The Balloon Brothers

A Reading A–Z Level Z2 Leveled Book
Word Count: 1,877

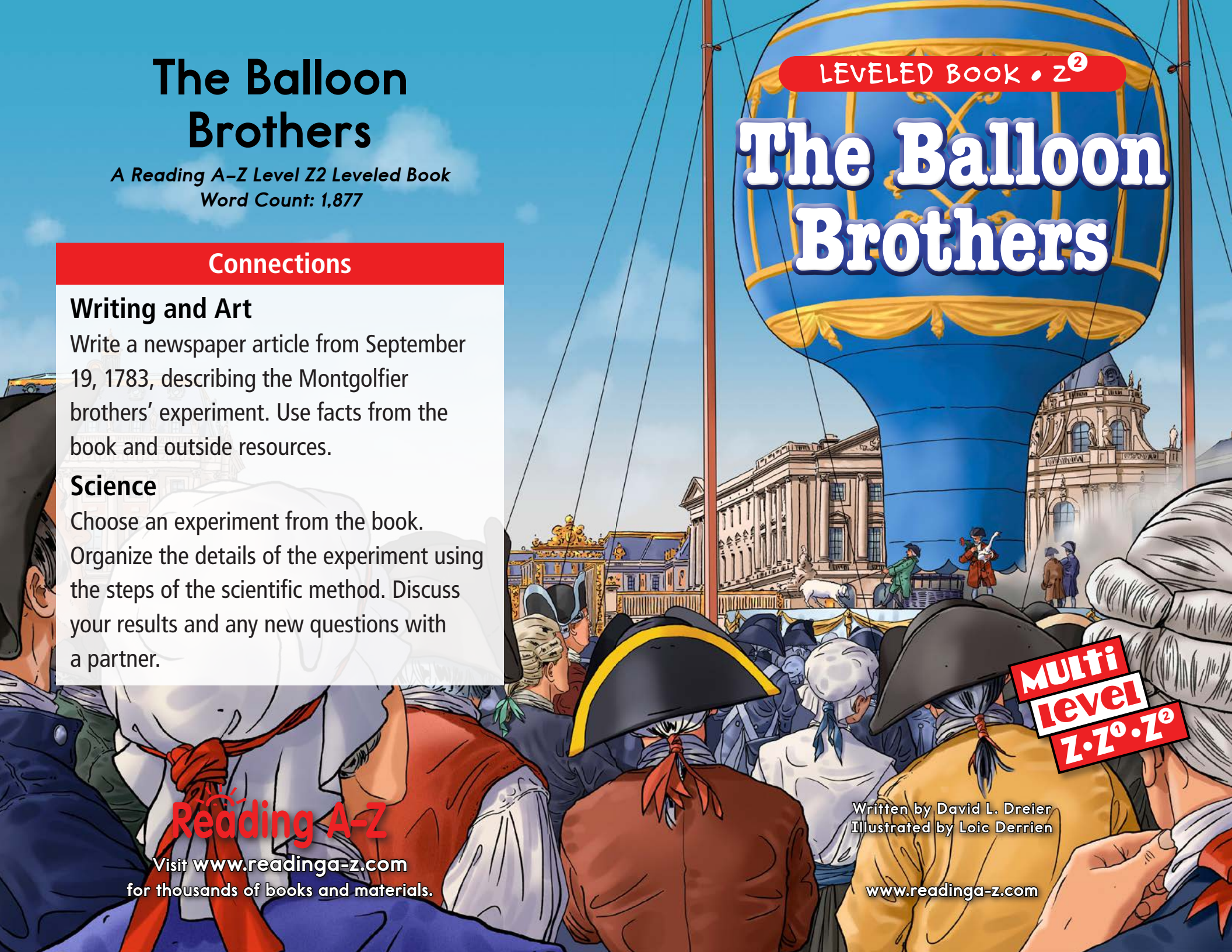
Connections

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.



The Balloon Brothers

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	immersed
buoyancy	inflammable
chemists	intrigued
combustible	molecules
envelope	physicist
experiment	prestige

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Correlation

LEVEL Z2	
Fountas & Pinnell	Y–Z
Reading Recovery	N/A
DRA	70+

Table of Contents

Witnessing the Birth of a New Age

An excited crowd of 130,000 thronged the grounds of the Palace of Versailles (vair-SYE), just outside Paris, France, on the afternoon of September 19, 1783. They had come to see the spectacle of a test flight of a large hot-air balloon constructed by two French brothers, Joseph-Michel and Jacques-Étienne Montgolfier (mon-GOLF-yay). King Louis XVI and Queen Marie Antoinette (an-twon-ET) 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. Since the dangers of flight were unknown, the passengers in the wicker basket suspended beneath the balloon were not human. Instead, they were a sheep, a rooster, and a duck.

These animals had been chosen as part of a scientific **experiment**. The sheep's anatomy was considered close enough to a human's to make it a reliable test subject. The rooster was included because, though it was a bird, it couldn't fly very high. The high-flying duck was used to test any other aspects of the flight that might be hazardous.

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 unharmed from the experience.

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

Two Brothers with Big Ideas

The Montgolfier brothers were two of the sixteen children of Pierre and Anne Montgolfier, who lived in Annonay (AN-on-ey), a town in southern France. Pierre was a successful paper manufacturer. His factories were the official suppliers of stationery to the court of King Louis XVI, a contract that gave the Montgolfiers financial security. When Joseph and Étienne took over the family business in the 1770s, they had ample 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 **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 in which it is **immersed**. (*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 in which it rests, the object will experience an upward force.

Joseph theorized that a lighter-than-air gas contained within a lightweight enclosure might create an effective buoyant force. He read about hydrogen gas, which was known at the time as "**inflammable** air" because of its explosive nature.

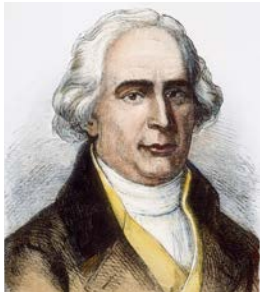
Scientists had been aware of hydrogen's existence for some time. Early **chemists** sometimes reported having produced a flammable gas during their experiments, but they didn't know what it was. In 1766, English chemist Henry Cavendish identified the gas as an element and gave it the name "inflammable air." French chemist Antoine Lavoisier (la-VWAH-zee-ay) renamed it "hydrogen" in 1783.

Joseph filled small paper spheres with hydrogen gas and released them to see if they would fly. The results of his experiments were disappointing; the spheres rose just a few meters before coming back down. Hydrogen atoms are so small that they were able to pass through the paper and dissipate 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 create an "ascending machine," as he called it. One day, he noticed that shirts drying over a smoky fire billowed 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 kinds of **combustible** materials to identify ones that produced a lot of smoke. They found that a mixture of damp straw and chopped-up wool released the most smoke of any materials they tested. It also produced a terrible stench. But the smoke did indeed give buoyancy to any sort of light container.

Jacques-Étienne Montgolfier

The brothers concluded that smoke must contain some previously unknown component with a lifting property. They dubbed 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's **envelope**, 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 believe in the existence of Montgolfier gas and to make foul-smelling smoke. The brothers had no reason to believe that their premise was wrong. After all, their test balloons were working.

The brothers experimented by using different materials for the envelope, including silk, paper, and linen. As their work progressed, they also increased the size of their hot-air balloons. The balloons rose ever higher into the air.

The brothers' experiments began to attract attention. A crowd filled the Annonay town square 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 sought official recognition of their work from the French Academy of Sciences. A "seal of approval" from this eminent institution was of great benefit to inventors, enhancing their **prestige** and earning them the admiration and, hopefully, the support of the king. The monarch would, in turn, bask in public adulation for his promotion of an impressive technological advance.

To the brothers' disappointment, the academy withheld approval of their work. It decided to take a wait-and-see approach 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, Charles began work on his balloon, financed by public donations. 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 to keep the hydrogen from escaping.

In the meantime, the Montgolfiers scored a major victory: King Louis, having heard reports of their experiments, invited them to Paris. He wanted the brothers to build a dazzling balloon that would display his glory to all of France. As the king's favorites, the brothers now received government funding for their work.

Charles had to content himself with the moral support of the Academy of Sciences. But he at least had the funding he needed from the public.

The two teams strove to become the first to launch a balloon with human passengers. The race was on, though the rivalry was a reasonably friendly one. As the summer waned, the Montgolfiers and Charles were getting ready to demonstrate their balloons.

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 white stripes had turned yellow, discolored by the rubber solution applied to the silk. Charles and the Robert brothers had generated hydrogen for the balloon by pouring sulfuric acid onto a half ton of scrap iron.

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.

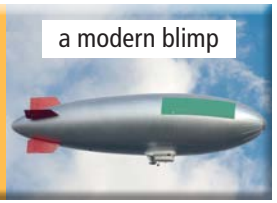
In the late afternoon, the unpiloted balloon was released from its moorings. It rose quickly and flew northeast for less than an hour, landing about 15 kilometers (9 mi.) away in the village of Gonesse. Terrified villagers attacked this strange monster from the heavens with their pitchforks.

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. Mindful of the danger if the balloon should fail in flight, the king proposed using condemned prisoners as the first human passengers. He was, however, dissuaded from that idea. Instead, 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 for this ascent was even more impressive than the last one; it towered 23 meters (75 ft.) high. The balloon was embellished with various golden designs. They included Louis's monogram—two intertwined capital L's—and a circle of fleurs-de-lis (flur-duh-LEES), stylized lilies that were the symbol of French royalty.

Do You Know?

Modern airships include blimps, which rely solely on gas pressure to maintain their shape, and dirigibles, which have an internal structure.



a modern blimp

With de Rozier and the marquis standing on opposite sides of a platform at the base of the balloon, the "aerostatic globe" 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 is the good of 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 elevated to nobility 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 initial balloon craze of the late 1700s had ended. In the 1800s, lighter-than-air vehicles were equipped with 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 in 1937, though, when the German airship *Hindenburg* caught fire and crashed while landing in New Jersey.

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)

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

chemists *(n.)* scientists who study chemical elements and how chemicals interact (p. 7)

combustible *(adj.)* easily catching fire or burning (p. 8)

envelope *(n.)* the outer covering or bag of an airship, such as a hot-air balloon, that holds gas or heated air (p. 8)

experiment *(n.)* a scientific test or trial (p. 5)

immersed *(v.)* dipped or placed into a fluid or some other substance that surrounds completely (p. 6)

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)

prestige *(n.)* a level of high standing or respect (p. 10)