**LOUIS PASTEUR**

Born on December 27, 1822 in Dole, France, Dr. Louis Pasteur discovered that microbes were responsible for souring alcohol and came up with the process of pasteurization, where bacteria is destroyed by heating beverages and then allowing them to cool. His work in germ theory also led him and his team to create vaccinations for anthrax and rabies.

**Early Life**

French chemist and microbiologist Louis Pasteur was born on December 27, 1822 in Dole, located in the Jura region of France. He grew up in the town of Arbois and his father, Jean-Joseph Pasteur, was a tanner and a sergeant major decorated with the Legion of Honour during the Napoleonic Wars. An average student, Pasteur was skilled at drawing and painting. He earned his Bachelor of Arts degree (1840), Bachelor of Science degree (1842) and a doctorate (1847) at the École Normale in Paris.

Pasteur then spent several years researching and teaching at Dijon Lycée. In 1848, he became a professor of chemistry at the University of Strasbourg, where he met Marie Laurent, the daughter of the university's rector. They wed on May 29, 1849, and had five children, though only two survived childhood.

**Commercial Success**

In 1854, Pasteur was appointed professor of chemistry and dean of the science faculty at the University of Lille. Here, he worked on finding solutions to the problems with the manufacture of alcoholic drinks. Working with the germ theory, which Pasteur did not invent, but further developed through experiments and eventually convinced most of Europe of its truth, he demonstrated that organisms such as bacteria were responsible for souring wine, beer and even milk. He then invented a process where bacteria could be removed by boiling and then cooling liquid. He completed the first test on April 20, 1862. Today the process is known as pasteurization.

In 1865, Pasteur helped save the silk industry. He proved that microbes were attacking healthy silkworm eggs, causing the disease, and that the disease would be eliminated if the microbes were eliminated.

Pasteur's first vaccine discovery was in 1879, with a disease called chicken cholera. After accidentally exposing chickens to the attenuated form of a culture, he demonstrated that they became resistant to the actual virus. Pasteur went on to extend his germ theory to develop causes and vaccinations for diseases such as anthrax, cholera, TB and smallpox.

In 1873, Pasteur was elected as an associate member of the Académie de Médecine. In 1882, the year of his acceptance into the Académie Franaise, he decided to focus his efforts on the problem of rabies. On July 6, 1885, Pasteur vaccinated Joseph Meister, a 9-year-old boy who had been bitten by a rabid dog. The success of Pasteur's vaccine brought him immediate fame. This began an international fundraising campaign to build the Pasteur Institute in Paris, which was inaugurated on November 14, 1888.

**Personal Life**

Pasteur had been partially paralyzed since 1868, due to a severe brain stroke, but he was able to continue his research. He celebrated his 70th birthday at the Sorbonne, which was attended by several prominent scientists, including British surgeon [Joseph Lister](http://www.biography.com/people/joseph-lister-37032). At that time, his paralysis worsened, and he died on September 28, 1895. Pasteur's remains were transferred to a Neo-Byzantine crypt at the Pasteur Institute in 1896.



**Quote**

*"Chance only favors the prepared mind."*

**Samuel Colt**

Born in Hartford, Connecticut on July 19, 1814. As a boy, he attended the local school, and he also worked in his father's textile mill. He was fascinated with machinery even as a youngster, and enjoyed taking things apart to see how they worked. Among the mechanical devices that he tinkered with were his father's firearms, disassembling and reassembling them. When he was just 15 years old, Samuel decided he needed more adventure than the mill offered him, so he found a ship that was building a crew, and he signed on as a sailor and went to sea.

According to legend, it was while at sea that Samuel Colt developed his idea for a pistol with a revolving cylinder. The legends vary, but some say it was while on deck watching the ship's wheel that he came up with the idea. Others say that it was while observing the operation of the ship's capstan that spawned the idea. Whatever the inspiration was, Samuel Colt did invent the revolver, which transformed a firearm from a single-shot device to a multiple-shot device. In 1835, Colt obtained his first European patent on his revolver, and in 1836 he patented his invention in the United States. He established a factory to manufacture firearms in Paterson, New Jersey, in 1836. But his revolving cartridge firearm was slow to gain acceptance, and the business, Patent Arms Manufacturing, closed down in 1842.

Samuel Colt was an inventor at heart, however. When his firearms business failed, he looked around and saw other areas that needed solutions. Colt was one of those extraordinary people who could see a problem or a need and could then envision a way to make things work. He saw so much potential in the discoveries and technologies of his day, that he just had to try and put them to use. He had experience in firearms, explosives, ships, and the sea, and so he used his experience and imagination to develop a device that could set off an underwater explosive by remote control. Later he became involved in telegraph technology, and developed the first underwater telegraph cable. In 1847 Colt rekindled his firearms business when the U.S. Army contacted him to purchase a sizable quantity of his revolvers. Colt was able to fulfill the government's request and it was the boost he needed to focus on firearms again.

As Colt's firearms business began to boom, he was looking to the future again. He opened a facility in England, advancing his international reputation, and he began to purchase land along the Connecticut River to construct a new facility there. In 1855, he completed construction of his new Hartford manufacturing plant, which was the largest private arms manufacturing facility in the world. Here he implemented new ideas in manufacturing, including the use of interchangeable parts, production lines, and advanced precision machinery. The Colt name became famous worldwide as demand for his products grew. Colt firearms were known for their high quality and dependability, and Samuel Colt became a very wealthy man.

Samuel Colt died in 1862 at the age of 47 in Hartford, but his wife Elizabeth took over and the company continued to thrive. Colt weapons were widely used in the Civil War, and the Colt .45 calibre Peacemaker model became synonymous with America's West



The .45 caliber "Peacemaker," the most famous revolver manufactured by Colt's company, wasn't created until 11 years after his death... Before Colt reopened his factory in 1847, he invented a system of submarine mines and a submarine telegraph cable... Colt's guns inspired an old saying: "God created man, Sam Colt made them equal."

**James Hargreaves**

Early in the eighteenth century Englishman John Kay (1704-1764) invented the flying shuttle, allowing weavers to produce material much faster than ever before. While this solved one problem, it created another: the spinning of yarn was still done by hand on the "Great Wheel," one thread at a time, and could not keep up with the demand brought on by Kay's new loom. To help increase the supply of yarn, the Royal Society of Arts offered cash prizes to anyone who invented a faster spinning machine. The first one to do so was James Hargreaves.

Hargreaves grew up in Lancashire, England, learning the trades of carpentry and weaving. He did not become an inventor until 1740, when he was employed by a local businessman to construct a better carding machine. A few years later, it is said, Hargreaves accidentally toppled the spinning wheel in his home. As it lay on its side, Hargreaves noticed the wheel and the spindle were still in motion, even though they had been tipped ninety degrees. It occurred to him that a mechanical spinner could be designed in which many spindles, set vertically and side-by-side, could spin a number of threads from just one horizontal wheel.

Hargreaves began constructing just such a machine in 1754; fourteen years and many prototypes later, the spinning jenny was complete. The spinning jenny was the first machine that accurately simulated the drafting motion of human fingers. This was vitally important to the success of the spinner, for it eliminated the need to draw cotton fibers out by hand. The jenny had one large wheel playing out cotton roving to eight different spindles, thus spinning eight threads at once.

Because the design was essentially the same as a spinning wheel (only eightfold) the yarn produced was still lumpy and uneven in places; however, it was sufficient for the weaving of many different fabrics, particularly when woven together with threads of linen. It was also ideal for the spinning of wool thread and yarn. Unlike many inventors that would follow him, Hargreaves did not plan to become wealthy from his invention--in fact, the first “Spinning Jennies” were used only in his home. Soon, however, the Hargreaves family suffered some financial setbacks, and he was forced to sell a few of his machines to mills.

His neighbors feared the new machine, thinking it would soon replace them all, and in 1768 they formed a mob that gutted the Hargreaves home and destroyed his jenny. Understandably upset, Hargreaves and his family moved to Nottingham. There he entered a partnership with Thomas James, and the two men opened their own cotton mill.

In 1769, Richard Arkwright successfully patented his water frame spinning machine. Inspired, Hargreaves enlisted legal aid to help him patent the jenny. By that time, many Lancashire mills had copied the jenny design illegally, an infringement for which Hargreaves sought restitution. His case was dismissed, however, when the court discovered that he had sold Jennies in Lancashire a few years earlier.

By 1777 the Arkwright’s water frame Jenny had almost completely replaced the Hargreaves original jenny as England's most popular spinning machine: the yarn it produced was stronger and smoother, much more suited to the needs of the now-dominant hosiery industry. (Both the jenny and the water frame would ultimately be replaced by Samuel Crompton's spinning mule.) Hargreaves was never awarded the patent or the restitution he fought for; he died poor in 1778.





**James Watt**

***Watt's early years:***James Watt was born on January 19, 1736, in Greenock, Scotland, the son of a shipwright (a carpenter who builds and fixes ships) and merchant of ships' goods. As a child James suffered from ill health. He attended an elementary school where he learned some geometry as well as Latin and Greek, but he was not well enough to attend regularly. For the most part he was educated by his parents at home. His father taught him writing and arithmetic, and his mother taught him reading. In 1755 Watt was apprenticed (working for someone to learn a craft) to a London, England, mathematical instrument maker. At that time the trade primarily produced navigational (ship steering) and surveying (land measuring) instruments. Watt found London to be unpleasant, however. A year later he returned to Scotland. Watt wanted to establish himself in Glasgow, Scotland, as an instrument maker. However, restrictions imposed by the tradesmen's guilds (associations of craftsmen) stood in his way. Friends at the University of Glasgow eventually arranged for him to be appointed as "mathematical instrument maker to the university" in late 1757. About this time Watt met Joseph Black, who had already laid the foundation (base) of modern chemistry and of the study of heat. Their friendship was of some importance in the early development of the steam engine.

## *Invention of the steam engine* At the University of Glasgow, Watt had become engaged in his first studies on the steam engine. During the winter of 1763–64 he was asked to repair the university's model of an earlier model of the steam engine made by Thomas Newcomen around the year 1711. After a few experiments, Watt recognized that the fault with the model rested not so much in the details of its construction as in its design. He found that a volume (amount of space taken up by an object or substance) of steam three or four times the volume of the piston cylinder (chamber with a moving object inside of it) was required to make the piston move to the end of the cylinder.

It took time for Watt to turn a good idea for a commercial invention into reality. A decade passed before Watt solved all the mechanical problems. Black lent him money and introduced him to John Roebuck of the Carron ironworks in Scotland. In 1765 Roebuck and Watt entered into a partnership. Watt still had to earn his own living but his employment as surveyor of canal construction left little time for developing his invention. However, Watt did manage to prepare a patent application on his invention, and the patent was granted on January 5, 1769.

By 1773 Roebuck's financial difficulties brought not only Watt's work on the engine to a standstill but also Roebuck's own business. Matthew Boulton, an industrialist (someone who owns and operates a factory) of Birmingham, England, then became Watt's partner. Watt moved to Birmingham. He was now able to work full time on his invention. In 1775 Boulton accepted two orders to build Watt's steam engine. The two engines were set up in 1776 and their success led to many other orders.

## *Other inventions*

On Watt's many business trips, there was always a good deal of correspondence (letters) that had to be copied. To avoid this tiresome task, he devised letter-press copying. This works by writing the original document with a special ink. Copies are then made by simply placing another sheet of paper on the freshly written sheet and then pressing the two together. Watt's interests in applied (practical) chemistry led him to introduce chlorine bleaching into Great Britain and to devise a famous iron cement. In theoretical chemistry, he was one of the first to argue that water was not an element (basic substance of matter made up of only one kind of atom) but a compound (substance made up of two or more elements). In 1794 Watt and Boulton turned over their flourishing business to their sons. Watt maintained a workshop where he continued his inventing activities until he died on August 25, 1819. Watt's achievements in perfecting the steam engine have been recognized worldwide. The watt, a unit of electrical power, was named after him.



**Henry Bessemer**

"Man of Steel" Henry Bessemer was born on January 19, 1813 in Charlton, Hertfordshire, England. The first to develop a process for mass-producing steel inexpensively, this son of an engineer was a prolific and diverse inventor throughout his life. At age 17, he came up with the idea of creating embossed stamps to use on title deeds. Then he realized a better idea was just to print new dates on stamps rather than use new ones. Implementing this practice saved the Stamp Service a great deal of money. Bessemer was not compensated for these ideas.

Bessemer, who was mostly self-educated, made his first fortune with an idea for using brass as a paint additive to produce a bronze-colored powder that could be used for dÈcor in place of gold. He invented machines to mix the substance automatically and set up a factory that he kept top-secret so his process would not be discovered. He and his brothers-in-law ran it, and were extremely successful.

In 1854, while the Crimean War was under way, Bessemer created a new type of artillery shell. His shells were heavier than the typically used cannon balls, and would be cut with spiral grooves that would give them spin and keep them on target. Bessemer had presented his shell idea to the War Department, but they had been disinterested. When Napoleon himself expressed interest during a dinner with Bessemer in Paris, he was encouraged, but first he needed to come up with a way to mass produce structural steel that he could use to create sturdier gun barrels to support these heavy shells. This would set him on a path to perhaps the greatest accomplishment of his life: the Bessemer Converter.

The Bessemer Converter could make 30 tons of high-grade steel in half an hour. Its evolution began with Bessemer's attempt to blow air in through a vat of molten iron. He found that the line along which the air blew produced a type of material that had a higher melting point than the rest of the substance. This was because the air removed some of the carbon in the material. Repeating the decarbonization process over and over would eventually refine the substance into very strong steel. It should be noted that American, William Kelly had held a patent for "a system of air blowing the carbon out of pig iron" but bankruptcy forced him to sell his patent to Bessemer. In 1856, Bessemer patented his refinery process, and created huge furnaces that could handle it.

Shortly after introducing the Bessemer Converter, Bessemer established Henry Bessemer & Co. to manufacture steel and was able to undersell nearly all competitors. This inspired a flood of applications to license the technology. As a result, he became a very wealthy man. Even now, modern steel is made using technology based on Bessemer's process. It was essential to the development of skyscrapers, to the railroad and construction business, and to the defense industry.

In 1860, Bessemer patented the tilting convertor, which produced steel more efficiently than the earlier fixed furnace. During his years as an inventor, Bessemer also created a method for embossing velvet, a hydraulic machine for extracting juice from sugar cane, steam-driven fans for ventilating mines, and a furnace designed especially for making sheet glass. But not all his ideas were successful. In 1869, he began working on a seasickness-proof sailing ship, based on an idea he had to mount the ship's interior cabin on top of a gyroscope. In theory this would keep the cabin horizontal at all times. He did not take the advice of critics who said it would never work. Instead he forged ahead and made the vessel, dubbed the Bessemer Saloon Ship, a reality. However, it was too unstable to steer, and crashed into a pier on its maiden voyage in 1875. The ship never sailed again.

Over the course of his lifetime, Bessemer earned a total of 110 patents. In 1879, he was knighted for his contributions to the scientific world, and that year he was also granted Fellowship in the Royal Society. He died on March 14, 1898, in London.

**Eli Whitney**

Whitney certainly transformed the economies of the antebellum North and South. But among invention aficionados, his invention of the cotton gin is a matter of some dispute.

Whitney was born in Westboro, Massachusetts in 1765. As a child, he showed an instinct and talent for machinery. He worked as a blacksmith, and invented a nail-making machine. Whitney's dream of attending Yale College was frustrated for some years, because no college then taught or much appreciated the "useful arts." But Whitney did attend Yale, and graduated at the age of 27, only to find that there were no jobs for engineers either. So he accepted a teaching position in South Carolina.

En route, in early 1793, Whitney was befriended by Katherine Greene, the widow of a Revolutionary War general. When Whitney's teaching job later fell through, Greene invited him to stay at her plantation, Mulberry Grove, where she thought he might make himself helpful. As Whitney soon discovered, most cotton plantations were then on the brink of insolvency, because "green seed" cotton, the only strain that would grow inland, took too long to cull from its seeds. To sift out a single "point" of cotton lint from its surrounding seeds required ten hard hours of hand labor.

Everyone agreed that the solution was a machine to do this work; but no one had been able to make one. According to legend, within ten days of his arrival Whitney had observed the manual process and built a machine that did the same thing much faster. It is clear that his very first model did not work. In it, the bulk cotton was pressed against a wire screen, which held back the seeds while wooden teeth jutting out from an adjacent rotating drum teased the cotton fibers out through the mesh. This model invariably jammed. The next version was a complete success, thanks to thin wire hooks replacing the wooden teeth, and a moving brush that constantly cleared away the collected fibers.

By all accounts, Greene encouraged Whitney. The vexed question is whether the key element, the wire hooks, was his idea or hers. Greene supporters cite the claim of a friend of a friend of her plantation foreman, that Greene invoked "a woman's wit" and told Whitney to replace his wooden pegs with the wires of a fireplace cleaning brush. Whitney supporters cite a letter to the editor of *Southern Agriculturalist* magazine, whose author heard from admittedly shadowy sources that Whitney had explicitly asked Greene for a pin to experiment with at the start of his efforts. (Note that for some time during his Massachusetts days, Whitney had been the New World's sole manufacturer of hatpins.)

Whatever the comparative contributions, the cotton gin ("gin" is simply short for "engine") was a stupendous success. After Whitney gave a one-hour demonstration, in which the machine did the day's work of many men, farmers raced to sow their fields with green seed cotton. As the cotton grew, Whitney's workshop was broken into and his machine was examined in detail: soon, copies were everywhere.

In 1798, Eli Whitney invented a way to manufacture muskets (a gun with a smooth-bore) by machine so that the parts were interchangeable. Ironically, it was as a manufacturer of muskets that Whitney finally became rich. The concept of interchangeable parts was soon applied to other firearms like Colt’s revolver and other machines like the Spinning Jenny.

In 1804, Whitney left the South forever, disappointed and disgusted. In his words, "An invention can be so valuable as to be worthless to the inventor." In fact, Whitney never attempted to patent any of his later inventions (for example, a milling machine). But after settling in New Haven, Connecticut, Whitney re-invented American manufacturing as a whole, through mass production. He died in 1825.

Edward Jenner

Edward Jenner was born in **1749** and died in **1823**. Edward Jenner’s great gift to the world was his vaccination for smallpox. This disease was greatly feared at the time as it killed one in three of those who caught it and badly disfigured those who were lucky enough to survive catching it.

Edward Jenner was a country doctor who had studied nature and his natural surroundings since childhood. He had always been fascinated by the rural old wives tale that milkmaids could not get smallpox. He believed that there was a connection between the fact that milkmaids only got a weak version of smallpox – the non-life threatening cowpox – but did not get smallpox itself. A milkmaid who caught cowpox got blisters on her hands and Jenner concluded that it must be the pus in the blisters that somehow protected the milkmaids.

Jenner decided to try out a theory he had developed. A young boy called James Phipps would be his guinea pig. He took some pus from cowpox blisters found on the hand of a milkmaid called Sarah. She had milked a cow called Blossom and had developed the tell-tale blisters. Jenner ‘injected’ some of the pus into James. This process he repeated over a number of days gradually increasing the amount of pus he put into the boy. He then deliberately injected Phipps with smallpox. James became ill but after a few days made a full recovery with no side effects. It seemed that Jenner had made a brilliant discovery.

He then encountered the prejudices and conservatism of the medical world that dominated London. They could not accept that a country doctor had made such an important discovery and Jenner was publicly humiliated when he brought his findings to London. However, what he had discovered could not be denied and eventually his discovery had to be accepted – a discovery that was to change the world.

So successful was Jenner's discovery, that in 1840 the government of the day banned any other treatment for smallpox other than Jenner's.

Jenner did not patent his discovery as it would have made the vaccination more expensive and out of the reach of many. It was his gift to the world. A small museum now exists in his home town. It was felt that this was appropriate for a man who shunned the limelight and London. In the museum are the horns of Blossom the cow. The word vaccination comes from the Latin ‘vacca’ which means cow – in honour of the part played by Blossom and Sarah in Jenner’s research. A more formal statue of Jenner is tucked away in one of the more quiet areas of Hyde Park in London.

As a young man, Jenner also wrote about what he had seen cuckoos doing. His were the first written records to describe a baby cuckoo pushing the eggs and the young of its host out of the nest so that the baby cuckoo was the only one to receive food from its foster parents. This was only confirmed many years later but it stands as a testament to the importance of the countryside for Jenner. If he had gone to a city to further his career, would he had been in the right environment to make his famous discovery? In 1980, the World Health Organization declared that smallpox was extinct throughout the world.

Smallpox was a major killer before Edward Jenner's vaccination that was to change medical history. Whilst Jenner’s vaccination did not eradicate smallpox, it had a marked impact on fatality rates in large and dirty cities such as London.

**Samuel Morse**

Samuel Finley Breese Morse, inventor of several improvements to the telegraph, was born in Charlestown, Mass. on April 27, 1791. As a student at Yale College, Morse became interested in both painting and in the developing subject of electricity. After his graduation in 1810, he first concentrated on painting, which he studied in England. He would later become a well-known portrait artist.

After moving to New York in 1825, he became a founder and the first president of the National Academy of Design. He also ran for office, but was defeated in both his campaigns to become New York mayor. Meanwhile, Morse maintained a steady interest in invention, taking out three patents for pumps in 1817 with his brother Sidney Edwards Morse. It wasn't until 1832 that he first became interested in telegraphy.

That year, Morse was traveling to the United States from Europe on a ship, when he overheard a conversation about electromagnetism that inspired his idea for an electric telegraph. Though he had little training in electricity, he realized that pulses of electrical current could convey information over wires. The telegraph, a device first proposed in 1753 and first built in 1774, was an impractical machine up until that point, requiring 26 separate wires, one for each letter of the alphabet. Around that time two German engineers had invented a five-wire model, but Morse wanted to be the first to reduce the number of wires to one.

Between 1832 and 1837 he developed a working model of an electric telegraph, using crude materials such as a home-made battery and old clock-work gears. He also acquired two partners to help him develop his telegraph: Leonard Gale, a professor of science at New York University, and Alfred Vail, who made available his mechanical skills and his family's New Jersey iron works to help construct better telegraph models.

Morse's first telegraph device, unveiled in 1837, did use a one-wire system, which produced an EKG-like line on tickertape. The dips in the line had to be de-coded into letters and numbers using a dictionary composed by Morse, this assuming that the pen or pencil wrote clearly, which did not always happen. By the following year he had developed an improved system, having created a dot-and-dash code that used different numbers to represent the letters of the English alphabet and the ten digits. (His assistant Vail has been credited by Franklin T. Pope--later a partner of Thomas Edison--with inventing this "dots and dashes" version). This coding system was significantly better, as it did not require printing or decoding, but could be "sound read" by operators. In 1838, at an exhibition of his telegraph in New York, Morse transmitted ten words per minute using the Morse code that would become standard throughout the world.

In 1842, Morse convinced Congress to provide $30,000 in support of his plan to "wire" the United States. Meanwhile, Morse also solicited and received advice from a number of American and European telegraphy experts, including Joseph Henry of Princeton, who had invented a working telegraph in 1831, and Louis Breguet of Paris. In 1844, Morse filed for a patent (granted 1849) of the printing telegraph. He had already proved that his device worked over short distances, and the Federal funds he raised had allowed him to string a wire from Baltimore to Washington. On May 11, 1844, Morse sent the first inter-city message. Soon thereafter, he gave the first public demonstration, in which he sent a message from the chamber of the Supreme Court to the Mount Clair train depot in Baltimore. The message itself was borrowed from the Bible by the daughter of the Commissioner of Patents and said, "What hath God wrought?" By 1846, private companies, using Morse's patent, had built telegraph lines from Washington to Boston and Buffalo, and were pushing further. The telegraph spread across the US more quickly than had the railroads, whose routes the wires often followed. By 1854, there were 23,000 miles of telegraph wire in operation. Western Union was founded in 1851, and in 1866, the first successful trans-Atlantic cable link was established. Though Morse didnât invent the telegraph and did not single-handedly create Morse Code, he may have been telegraphy's greatest promoter, and undoubtedly contributed to its rapid development and adoption throughout the world.

Morse died of pneumonia in New York on April 2, 1872. Late in his life, he shared his considerable wealth through grants to colleges such as Yale and Vassar, in addition to charities and artists. e English surgeon (doctor

**Joseph Lister**

Was born in Upton, Essex, England, on April 5, 1827, the fourth of Joseph Jackson Lister and Isabella Harris Lister's seven children. His father was a wealthy wine merchant and student of Latin and mathematics who also developed an achromatic (possessing no color) lens for the microscope. As a child Lister studied fish and small animals. He also did microscopic research, and his later acceptance of Louis Pasteur's (1822–1895) work may be related to his understanding of the process of fermentation (the chemical breakdown of a compound) in relation to the making of wine.

Lister knew at a young age that he wanted to be a surgeon, but his father made sure he completed his formal education first, just in case. As a teenager Lister attended schools at Hitchin and Tottenham, England, studying mathematics, natural science, and languages. In 1844 he entered University College in London, England, to study medicine. After graduating in 1852, he began a surgical career in Edinburgh, Scotland. In 1860 he became professor of surgery at the Royal Infirmary in Glasgow, Scotland.

With the introduction of anesthesia (something that causes a patient to lose sensation in a certain area of the body or the entire body) in the 1840s, operations had become more common. Except, many patients died from infection following surgery. Inflammation (swelling) and suppuration (pus formation) occurred in almost all accidental wounds after surgery, and more so when patients were treated at the hospital rather than at home by a visiting surgeon. The reason was unknown, but it was believed to be something in the air. As a result wounds were heavily dressed or washed with water to keep the air out; operations were a last resort. The head, chest, and stomach were almost never opened, and injured limbs were usually amputated (cut off).

Lister's research centered on the microscopic changes in tissue that result in inflammation. When he read Pasteur's work on germs in 1864, Lister immediately applied Pasteur's thinking to the problem he was investigating. He concluded that inflammation was the result of germs entering and developing in the wound. Since Pasteur's solution of killing germs with heat could not be applied to the living body, Lister decided to try a chemical to destroy the germs.

That same year Lister read in the newspaper that the treatment of sewage (liquid waste matter from sewers) with a chemical called carbolic acid had led to a reduction of diseases among the people of Carlisle, England, and among the cattle grazing on sewage-treated fields. In 1865 he developed a successful method of applying carbolic acid to wounds. The technique of spraying the air in the operating room with carbolic acid was used only briefly, as it was recognized that germs in the air were not the main problem. Lister perfected the details of the antiseptic method and continued his research. He developed the surgical use of a sterile (germ-free) thread for closing wounds and introduced gauze dressings. Antisepsis became a basic principle for the development of surgery. Amputations became less frequent, as did death from infections. Now new operations could be planned and executed safely.

In 1869 Lister returned to Edinburgh, and in 1877 he was appointed professor of surgery at King's College in London, England. He won worldwide acclaim, honors, and honorary (received without fulfilling the usual requirements) doctorates and was made a baron in 1897. After he retired from medicine in 1893 he became foreign secretary of the Royal Society (Great Britain's oldest organization of scientists), and he was its president from 1895 to 1900. He died at Walmer, Kent, England, on February 10, 1912. Although Lister's antiseptic method was soon replaced by the use of asepsis (keeping the site of the operation and the instruments used free from germs), his work represented the first successful application of Pasteur's theory to surgery and marked the beginning of a new era.

