



Science and Urban Life

MAIN IDEA

Advances in science and technology helped solve urban problems, including overcrowding.

WHY IT MATTERS NOW

American cities continue to depend on the results of scientific and technological research.

Terms & Names

- Louis Sullivan
- Daniel Burnham
- Frederick Law Olmsted
- Orville and Wilbur Wright
- George Eastman

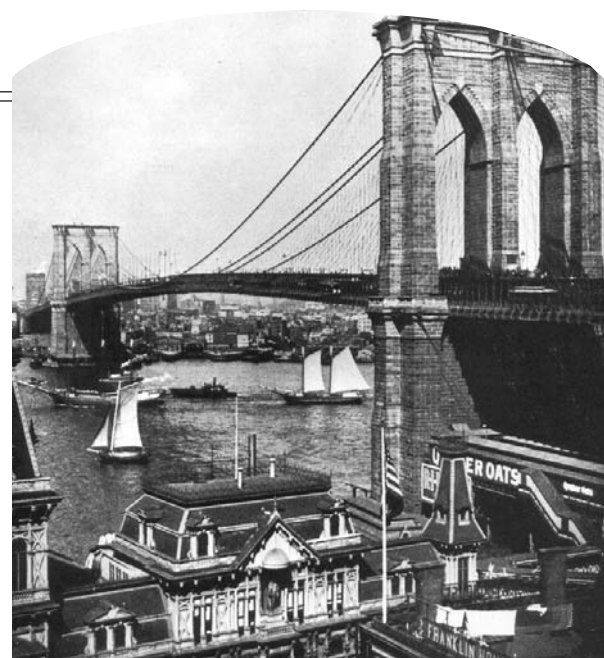
The Brooklyn Bridge, connecting Brooklyn to the island of Manhattan in New York City, opened in 1883. It took 14 years to build. Each day, laborers descended to work in a caisson, or water tight chamber, that took them deep beneath the East River. E. F. Farrington, a mechanic who worked on the bridge, described the working conditions.

A PERSONAL VOICE E. F. FARRINGTON

“Inside the caisson everything wore an unreal, weird appearance. There was a confused sensation in the head . . . What with the flaming lights, the deep shadows, the confusing noise of hammers, drills, and chains, the half-naked forms flitting about . . . one might, if of a poetic temperament, get a realizing sense of Dante’s *Inferno*.”

—quoted in *The Great Bridge*

Four years later, trains ran across the bridge 24 hours a day and carried more than 30 million travelers each year.

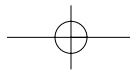


▲ In 1883, New Yorkers celebrated the opening of the world’s longest suspension bridge, the 1,595-foot-long Brooklyn Bridge.

Technology and City Life

Engineering innovations, such as the Brooklyn Bridge, laid the groundwork for modern American life. Cities in every industrial area of the country expanded both outward and upward. In 1870, only 25 American cities had populations of 50,000 or more; by 1890, 58 cities could make that claim. By the turn of the 20th century, due to the increasing number of industrial jobs, four out of ten Americans made their homes in cities.

In response to these changes, technological advances began to meet the nation’s needs for communication, transportation, and space. One remedy for more urban space was to build toward the sky.



SKYSCRAPERS Architects were able to design taller buildings because of two factors: the invention of elevators and the development of internal steel skeletons to bear the weight of buildings. In 1890–1891, architect **Louis Sullivan** designed the ten-story Wainwright Building in St. Louis. He called the new breed of skyscraper a “proud and soaring thing.” The tall building’s appearance was graceful because its steel framework supported both floors and walls.

The skyscraper became America’s greatest contribution to architecture, “a new thing under the sun,” according to the architect Frank Lloyd Wright, who studied under Sullivan. Skyscrapers solved the practical problem of how to make the best use of limited and expensive space. The unusual form of another skyscraper, the Flatiron Building, seemed perfect for its location at one of New York’s busiest intersections. **Daniel Burnham** designed this slender 285-foot tower in 1902. The Flatiron Building and other new buildings served as symbols of a rich and optimistic society. **A**

MAIN IDEA

Analyzing Causes

A How did new technologies make the building of skyscrapers practical?

ELECTRIC TRANSIT As skyscrapers expanded upward, changes in transportation allowed cities to spread outward. Before the Civil War, horses had drawn the earliest streetcars over iron rails embedded in city streets. In some cities during the 1870s and 1880s, underground moving cables powered streetcar lines. Electricity, however, transformed urban transportation.

In 1888 Richmond, Virginia, became the first American city to electrify its urban transit. Other cities followed. By the turn of the twentieth century, intricate networks of electric streetcars—also called trolley cars—ran from outlying neighborhoods to downtown offices and department stores.

New railroad lines also fed the growth of suburbs, allowing residents to commute to downtown jobs. New York’s northern suburbs alone supplied 100,000 commuters each day to the central business district.

A few large cities moved their streetcars far above street level, creating elevated or “el” trains. Other cities, like New York, built subways by moving their rail lines underground. These streetcars, elevated trains, and subways enabled cities to annex suburban developments that mushroomed along the advancing transportation routes. **B**

MAIN IDEA

Summarizing

B How did electric transit impact urban life?

Vocabulary

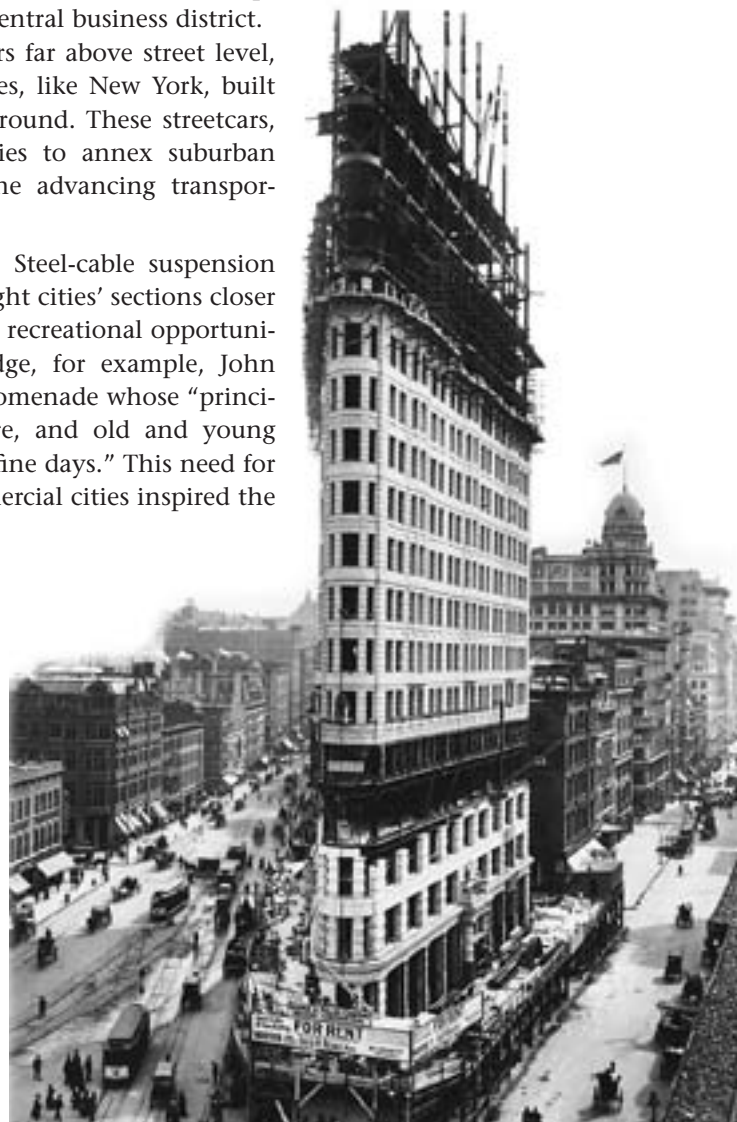
promenade: a public place for walking

ENGINEERING AND URBAN PLANNING Steel-cable suspension bridges, like the Brooklyn Bridge, also brought cities’ sections closer together. Sometimes these bridges provided recreational opportunities. In his design for the Brooklyn Bridge, for example, John Augustus Roebling provided an elevated promenade whose “principal use will be to allow people of leisure, and old and young invalids, to promenade over the bridge on fine days.” This need for open spaces in the midst of crowded commercial cities inspired the emerging science of urban planning.

City planners sought to restore a measure of serenity to the environment by designing recreational areas. Landscape architect **Frederick Law Olmsted** spearheaded the movement for planned urban parks.

In 1857 Olmsted, along with English-born architect Calvert Vaux, helped draw up a plan for “Greensward,” which was selected to become Central Park, in New York City. Olmsted envisioned the park as a rustic haven in the center of the busy city. The finished park featured boating and

The Flatiron Building, shown here under construction, stands at the intersection of Fifth Avenue and 23rd Street in New York City.





tennis facilities, a zoo, and bicycle paths. Olmsted hoped that the park's beauty would soothe the city's inhabitants and let them enjoy a "natural" setting.

A PERSONAL VOICE FREDERICK LAW OLMSTED

"The main object and justification [of the park] is simply to produce a certain influence in the minds of people and through this to make life in the city healthier and happier. The character of this influence . . . is to be produced by means of scenes, through observation of which the mind may be more or less lifted out of moods and habits."

—quoted in *Frederick Law Olmsted's New York*

In the 1870s, Olmsted planned landscaping for Washington, D.C., and St. Louis. He also drew the initial designs for "the Emerald Necklace," Boston's parks system. Boston's Back Bay area, originally a 450-acre swamp, was drained and developed by urban planners into an area of elegant streets and cultural attractions, including Olmsted's parks.

CITY PLANNING By contrast, Chicago, with its explosive growth from 30,000 people in 1850 to 300,000 in 1870, represented a nightmare of unregulated expansion. Fortunately for the city, a local architect, Daniel Burnham, was intrigued

History Through *Architecture*

THE CHICAGO PLAN

This map from Daniel Burnham's original plan of Chicago looks deceptively like an ordinary map today. But at the time, it was almost revolutionary in its vision, and it inspired city planners all over the country.

- 1 Chicago's Lakefront** First, Burnham designed the "White City" to host the 1893 World's Columbian Exposition. His greatest legacy to Chicago may have been his idea for a lakefront park system, complete with beaches, playing fields, and playgrounds.
- 2 Neighborhood Parks** Though not all cities could claim a lakefront vista for recreation, most cities sprinkled neighborhood parks where their residents needed them. Urban planners provided for local parks—such as Lincoln Park in Chicago—so that "the sweet breath of plant life" would be available to everyone.
- 3 Harbors For Cities** On the Great Lakes, the shipping business depended on accessible harbors. Burnham saw the advantage of harbors for recreation and commercial purposes, but he advocated moving the harbors away from the central business districts to free space for public use.
- 4 The Civic Center** Burnham redesigned the street pattern to create a group of long streets that would converge on a grand plaza, a practice reflected in other American cities. The convergence of major thoroughfares at a city's center helped create a unified city from a host of neighborhoods.

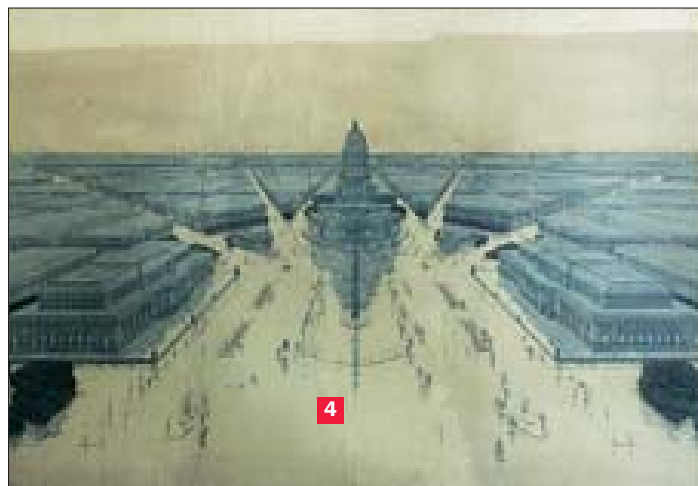
SKILLBUILDER Interpreting Visual Sources

- 1.** Why did Chicago's location make it a good choice for urban planning?
- 2.** How was Chicago's importance as a shipping center maintained?

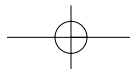


SEE SKILLBUILDER HANDBOOK, PAGE R23.

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▲ Unity was the goal of the architect of Chicago's city center.



by the prospect of remaking the city. His motto was “Make no little plans. They have no magic to stir men’s blood.” He oversaw the transformation of a swampy area near Lake Michigan into a glistening White City for Chicago’s 1893 World’s Columbian Exposition. Majestic exhibition halls, statues, the first Ferris wheel, and a lagoon greeted more than 21 million visitors who came to the city.

MAIN IDEA

Summarizing

C List three major changes in cities near the turn of the century. What effect did each have?

Many urban planners saw in Burnham’s White City glorious visions of future cities. Burnham, however, left Chicago an even more important legacy: an overall plan for the city, crowned by elegant parks strung along Lake Michigan. As a result, Chicago’s lakefront today features curving banks of grass and sandy beaches instead of a jumbled mass of piers and warehouses. **C**

New Technologies

New developments in communication brought the nation closer together. In addition to a railroad network that now spanned the nation, advances in printing, aviation, and photography helped to speed the transfer of information.

A REVOLUTION IN PRINTING By 1890, the literacy rate in the United States had risen to nearly 90 percent. Publishers turned out ever-increasing numbers of books, magazines, and newspapers to meet the growing demand of the reading public. A series of technological advances in printing aided their efforts.

American mills began to produce huge quantities of cheap paper from wood pulp. The new paper proved durable enough to withstand high-speed presses. The electrically powered web-perfecting press, for example, printed on both sides of a continuous paper roll, rather than on just one side. It then cut, folded, and counted the pages as they came down the line. Faster production and lower costs made newspapers and magazines more affordable. People could now buy newspapers for a penny a copy.

AIRPLANES In the early 20th century, brothers **Orville** and **Wilbur Wright**, bicycle manufacturers from Dayton, Ohio, experimented with new engines powerful enough to keep “heavier-than-air” craft aloft. First the Wright brothers built a glider. Then they commissioned a four-cylinder internal combustion engine, chose a propeller, and designed a biplane with a 40’4” wingspan. Their first successful flight—on December 17, 1903, at Kitty Hawk, North Carolina—covered 120 feet and lasted 12 seconds. Orville later described the take-off.

Vocabulary

internal

combustion

engine: an engine in which fuel is burned within the engine rather than in an external furnace

A PERSONAL VOICE ORVILLE WRIGHT

“After running the motor a few minutes to heat it up, I released the wire that held the machine to the track, and the machine started forward into the wind. Wilbur ran at the side of the machine . . . to balance it. . . . Unlike the start on the 14th, made in a calm, the machine, facing a 27-mile wind, started very slowly. . . . One of the life-saving men snapped the camera for us, taking a picture just as the machine had reached the end of the track and had risen to a height of about two feet.”

—quoted in *Smithsonian Frontiers of Flight*

WORLD STAGE

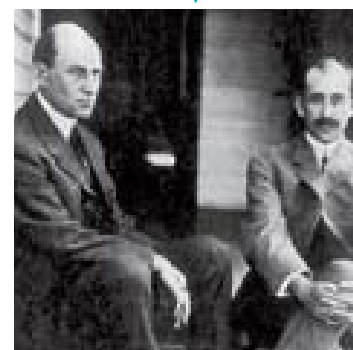
THE GARDEN CITY

Urban planning in the United States had European counterparts. In *Tomorrow: A Peaceful Path to Social Reform* (1898), for example, the British city planner Ebenezer Howard wrote of a planned residential community called a garden city.

Howard wanted to combine the benefits of urban life with easy access to nature. His city plan was based on concentric circles—with a town at the center and a wide circle of rural land on the perimeter. The town center included a garden, concert hall, museum, theater, library, and hospital.

The circle around the town center included a park, a shopping center, a conservatory, a residential area, and industry. Six wide avenues radiated out from the town center. In 1903, Letchworth, England served as the model for Howard’s garden city.

Orville (right) and Wilbur Wright at home in Dayton, Ohio, in 1909.





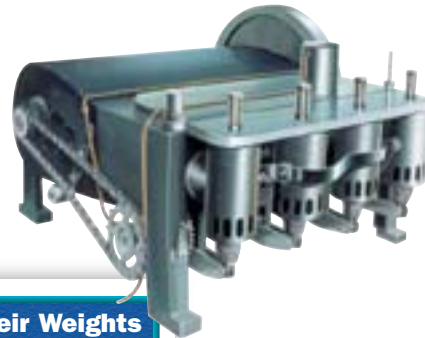
Science & Technology

AVIATION PIONEERS

In 1892, Orville and Wilbur Wright opened a bicycle shop in Dayton, Ohio. They used the profits to fund experiments in aeronautics, the construction of aircraft. In 1903, the Wright brothers took a gasoline-powered airplane that they had designed to a sandy hill outside Kitty Hawk, North Carolina.

The airplane was powered by a 4-cylinder 12-horse-power piston engine, designed and constructed by the bicycle shop's mechanic, Charles Taylor. The piston—a solid cylinder fit snugly into a hollow cylinder that moves back and forth under pressure—was standard until jet-propelled aircraft came into service in the 1940s.

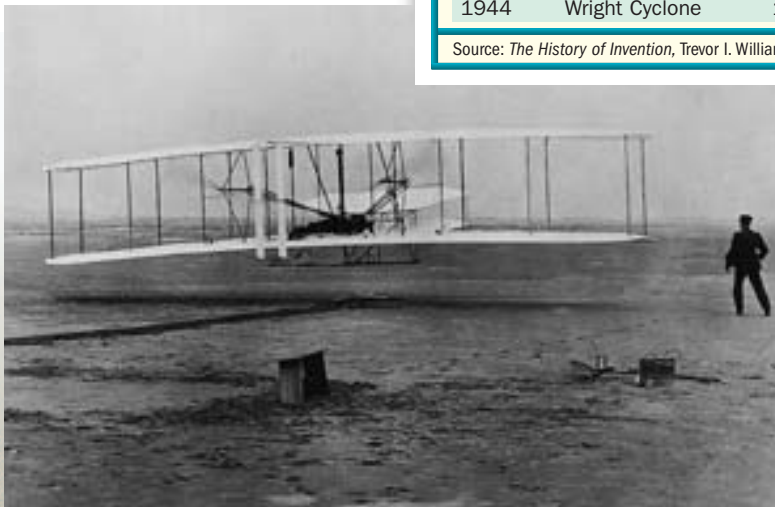
The engine is the heaviest component in airplane construction. The design of lighter engines was the most important development in early aviation history.



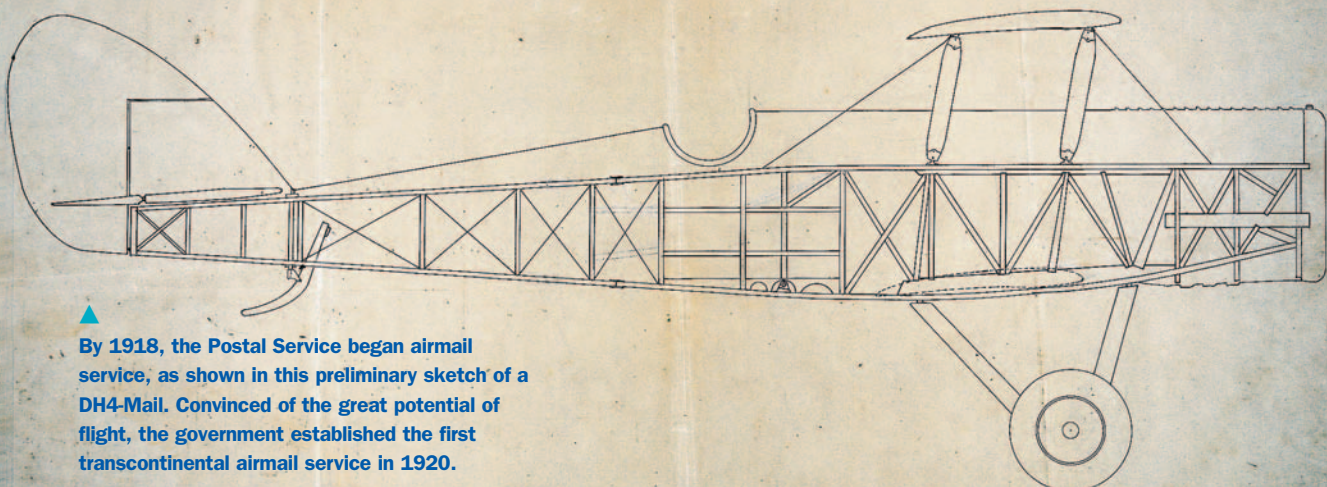
Early Airplane Engines and Their Weights

Date	Name of Engine	Approximate Weight per Unit of Horsepower
1880s	Otto	440 lbs (200 kg)
1903	Wright	13 lbs (6 kg)
1910	Gnome	3.3 lbs (1.5 kg)
1918	V-12 Liberty	2 lbs (1 kg)
1944	Wright Cyclone	1.1 lbs (0.5 kg)

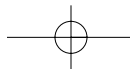
Source: *The History of Invention*, Trevor I. Williams



On December 17, Orville Wright made the first successful flight of a powered aircraft in history. The public paid little attention. But within two years, the brothers were making 30-minute flights. By 1908, the pioneer aviators had signed a contract for production of the Wright airplane with the U.S. Army.



By 1918, the Postal Service began airmail service, as shown in this preliminary sketch of a DH4-Mail. Convinced of the great potential of flight, the government established the first transcontinental airmail service in 1920.



Within two years, the Wright brothers had increased their flights to 24 miles. By 1920, convinced of the great potential of flight, the U.S. government had established the first transcontinental airmail service.

PHOTOGRAPHY EXPLOSION Before the 1880s, photography was a professional activity. Because of the time required to take a picture and the weight of the equipment, a photographer could not shoot a moving object. In addition, photographers had to develop their shots immediately.

New techniques eliminated the need to develop pictures right away. **George Eastman** developed a series of more convenient alternatives to the heavy glass plates previously used. Now, instead of carrying their darkrooms around with them, photographers could use flexible film, coated with gelatin emulsions, and could send their film to a studio for processing. When professional photographers were slow to begin using the new film, Eastman decided to aim his product at the masses.

In 1888, Eastman introduced his Kodak camera. The purchase price of \$25 included a 100-picture roll of film. After taking the pictures, the photographer would send the camera back to Eastman's Rochester, New York, factory. For \$10, the pictures were developed and returned with the camera reloaded. Easily held and operated, the Kodak prompted millions of Americans to become amateur photographers. The camera also helped to create the field of photojournalism. Reporters could now photograph events as they occurred. When the Wright brothers first flew their simple airplane at Kitty Hawk, an amateur photographer captured the first successful flight on film.



◀ Copyright © Eastman Kodak Company

KEY PLAYER



GEORGE EASTMAN
1854–1932

In 1877, when George Eastman took up photography as a hobby, he had to lug more than 100 pounds of equipment for one day's outing. To lighten his load, he replaced heavy glass plates with film that could be rolled onto a spool.

In 1888, Eastman sold his first roll-film camera. Eastman called his new camera (shown at left) the Kodak, because the made-up name was short and memorable. It was popularized by the slogan "You Press the Button, We Do the Rest."



ASSESSMENT

1. TERMS & NAMES For each term or name, write a sentence explaining its significance.

• Louis Sullivan
• Daniel Burnham

• Frederick Law Olmsted
• Orville and Wilbur Wright

• George Eastman

MAIN IDEA

2. TAKING NOTES

Using a three-column chart, such as the one below, list three important changes in city design, communication, and transportation.

City Design	Communication	Transportation
1.	1.	1.
2.	2.	2.
3.	3.	3.

Which change had the greatest impact on urban life? Why?

CRITICAL THINKING

3. HYPOTHESIZING

If you had been an urban planner at the turn of the century, what new ideas would you have included in your plan for the ideal city?

Think About:

- Olmsted's plans for Central Park
- Burnham's ideas for Chicago
- the concept of the garden city

4. EVALUATING

Which scientific or technological development described in this section had the greatest impact on American culture? Use details from the text to justify your choice.

5. SUMMARIZING

How did bridge building contribute to the growth of cities?