Legends of Chima* began in 2013. A television series of *Lego City* has also been announced.^[78]

The Lego Movie, a feature film based on Lego toys, was released by Warner Bros. in February 2014.^[79] It featured Chris Pratt in the lead role, with substantial supporting characters voiced by Will Arnett, Morgan Freeman, Liam Neeson, Alison Brie, Will Ferrell and Nick Offerman.^[80] A contest was held for contestants to submit designs for vehicles to be used in the film.^[81] After the release of *The Lego Movie*, independent Canadian toy retailers reported issues with shortages of Lego products and cited cancellations of Lego pre-orders without warning^[82] as a motive to stock compatible, rival products.^[83]

7.4 Books and magazines

Lego has an ongoing deal with publisher Dorling Kindersley (DK), who are producing a series of illustrated hardback books looking at different aspects of the construction toy. The first was “The Ultimate Lego Book”, published in 1999. More recently, in 2009, the same publisher produced *The LEGO Book*, which was sold within a slipcase along with *Standing Small: A celebration of 30 years of the LEGO minifigure*, a smaller book focused on the minifigure. In 2012, a revised edition was published. Also in 2009, DK also published books on Lego Star Wars (*Lego Star Wars: The Visual Dictionary*) and a range of Lego-based sticker books.^[84]

Although no longer being published in the United States by Scholastic, books covering events in the Bionicle storyline are written by Greg Farshtey. They are still being

published in Europe by AMEET. Bionicle comics, also written by Farshtey, are compiled into graphic novels and were released by Papercutz. This series ended in 2009, after nine years.^[85]

There is also the Lego Club and Brickmaster magazine, the latter discontinued in 2011.^[86]

7.5 Children's clothing

Since 1993, LEGOWear Clothes have been produced and marketed by a Danish company called Kabooki under license from Lego Group. The clothes are for boys and girls from 0–12 years old and the partnership also ties in with other Lego products such as 'Ninjago', 'Hero Factory' and the new 'Friends' theme for girls.^[87]

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