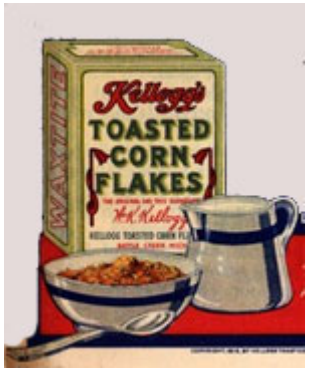
Inventions That Led to a New Life Resource Guide

Life Changing Inventions-Business Productivity		
Invention	**Image**	**Description**
Typewriter	 (National Museum of American History)	Many attempts were made to make a workable typewriter in the mid –1800s. These first typewriters were slow and cumbersome and were not well accepted. Christopher Latham Sholes (1819-1890) patented the first practical typewriter in 1868. After five years, dozens of experiments, and two patents, Sholes and his partners made improvements until they finished a model similar to today's typewriters. The Remington Arms Company manufactured their machine. Their design for the typewriter was unique to other attempts in that it employed a type-bar system and a universal keyboard. Their typewriter worked by pressing a key. The key would make a lever with a letter or symbol etched into the end strike an inked ribbon and then a piece of paper backed by a bar or roller. In the first models, typing too quickly would make the keys jam. To solve this problem, they split up the keys for letters commonly used together to slow down the typing. This became today's "QWERTY" keyboard. Remington Manufacturing made and marketed this typewriter. It was offered for sale in 1874, but wasn't a success at first. Later improvements made the machine more appealing and sales improved drastically. Typewritten documents could now be done on a machine sitting on a person's desk, rather than taken to a printer, who would set the type.

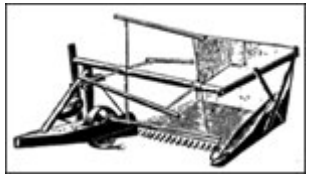
Cash register	 (National Museum of American History)	Stealing by store clerks was one of the problems faced by storeowners during the late 1800s. As more and more manufactured items became available from stores selling a variety of items, something had to be done to better keep up with sales and to keep clerks honest. A Dayton, Ohio saloonkeeper named James Ritty was having this type of problem with his help. While on an Atlantic cruse, he was inspired by a machine on the ship that recorded the revolutions of the ship's propeller. From this inspiration came the idea for the first cash register. When Ritty returned from the cruise, he and his brother patented the first cash register in 1879. They called the device "Ritty's Incorruptible Cashier." Their cash register operated by pressing a key, which represented an amount of money. The unmistakable ring of a bell when a sale was rung up on these first models became known as the "Bell Heard Around the World." This model had no cash drawer. Ritty continued to work on the device by adding paper rolls to record the transactions. He opened a small factory to make his device, but the demand for his product came so great that he sold the business to Jacob H. Eckert. Eckert incorporated his new company to raise money to expand. This company became know as the National Manufacturing Company. In 1883 a businessman, John Patterson, entered the business of making cash registers. He had purchased many of Eckert's cash registers for his assorted stores, so he decided to invest in the National Manufacturing Company and eventually bought the company. He renamed the company the National Cash Register Company. Many improvements were made to the original invention. A cash drawer was later added and eventually an electric motor was used to operated the machine. This company is still in business today.
Calculating machine	 (National Museum of American History)	There had been many attempts in creating a calculator through out the centuries. Even Leonardo De Vinci drew a design for a calculator in the 15th century. Blaise Pascal created a working calculator in 1624. In all, there were about twenty-five attempts at making a calculator in the 19th century. All worked poorly or were impractical until 1885. During that year, William Seward Burroughs invented the first practical adding machine and obtained a patent in 1888. Borroughs and other investors formed the American Arithmometer Co. to manufacture and market the machine. The first machines employed a lever to be pulled to make them calculate. Unfortunately, these first machines required a special skill for pulling the lever to make it calculate correctly. New users of the machine would get different sums depending on how hard or rapidly they pulled the lever. In 1893, Borroughs improved the machine and received a patent for it. The new machine employed a hydraulic governor that enabled the device to work no matter how the handle was pulled. Other features, like the paper roll were added later. There were hundreds of manufacturers, which produced an amazing variety of calculating machines up to the late 1960s. At this time, the mechanical calculator disappeared as the electrical calculating machine and later the electronic computer replaced them.

Sewing machine	 (National Museum of American History)	Prior to the 1800s, all clothes had to be sewn by hand. Sewing was a time-consuming job that was difficult and hard on the hands. The common people wore clothes that were usually coarse and simple in design. The more wealthy people could hire tailors to hand-make their fancier clothes. This all changed in the early 1800s with the invention of the sewing machine. There were several inventors that patented sewing machines in the late 1700s and early 1800s. Thomas Saint in England in 1790, and Frenchmen, Thomas Stone and James Henderson in 1804, and Barthelemy Thimonner in 1830 all worked on a variation of the sewing machine. It was American inventors that furthered the design during the 1800s. Best known of these inventors was Massachusetts's farmer Elias Howe, who built his sewing machine in 1844. Even though he had patents on his machine, several other manufacturers reproduced his design. The best known of these imitators was Issac Singer, who formed Singer Sewing Machines, which is still in operation. The impact of the sewing machine was tremendous. A garment that would take hours to sew by hand could now be made in minutes. Large manufacturing facilities were set up to mass produce garments. These facilities housed large spaces with numerous sewing machines manned usually by women. Many of the immigrants to America's large cities became garment workers in these factories. These factories became known as "Sweat Shops" because of the difficult working conditions. Clothing items could be produced faster and for less expense once the sewing machine became widely used. All Americans could now afford better clothes in a larger variety.

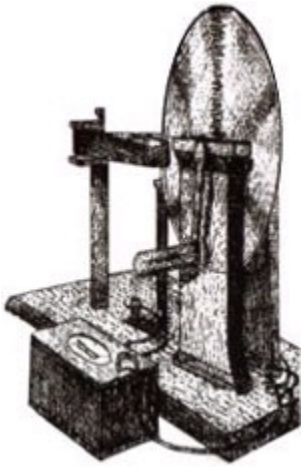
Food Preservation		
Invention	**Image**	**Description**
Canned foods and the can opener	 **Early Tin Can** **(cannedfood.org)**  **Early Can Opener** **(American Memory Collection-Smithsonian Institute)**	Nicolas Appert pioneered the process of canning in the 1790s. He discovered that the application of heat to food in sealed glass bottles preserved the food from deterioration. The French Navy successfully employed this process for foods including meat, vegetables, fruit and even milk. Glass containers proved to be difficult to use due to the fragility of glass. In 1810 Englishman Peter Durand patented the food canning process. His method was to package food in sealed airtight tin-plated wrought-iron cans. His directions for opening his “cans” were to "Cut round on the top near to the outer edge with a chisel and hammer." This process revolutionized the preservation of foods. The first cans were made by hand which was slow and expensive. A good tinsmith could only make about sixty cans a day. The industry began to assume importance with the invention in 1847 of the stamped can made by machines. The can came into its own in the United States during the Civil War. Because of the food requirements of soldiers during the U.S. Civil War, considerable amounts of canned meats and vegetables were produced. At this point the can became an important item in American life. The processes of making cans and canning food have improved throughout the years. Highly specialized machinery, knowledge of bacteriology and food chemistry, as well as more efficient processes of cooking, have combined to make the commercial canning of food an important feature of modern life. As canned food became popular, a method to open the can had to be invented. As referred to above, the first method for opening cans was a hammer and chisel, which proved to be cumbersome. As cans became thinner, it became practical to use a device designed for the purpose of opening a can. Ezra J. Warner of Waterbury, Connecticut patented the first can opener in 1858. These first can openers were used by the military in the Civil War. As canned foods became more popular, William Lyman patented an easy to use household can opener in 1870. His can opener was the kind with the wheel that rolls and cuts around the rim of a can. Refinements were made throughout the years, which included the addition of a serrated wheel and eventually an electric version of the can opener.

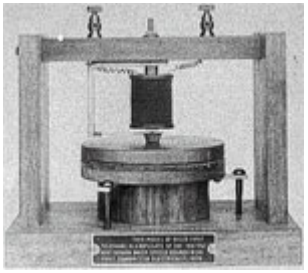
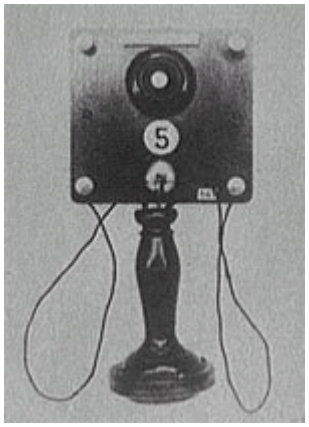
Condensed milk	 **(American Memory Collection-Smithsonian Institute)**	An advance in food preservation came in 1856 when a process for preserving milk was patented. A patent for condensed or evaporated milk was given to Gail Borden. Condensed milk is produced when sweetened milk is condensed to half its volume by removing part of the moisture in a vacuum evaporator. To ensure its preservation, sugar is added. The high content of sugar in the resulting product increases the pressure to such a level that most of the contaminants are destroyed. Therefore, no sterilization has to take place after canning. This process allowed milk to be kept for up to twelve weeks before using. After the patent was issued to Gail Borden, he opened a factory in Connecticut but it failed. Borden was given new backing from Jeremiah Milbank, a New York financier, and established a new company, the Borden Milk Company. This effort was successful because the Civil War brought increased demand for condensed milk; sales grew so much that success was guaranteed.
Packaged cereal	 **(American Memory Collection-Smithsonian Institute)**	Another advancement in food processing came with the invention of the modern breakfast cereals. The first precooked cereal was probably invented in 1863 by James Jackson. He broke up hardened loaves of unleavened whole grain bread into little pieces and served it for breakfast after soaking the brittle chunks overnight in milk. A church group, the American Seventh-day Adventists, created the first modern and commercial cereal foods. Strict vegetarians, the Adventists formed the Battle Creek Sanitarium after its location in Battle Creek, Michigan. The Adventists manufactured, promoted and sold wholesome cereals, but their distribution was limited at that time. Will Keith Kellogg made the first cereal that was a commercial success. In 1984, Kellogg was trying to improve the vegetarian diet of hospital patients. He was searching for a digestible bread substitute using the process of boiling wheat. Kellogg accidentally left a pot of boiled wheat to stand and the wheat became tempered. When Kellogg rolled the tempered wheat, each grain of wheat emerged as a large thin flake. The flakes turned out to be a tasty cereal. The popularity of breakfast cereals increased during the 20th century. With the exception of bread, cereal is the most popular way of consuming grain in the United States.

Refrigeration	 **(American Memory Collection-Smithsonian Institute)**	Another breakthrough in food preservation came with the invention of mechanical refrigeration. Before this invention people cooled their food with ice and snow or in cool and dark root cellars. William Cullen in Glasgow, Scotland invented the first mechanical refrigeration process in 1748, however, he did not use his discovery for any practical purpose. In the early 1800s, a Londoner, Michael Farady, used liquefied ammonia to cause cooling. In 1805, an American inventor, Oliver Evans, designed the first refrigeration machine. Jacob Perkins built the first practical refrigerating machine in 1834. It used ether in a vapor compression cycle. John Gorrie, built a refrigerator based on Oliver Evans' design in 1844 to make ice to cool the air for his yellow fever patients in Apalachicola, Florida. Modern refrigerators use a combination of these early inventions, but are mostly based on Farady's ideas and experiments. This process involves compressing gas into a liquid which will then absorb heat. In doing so, it returns to gas. This is a simplified description of what happens in a home refrigerator, freezer, air conditioner or dehumidifier. Warm winters in 1889 and 1890 created severe shortages of natural ice in the U.S. This stimulated the use of mechanical refrigeration for the freezing and storage of fish and in the brewing, dairy, and meat packing industries. Commercial refrigeration techniques were also applied to railroad cars, used in "coolers" in grocery stores, and in various ways in manufacturing industries. Home use of refrigerators was slow to catch on. In the early 1900's, home versions were beginning to be manufactured. It wasn't until after World War II that refrigerators were mass-produced and became commonplace in most households in America.

Agricultural Production		
Invention	Image	Description
Mechanical Reaper	 **(American Memory Collection-Smithsonian Institute)**	Several inventions ushered in major changes in agriculture during the early 1800s. One of the most important was the invention of the mechanical reaper in 1834 by Cyrus Hall McCormick. His harvesting machine combined all the steps that earlier harvesting machines had performed separately. It cut wheat stalk and laid it on the ground to be raked, bundled, and carried out of the field. At first, the McCormick reaper failed to catch on. After setting up a factory in Chicago in 1843, the mechanical reapers began to be accepted by farmers. By 1871, his company sold 10,000 machines per year. This company was to become one of the greatest industrial establishments in the country. His timesaving invention allowed farmers to more than double their crop size and spurred other innovations in farm machinery. The subsistence farming that prevailed during the early history of the United States, was rapidly changing to larger, more businesslike farms capable of raising a surplus. These surpluses allowed the urbanization of the second part of the 19th century.
Steel plow	 **(John Deere Corp.)**	An invention of a new type of plow would open up farming to the vast prairie lands of the interior of the United States. The plows that were used in New England by the first farmers were made of cast iron. These plows worked well in the sandy New England soil. As Americans migrated westward, the plows that were used in New England proved to be ineffective for cutting the prairie soil. The sticky soil of the prairie would cling to these plows, causing the farmer to have to stop every few feet to clean the soil off. An innovative blacksmith, John Deere, who was known for his careful workmanship and ingenuity, solved the problem 1837. He made the cutting part of a plow out of a steel saw blade that he shaped by bending it over a log. The moldboard, used for lifting and turning, was made of wrought iron and polished on the upper surface to prevent clogging. This new type of plow was so successful that by 1846 Deere and his partner were selling a thousand a year. In 1868, his company was incorporated under the name, Deere and Company and became one of the largest farm implement manufacturing companies in the United States. This invention changed the landscape of the interior of the United States. The prairies were tilled up and became corn and wheat farms. Their surpluses would feed the workers of the nation's growing cities.

Tractor	 **(American Memory Collection-Smithsonian Institute)**	The invention of the farm tractor was one of the most important technological advancements of modern agriculture in the United States. The first tractors were made in 1868 and were powered by steam engines. These first attempts were very heavy and cumbersome. Shortly thereafter, the first gasoline engines were used to power early tractors. This application of the internal combustion engine rivaled the importance of its use in the automobile and the truck. These early tractors weighed in excess of 20,000 pounds, with huge steel wheels or tracks and were large and expensive. Soon, manufacturers had reduced the size and cost. Ford Motor Company introduced its "Fordson" model, the first successful small tractor that weighed less than 6000 pounds and cost under $1000. These tractors proved to be excellent at plowing, and were capable of driving mowers and reapers. These early tractors were a replacement for human and draft animal effort that had powered the farm before this time. The consequences of this change were huge for the United States. The switch to mechanized farming fundamentally changed the nature of farm work and altered the structure of rural America. Mechanization replaced the need for human labor on the farms of America. It freed up millions of workers to be absorbed into the rapidly growing manufacturing and service sectors of the country located in the urban manufacturing centers.

Electrical and Communications Inventions		
Invention	Image	Description
Electric dynamo	 **(Inventor's Hall of Fame)**	The existence and explanation of static electricity existed prior to the 19th century, but understanding of current electricity was just beginning at the beginning of the century. The creation of electricity in batteries through chemical means had be demonstrated by Luigi Galvani in 1791 and brought to fruition by Alexandro Volta in 1800. Producing electricity by non-chemical means was the real challenge at the time. In 1820, Hans Christian Oersted showed that an electric current produced a magnetic field. The real break through came when Michael Faraday surmised that if electric currents in a wire can produce magnetic fields, then magnetic fields should produce electricity. Faraday was able to prove this assumption. His experiments with induction rings showed that these magnetic fields were lines of force. These lines of force would cause a current to flow in a coil of wire, when the coil is rotated between the poles of a magnet. This action then shows that the coils of wire being cut by lines of magnetic force, in some strange way, produces electricity. This discovery became the basis for modern electromagnetic technology. Faraday continued to improve his "dynamo" that we would now call an electric generator. Thus began the "electrification" of America.
Telegraph	 **(American Memory Collection-Smithsonian Institute)**	One of the first practical applications of the new electrical discoveries of the 19th century was the telegraph. In 1831 Samuel Morse, an American inventor, combined the new battery advances with a practical application of an electro magnet to create and send electric impulses over a wire. These impulses were identified as a system of dots and dashes that corresponded with the alphabet thus becoming a means of communication. This system became known as "Morse Code." The electric telegraph, therefore, become the first practical use of electricity and the first system of electrical communication in the United States. Five years after Morse gave a demonstration to the U.S. Congress in 1838, money was allocated to create the first telegraph line from Washington, D.C. to Baltimore. The first communication over these lines occurred in 1844. The company established by Morse and his partners, as well as many other private companies created other lines. This started a revolution in communications within the United States and abroad. Thousands of miles of telegraph lines were strung within the country and transatlantic cables were laid to Europe. The ability to communicate instantly over long distances dramatically changed life during this period. Our country depended on the telegraph for long-distance communication until the invention of the telephone in 1877.

Telephone	 **First Telephone** **(American Memory Collection-Smithsonian Institute)**  **Early Telephone** **(American Memory Collection-Smithsonian Institute)**	The telephone came as a result of the telegraph. In the 1870s two inventors were working to improve the telegraph, Alexander Graham Bell and Elisha Gray. Bell patented his device first, thus beating out Elisha Gray. When Bell started working on his invention, the telegraph had been the only means of long-distance communications in the United States. Although the telegraph was very successful, it could only transmit and receive one message at a time over the wire. Bell's experience with music and the nature of sound led him to believe that multiple messages could be transmitted over the same wire at the same time. Others, at the time, had the same idea, but Bell added his own personal touch to the issue. Bell offered his own musical or harmonic approach as a possible practical solution. His "harmonic telegraph" was based on the principle that several notes could be sent simultaneously along the same wire if the notes or signals differed in pitch. He was able to get financial backing to pursue this alternative, but he was also experimenting at the same time with the ability to actually transmit the human voice over wires. After getting encouragement from Joseph Henry at the Smithsonian Institute, he actively worked on the first telephone. By June 1875 the goal of creating a device that would transmit speech electrically was about to be realized. Bell and his assistant, Thomas Watson, had proven that different tones would vary the strength of an electric current in a wire. To achieve success they therefore needed only to build a working transmitter with a membrane capable of varying electronic currents and a receiver that would reproduce these variations in audible frequencies. On June 2, 1875, Alexander Graham Bell while experimenting with his technique called "harmonic telegraph," discovered he could hear sound over a wire. The sound was that of a twanging clock spring. Bell's greatest success, achieved on March 10, 1876, marked not only the birth of the telephone but the death of the multiple telegraph as well. Speaking through the instrument to his assistant, Thomas A. Watson, in the next room, Bell utterd these famous first words, "Mr. Watson -- come here -- I want to see you." The communications potential contained in his demonstration of being able to "talk with electricity" far outweighed anything that simply increasing the capability of a dot-and-dash system could imply. In 1877 the first telephone line was completed. By the end of 1880, there were 48,000 telephones in the United States. Service between New York and Chicago started in 1892. Transcontinental service by wire was not to come until 1915. The first Bell telephone company, the American Telephone and Telegraph Company (AT&T) started in 1878, and incorporated in 1885.

Electric light	 **(American Memory Collection-Smithsonian Institute)**	One of the most significant inventions that used electricity was the electric light bulb. Its invention and use changed the way humans existed by lighting up the night for a wide range of human activities. The basis of this invention came in 1811, when Sir Humphrey Davy discovered that an electrical arc passed between two poles produced light. Using this principle, the first experimental arc lights were used for public lighting in Paris, France, in 1841. The arc light did not work well because it burned out too quickly. Inventors continued to try to find a way to replace the common gas lights of that time with a practical electric light for home and public use. Inventors moved away from lights that utilized an arc in an open space. Instead, inventors focused on passing electricity through a filament. This was due to a theory proposed by James Joule, who thought that electrical current, when passing through a resistant conductor, would glow white-hot causing light. Two inventors, Joseph Swan and Thomas Edison, took Joule's theory and tried to make practical use of it. Swan was the first to succeed in constructing an electric light bulb, but his bulb couldn't maintain a vacuum, a necessity for success. About the same time in 1878, Edison created a lamp that consisted of a filament housed in a glass vacuum bulb. His first light bulbs worked by passing electricity through a thin platinum filament in the glass vacuum bulb, which delayed the filament from melting. Unfortunately his first light bulbs only glowed for a few hours. To improve the performance of Edison's bulb required hundreds of hours of experimentation. Between 1878 and 1880, he and his associates tested thousands of different materials to find one that would not burn out so quickly. One of the processes that brought him some success was with carbonized materials. He carbonized all types of plants from all over the world in his search for the perfect carbonized material. Eventually, Edison tried carbonized cotton thread filament. When voltage was applied to the completed bulb, it radiated a soft orange glow. After about fifteen hours, the filament finally burned out. After more refinements, the filament was able to burn for longer and longer periods. By 1880, he had produced a 16-watt bulb that could last for 1500 hours and made his new invention available to the public. The electric light soon replaced gaslights and became a standard feature in the United States. In 1910, William Coolidge of the General Electric Company invented the tungsten filament, which further improved the life of the light bulb. Interestingly, Edison tried this filament in his search for the right material for his first bulb, but the technology at that time would not allow him to produce it.

Electric delivery system	 **(American Memory Collection-Smithsonian Institute)**	Electricity was originally provided by private companies for lighting of streets, theatres, and galleries. Eventually electricity became less expensive than gas and many municipalities switched to the more economical electricity. By 1881, many cities had started to use electricity as their source of power. These early sources of electricity were mills that were converted to use the waterwheels to turn the generators. Early electric generating stations had to be close to the cities and towns that they served because each station could only supply a few blocks. In 1882, the Edison Electric Light Company and the Hammond Electric Light Company opened power stations designed solely for that purpose. They used coal-fired steam to turn the generators. The early focus of electrical delivery was to business customers, although some wealthy homeowners had electric lighting installed. Because the early generating capacity was so low, homes could only have three or four electric lights, and only one could be used at a time. Many of the existing telegraph and telephone poles were utilized to string wires in the cities. In 1892, the use of electricity expanded from primarily lighting to include heating and, soon after, cooking. As demand expanded, more and more electrical generating plants appeared and electricity was delivered to more urban areas. Private companies could not afford to supply power to the rural areas of the country, because of the expense to string lines over such large areas. Until 1920, most cities had competing electric companies with their own sets of poles and wires. In order to bring electricity to more people, laws were passed providing for single electrical companies in the cities. These laws provided the foundation for the electrical system we use today. A utility company would have the exclusive right to supply electricity to an area. In return for this monopoly, the company agreed to supply anyone that wanted electricity, including the rural areas. This pact paved the way for everyone in both urban and rural areas to have access to electricity.

Transportation and Production		
Invention	Image	Description
Automobile	 **First four-wheeled auto**  **Model T Ford** **(American Memory Collection-Smithsonian Institute)**	The steam engine worked well to power locomotives and ships. For transportation over roads, however, it proved impractical. The invention that turned carriages into automobiles was the internal-combustion engine invented in the last part of the 1800s. Gottlieb Daimler, a German, built the first automobile in 1885. He established a company to build these autos named after his daughter, Mercedes. By 1900, there were about 12,000 automobiles on the roads of Europe and the United States. Henry Ford, an automobile mechanic in Detroit, Michigan, wanted to build automobiles that everyone could afford. His idea was to build them all alike. In 1913, by using interchangeable parts and the assembly line, his factories could produce 2,000 Model T Fords every hour. These autos cost about $500 or about half of what a usual car cost. By 1914, there were about 600,000 cars in the world. Automobiles changed the way people traveled and how goods were transported. Since they were so affordable, more and more people could own them. This provided instant transportation to the masses. The roadways were now part of the Industrial Revolution. The automobile age had come into being.

Assembly line	 (Beacon Learning Center/SiteMaker)	One of the major effects of the Industrial Revolution was the introduction of the assembly line and mass production. These processes made factory production more efficient. This resulted in more and cheaper products. Mass production had been around in some form from the beginning of the Industrial Revolution. The assembly line opened the door for true mass production. The individual usually attributed to perfecting the assembly line was Henry Ford. He began to use this process to build the Ford automobile in 1917. The assembly line was important because it made the manufacturing process more efficient. Before the invention of this new process, a single person made most items. For example, in Henry Ford's factory, a single worker could build an automobile in 12.5 hours. Ford's invention involved the automobile moving through the factory. Each worker had the responsibility for putting on one part or piece of the auto. Once the auto finished its journey through the factory, a complete automobile emerged. Now an automobile could be assembled on the assembly line in 93 minutes. This increased efficiency tremendously. More autos could be produced at a reduced labor cost. This made the Model T Ford more affordable to more people. Ford's invention spread to all sectors of manufacturing.
Airplane	 (Beacon Learning Center/SiteMaker)	The gasoline engine was not limited in its use just to the automobile. During the latter part of the Industrial Revolution, it was also used to power the first airplane. The Wright brothers built and flew the first airplane in 1903. With this first flight, they ushered in the age of flight. Although first flight was important at this time, the airplane did not catch on like the automobile. In 1914, the total number of airplanes in the world numbered less than one thousand. This invention is important due to its potential. Its birth was in the Industrial Revolution, but its success was in the 20th century.