The Balloon Brothers

A Reading A–Z Level Z Leveled Book
Word Count: 1,657

Connections

Writing and Art

Write a newspaper article from September 19, 1783, describing the Montgolfier brothers' experiment. Use facts from the book and outside resources.

Science

Choose an experiment from the book. Organize the details of the experiment using the steps of the scientific method. Discuss your results and any new questions with a partner.

LEVELED BOOK • Z

The Balloon Brothers

MULTI LEVEL Z·Z¹·Z²

Written by David L. Dreier
Illustrated by Loic Derrien

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Focus Question

Who were the Montgolfier brothers, and why are they remembered?

Words to Know

airships	experiment
atoms	immersed
buoyancy	inflammable
chemist	intrigued
element	molecules
envelope	physicist

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Correlation

LEVEL Z	
Fountas & Pinnell	U–V
Reading Recovery	N/A
DRA	50

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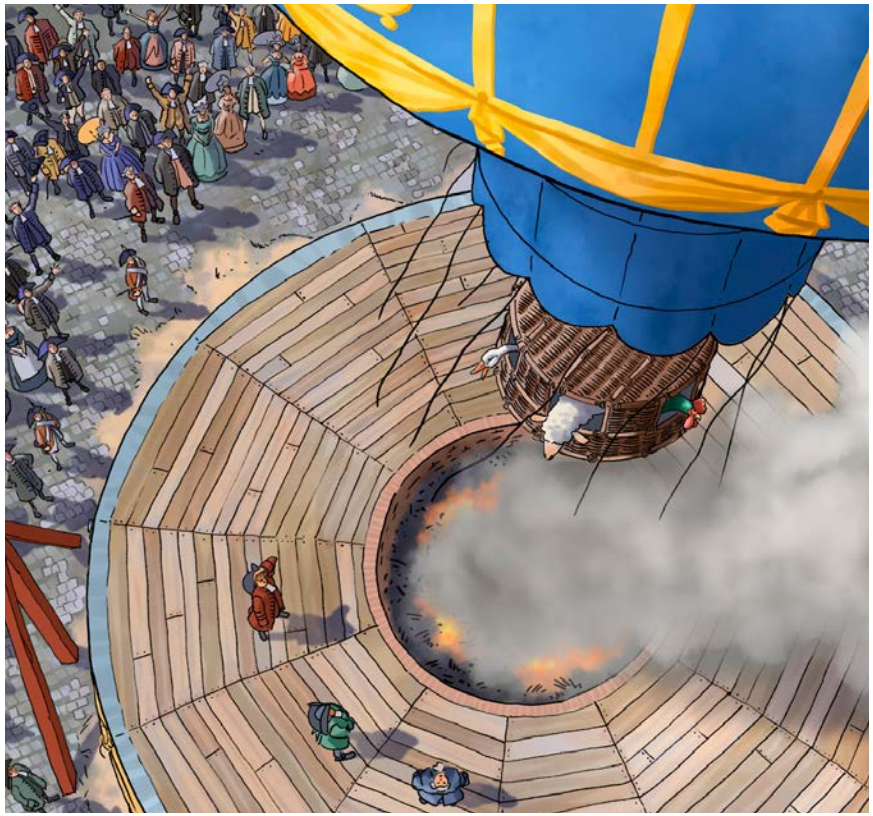
Witnessing the Birth of a New Age

An excited crowd of 130,000 gathered outside the Palace of Versailles (vair-SYE), just outside Paris, France, on the afternoon of September 19, 1783. They had come to see the flight of a large hot-air balloon built by two brothers. This was the moment of truth for Joseph-Michel and Jacques-Étienne Montgolfier (mon-GOLF-yay). The king and queen of France watched from the palace courtyard.

The beautiful silk-and-paper balloon was decorated with gold designs on a blue background. There was tension in the air. Three animals waited in the wicker basket suspended beneath the balloon. The unusual passengers were a sheep, a rooster, and a duck.

These animals had been chosen as part of a scientific **experiment**. No one was sure what would happen to people who went up in a balloon. Since ducks often fly in the air, the brothers thought the duck would be fine. The rooster was included because it was also a bird, but one that didn't fly very high. The sheep was thought to be similar to a person since it was a mammal that lived on the ground. The brothers were anxious to learn if these animals could go up in a balloon and come down unharmed.



The Montgolfiers filled their balloon with hot, smoky air from a fire burning in a pit. Shortly after 1:00 PM, the balloon was released. As the crowd looked on in wonder, it rose to a height of about 460 meters (1,500 ft.). Eight minutes later, it settled back to Earth 3.2 kilometers (2 mi.) away. The animals were just fine.

The age of flight—long a dream of humanity—had finally dawned. The way was now clear for people to fly into the clouds. And the Montgolfiers deserved much of the credit.

Two Brothers with Big Ideas

The Montgolfier brothers were part of a large family from a small town in southern France. Their father, Pierre Montgolfier, was a successful paper manufacturer. His factories were the official suppliers of stationery to the court of King Louis XVI. Joseph and Étienne took over the family business in the 1770s. Their successful business left them plenty of free time to pursue other interests.

In his early forties, Joseph became **intrigued** with the possibility of flight. Since the 1600s, scientists had been exploring the possibility of making a lighter-than-air craft that would fly because of the principle of **buoyancy**. No one had yet figured out how to build such a vehicle, however.

Buoyancy was first understood by the ancient Greek mathematician Archimedes (ark-uh-MEE-deez). It involves the density of an object—its weight for a given volume—compared with that of a fluid around it. (*Fluid* in this sense can mean either a liquid or a gas.) If the density of an object is less than that of the fluid surrounding it, the object will experience an upward force. A cork floats because its density is less than that of water. A balloon filled with hot air rises because the

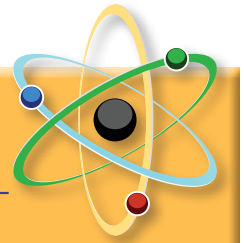
heated air in the balloon is less dense than the surrounding air. An object with a density greater than the fluid in which it is **immersed** will sink.

Joseph suspected that a light gas contained within a lightweight enclosure might make flight possible. He read about such a gas that several past researchers had reported from their experiments.

Scientists had known about this mysterious gas for many years. In 1766, English **chemist** Henry Cavendish identified the gas as an **element**. He gave it the name "**inflammable** air" because it was highly explosive. French chemist Antoine Lavoisier (la-VWAH-zee-ay) renamed it "hydrogen."

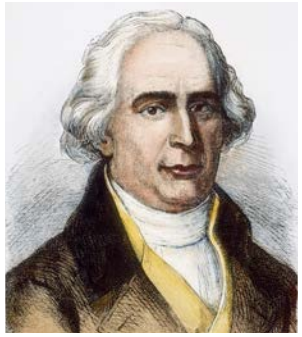
Joseph filled small paper spheres with hydrogen and released them, but his experiments were disappointing. The spheres rose just a few meters before coming back down. Hydrogen **atoms** are so small that they passed right through the paper into the surrounding air.

Elements and Atoms



Elements are the chemical building blocks of the universe. Every element is made up of atoms—the smallest particles of substances that still have the properties of that substance. Oxygen and hydrogen are both elements. One oxygen atom and two hydrogen atoms can combine to form one molecule of water.

Joseph looked for another way to build a flying machine. One day, he noticed that shirts drying over a smoky fire puffed upward. Like most people, he had often seen smoke rising from chimneys. This, he concluded, was the answer: smoke!



Joseph-Michel Montgolfier

In early 1783, the Montgolfiers began burning different materials to find ones that produced a lot of smoke. They found that a mixture of damp straw and chopped-up wool worked best. It also smelled terrible. But the smoke did indeed give buoyancy to any sort of light container.

Jacques-Étienne Montgolfier

The brothers concluded that smoke must contain something unknown with a lifting property. They named this marvelous substance "Montgolfier gas." Of course, there was no such substance. The lifting effect was caused by the hot air itself. When air gets heated, the **molecules** within it move around faster, causing the air to expand and become less dense. When contained within a balloon, the lighter air makes the balloon rise.

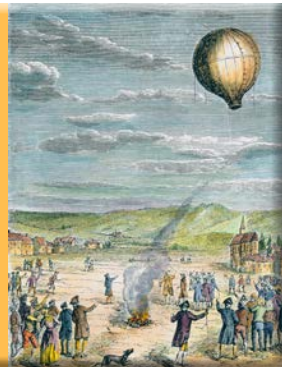
Constructing "Smoke-Powered" Balloons

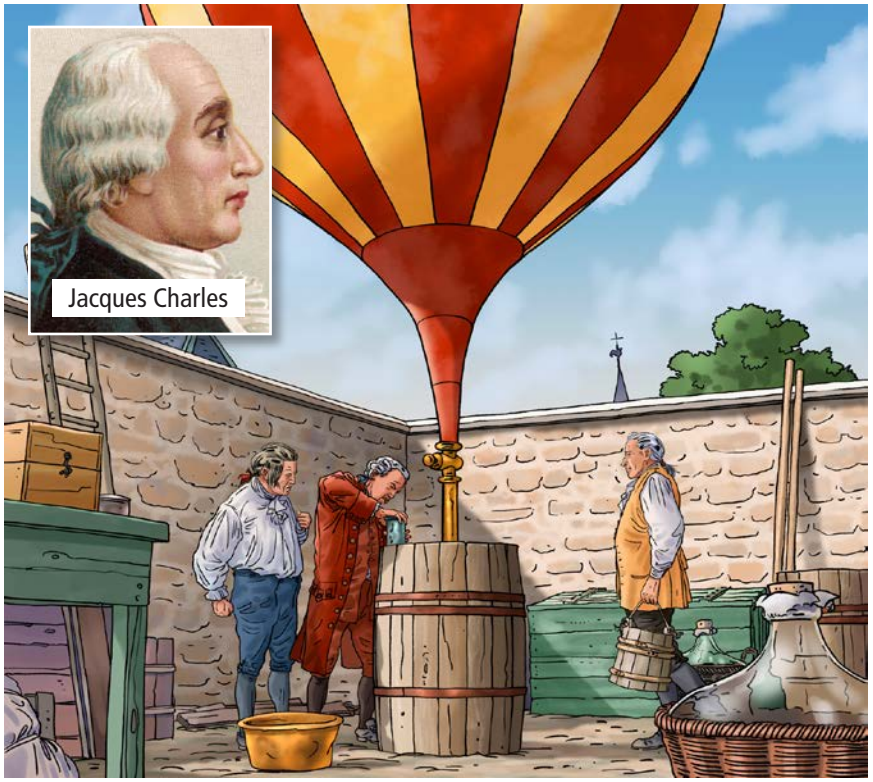
Without understanding the real science behind hot-air balloons, Joseph and Étienne continued to build and test new balloons. The brothers experimented by using different materials for the **envelope**, including silk, paper, and linen. As their work moved forward, they also increased the size of their balloons. The balloons rose ever higher into the air.

The brothers' experiments began to attract attention. A crowd filled the town square of a village in southern France on June 4, 1783, for the test of a large balloon made of cloth lined with paper. The crowd watched in amazement as the unoccupied balloon soared some 2,000 meters (6,560 ft.) into the sky. After a ten-minute flight, the balloon landed about 2 kilometers (1.2 mi.) away. Successful test flights such as this one launched a balloon craze in France.

From "Ascending Machines" to Balloons

The "ascending machines"—or later, "aerostats"—that got the French people so excited were not called "balloons" until sometime after the Montgolfiers made history. That name was adapted from the French word *ballon*, meaning "a large ball used in games."





A Balloon Rivalry

The Montgolfier brothers asked the French Academy of Sciences to officially recognize their work. The academy withheld approval, however. It decided to wait in case someone else invented a better balloon. The Montgolfiers' chief rival was a **physicist** named Jacques Charles (ZHOCK SHARL), who proposed building a hydrogen balloon. The Montgolfiers had long since given up on using hydrogen in favor of their hot-air balloons, but Charles saw great possibilities in this approach.

In July 1783, with the academy's approval, Charles began work on his balloon. He was assisted by two brothers, Nicolas-Louis and Anne-Jean Robert (roh-BEAR), both professional engineers. The three constructed a small test balloon made of silk with a rubberized surface designed to keep the hydrogen from escaping.

In the meantime, King Louis invited the Montgolfier brothers to Paris. He wanted them to build a dazzling balloon that would display his glory to all of France. As the court favorites, the brothers now received government funding for their work.

The two teams each wanted to be the first to launch a balloon with human passengers. The race was on.

A Better Gas for Balloons: Helium

Hydrogen is the lightest element—only one-fourteenth the weight of air—so at first glance it seems like the perfect gas for balloons. However, hydrogen is dangerous to work with because it catches fire and explodes easily.

A much better gas for balloons is helium, the second-lightest element. Helium does not catch fire or explode. It is therefore completely safe for use in lighter-than-air flight. Helium was not discovered until the 1880s, so it was not available to balloon makers in the 1700s.

Soaring into the Blue

On August 27, 1783, a large crowd gathered at a grassy area in Paris where the Eiffel Tower now stands. They had come to witness the launch of the Charles balloon. Among the onlookers was a famous American, Benjamin Franklin, who was serving as U.S. ambassador to France.

The balloon was relatively small—about 4 meters (13 ft.) in diameter—with alternating red and white stripes.

The Scientific Method

The Montgolfier brothers and Jacques Charles aimed to answer a question: Is it possible to construct a lighter-than-air device that will enable people to fly? To answer that question, they followed a procedure known as the "scientific method."

The scientific method has several steps:

- Ask a question.
- Do background research.
- Construct a hypothesis.
- Test your hypothesis with observations or experiments.
- Analyze your data and draw a conclusion.
- Communicate your results.

In the late afternoon, the unpiloted balloon was released. It rose quickly and flew northeast for less than an hour, landing about 15 kilometers (9 mi.) away in a small village. Terrified villagers attacked this strange monster from the heavens with their pitchforks.

Now it was the Montgolfiers' turn to wow Paris. On September 19, they launched their test balloon with its animal passengers at Versailles. When the animals landed safely, the time for a human trial was finally at hand. Since the flight would be very dangerous, the king felt it should be done by a pair of prisoners who had been sentenced to death. However, a science teacher, Jean-François Pilâtre de Rozier (ROZE-ee-ay), and a soldier, the Marquis d'Arlandes (mar-KEE dar-LOND), volunteered.

Their historic flight took place on November 21, this time from the outskirts of Paris. The balloon towered 23 meters (75 ft.) high. It was covered with various golden designs in honor of the king and royal family.

With de Rozier and the marquis aboard, the balloon rose into the air. Twenty-five minutes later, it landed about 8 kilometers (5 mi.) away, settling between a pair of windmills outside the city. The two men were hailed as heroes.

Benjamin Franklin observed the historic flight. Asked by another spectator what this balloon was good for, he reportedly answered, "What good is a newborn baby?"

On December 1, just ten days after the Montgolfiers' triumph, Jacques Charles and Nicolas-Louis Robert made the first human ascent in a hydrogen balloon. Taking off from the Tuileries (TWEE-luh-reez) Garden in Paris, they flew for more than two hours, coming down in a town about 36 kilometers (22 mi.) away.

In the following years, the Montgolfiers launched several more balloons. The brothers were honored by the French Academy of Sciences, and their father, Pierre, was made a nobleman by King Louis.

The Legacy of Lighter-Than-Air Flight

The passion for ballooning soon spread throughout Europe. It was not long, however, before the risks involved became clear. In June 1785, de Rozier and his copilot, Pierre Romain, were killed while attempting to fly across the English Channel in a balloon.

Despite the risks, pioneers continued to develop balloon designs long after the balloon craze of the late 1700s had ended. In the 1800s, lighter-than-air vehicles were given rudders and motorized propellers. By the 1930s, huge **airships** were flying passengers back and forth across the Atlantic Ocean. The golden age of airships ended abruptly when the German airship *Hindenburg* caught fire and crashed while landing in New Jersey in 1937.

Today, airships are mostly used for advertising and can often be seen flying above open-air stadiums during large sporting events. Gas balloons are mostly used for gathering weather data, while hot-air balloons are mostly used for recreation. Many areas hold festivals each year in which hundreds of colorful hot-air balloons fill the sky. These events can make it appear as though balloon mania never ended.

Glossary

airships *(n.)* wingless, steerable aircraft capable of powered flight that use bodies filled with gas to make them lighter than air (p. 15)

atoms *(n.)* the smallest parts in an element (p. 7)

buoyancy *(n.)* the ability or tendency to float (p. 6)

chemist *(n.)* a scientist who studies chemical elements and how chemicals interact (p. 7)

element *(n.)* a substance that cannot be broken down into simpler substances and is made up of only one kind of atom (p. 7)

envelope *(n.)* the outer covering or bag of an airship, such as a hot-air balloon, that holds gas or heated air (p. 9)

experiment *(n.)* a scientific test or trial (p. 4)

immersed *(v.)* dipped or placed into a fluid or some other substance that surrounds completely (p. 7)

inflammable *(adj.)* easily able to catch fire and burn quickly (p. 7)

intrigued *(adj.)* very curious or interested (p. 6)

molecules *(n.)* the smallest parts of a substance that can exist by themselves, made of one or more atoms (p. 8)

physicist *(n.)* a scientist who studies the nature and properties of energy and matter (p. 10)