

Designing the First Flying Machine

By ReadWorks



Inventor Wilbur Wright's 1904 notes on flight

Orville and Wilbur Wright, two brothers who lived at the turn of the 20th century, are often credited with being the inventors of the airplane. But in fact, they were not the first humans to launch an object into flight. Many had flown (and crashed) experimental aircraft before. They weren't even inventors to begin with. Instead, they started their careers as newspaper printers and bicycle-makers, then applied the design concepts and scientific principles they learned along the way to their ultimate innovation: a system of controls to *fly* the plane and keep it from crashing. It is this invention that gained them notice as inventors, and the admiration of the world.

The Wright brothers were born in the Midwest. Wilbur was born in Indiana in 1867, and Orville followed four years later, in 1871, after the Wright family moved to Ohio. The two often played together as boys, and their favorite toy was a helicopter, brought home by their father from his travels in 1878. Adapted from a design created a few years earlier by French inventor Alphonse P  naud, the toy had blades that twirled with the help of a rubber band. When it inevitably broke, the boys built a replacement by themselves.

Though the boys never stopped tinkering, neither of them graduated from high school. Orville dropped out in 1889, his junior year of high school, to start a printing business. Together, the two published a newspaper, and they worked for commercial clients (including the famous African-American poet and writer Paul Dunbar, who had been their classmate in school). A few years later, when bicycles became all the rage in America, they added a repair and sales shop to their projects. By 1896, they had created and begun manufacturing their very own brand.

If the brothers had kept on building bikes and printing poetry, they might have done very well for themselves, and we might have forgotten them by now. But instead, they used the proceeds from their business ventures to fund further tinkering in a new kind of interest: flying.

By this time, many people had been trying to invent an airplane that worked. Some airplanes were steam-powered; others had flapping wings, like birds. The German inventor Otto Lilienthal, also known as "The Glider King," was appearing in all the papers, showing off

his gliding machine, which he'd built based on his studies of storks. Though his gliders had no motors, instead coasting purely on air, they could keep a pilot hanging in the air under the right conditions. When Lilienthal made headlines again by plunging to his death in August of 1896 during a gliding accident, inventors knew they had to improve upon his designs, or else.

There was no Internet to research designs back in 1896, so the brothers had to write letters to the Smithsonian Institution (today the world's largest museum and research complex) to request more information about early flight pioneers. They pored over everything they could find, from Lilienthal's designs to the diagrams of Leonardo da Vinci, who had sketched designs for both gliders and helicopters as early as the 1400s. And like many inventors before them, they watched a lot of birds.

One big difference between birds and early gliders, the brothers noticed, was that birds were able to "roll" right or left as the winds changed, and turned by shifting the angles of their wings. Much like a person riding a bicycle, they thought birds could "bank" or lean into turns, while still remaining stable and upright. By contrast, a glider pilot did not have the same level of control as a bird, leading him or her to topple over or crash, as Lilienthal did.

The Wright brothers loved experimenting with flight, but they certainly didn't want to die trying, so from the beginning, they focused on bringing more control to the flying experience. The brothers drew from their research of flying machines and utilized the design

principles from the bicycle world. Once they figured out how to control the movement of a machine as well as their bird friends could control their bodies, the brothers thought they could easily find the right parts to add on wings and motors to create a viable flying machine. This approach was very different from the approaches of other would-be airplane inventors of the day. Other engineers were studying trains or ships, and thus, spent most of their time building stronger engines (as it was thought that a strong engine could propel a plane into the air more easily) or ship-like rudders to guide the airplanes along. As it turned out, the Wright brothers had the winning approach.

Once the brothers had decided to begin testing their experiments with gliders, they needed to find a better place to glide as Ohio wasn't quite windy enough. After writing to the U.S. Weather Bureau, analyzing the weather data for various areas and asking other inventors for advice, the Wright brothers decided that Kitty Hawk in North Carolina would be the best place to take advantage of sea breezes for gliding practice. From 1900 to 1903, they set up camp at Kitty Hawk, testing designs by making "glider kites" that could be flown without pilots for safety.

Still comparing human innovations with birds in flight, the brothers changed each small part of their design. Some had giant wings; some came without tails. Many were still crashing, but the brothers tried not to become frustrated. During one winter, they returned home to Ohio, where they tried different ways of testing that weren't so expensive. On some days, they

could be seen pedaling bicycles equipped with wings down the streets and startling passersby. On others, they'd create tiny airplane prototypes to test in the Ohio wind.

Over time, the brothers discovered many errors in the designs of the inventors that had come before them, including Lilienthal, and fixed them by creating their own calculations. The biggest difference between riding a bicycle and flying a plane, they realized, was that machines on the ground only had to move forward or backward in order to get going. An airplane had to be controlled in three dimensions: it could point up or down, curve from side to side, and roll upside-down. So they knew their final design had to have elements that controlled movement in each of these three ways to keep them from crashing. The resulting design was called "three-axis control," and it is still used today.

The Wright brothers designed three-axis control to help the pilot guide the plane in all three dimensions. They created one innovation called "wing-warping" which allows the pilot to bend (or "warp") the wings and help to turn the plane like a bird might do with its wings. They created another innovation called the "forward elevator" which helps the pilot to turn the plane upwards, toward the sky, or downward, toward the ground. And finally, they figured out a way to use that ship rudder after all: it could be used during turns to keep the plane from flipping over, as it had done in earlier gliding experiments.

By 1902, the Wright brothers were piloting hundreds of well-controlled glider flights (between September and October of 1902, they made between 700 and 1,000 glides). They finally felt confident enough to patent their “three-axis control” system. And they were ready to add engines to the equation. After searching around for the right motor for weeks, the brothers asked their bike-shop buddy, Charlie Taylor, to try his hand at creating a motor for an airplane. In six weeks, he had it ready. Just one year after they created their three-axis system, the brothers made their first motorized flight, and by doing so, made history.

Name: _____ Date: _____

1. Who is credited as the inventor(s) of the airplane?
 - A Otto Lilienthal
 - B Orville and Wilbur Wright
 - C Alphonse Pénaud
 - D Charlie Taylor

2. What does the author describe in the passage?
 - A Orville and Wilbur Wright's childhood in Indiana
 - B how French inventor Alphonse Pénaud designed the helicopter
 - C how the first airplane was invented
 - D flight patterns of migratory birds

3. Otto Lilienthal's gliding airplane design was not a success. What evidence from the text supports this statement?
 - A "By this time, many people had been trying to invent an airplane that worked. Some airplanes were steam-powered; others had flapping wings, like birds."
 - B "The German inventor Otto Lilienthal, also known as "The Glider King," was appearing in all the papers, showing off his gliding machine, which he'd built based on his studies of storks."
 - C "Though his gliders had no motors, instead coasting purely on air, they could keep a pilot hanging in the air under the right conditions."
 - D "When Lilienthal made headlines again by plunging to his death in August of 1896 during a gliding accident, inventors knew they had to improve upon his designs, or else."

4. Which of the following helped Orville and Wilbur to finally create a successful plane?
 - A directly working with the German inventor Otto Lilienthal
 - B their experience building experimental aircraft during their childhood
 - C the research and designs of other inventors which Orville and Wilbur improved upon
 - D the formal education in Physics that Orville and Wilbur had both received

5. What is this passage mostly about?
 - A the creation of the first motorized airplane
 - B the Wright Brothers' bicycle business
 - C Otto Lilienthal's gliders
 - D the first transcontinental flight

6. Read the following sentences: "If the brothers had kept on building bikes and printing poetry, they might have done very well for themselves, and we might have forgotten them by now. But instead, they used the proceeds from their business **ventures** to fund further tinkering in a new kind of interest: flying."

As used in the passage, what does "**ventures**" most nearly mean?

- A distractions
- B inventions
- C designs
- D projects

7. Choose the answer that best completes the sentence below.

_____ many of Orville and Wilbur's first airplane models crashed, they persevered and were eventually successful.

- A Even though
- B As a result
- C Initially
- D Above all

8. What difference did the Wright Brothers notice between birds and early gliders?

9. Describe the gliding machine Otto Lillenthal had invented.

10. How was Orville and Wilbur's approach to building a successful airplane different from that of other inventors who were working on airplanes? Use information from the text to support your answer.

Teacher Guide & Answers

Passage Reading Level: Lexile 1240

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8. What difference did the Wright Brothers notice between birds and early gliders?

Suggested answer: They noticed that birds could roll left or right as winds changed in order to remain stable, but glider pilots had very little control over their movements, which led to crashes.

8. Describe the gliding machine Otto Lilienthal had invented.

Suggested answer: The gliding machine had gliders that did not have motors but could coast on air under the right conditions.

10. How was Orville and Wilbur's approach to building a successful airplane different from that of other inventors who were working on airplanes? Use information from the text to support your answer.

Suggested answer: Orville and Wilbur's approach was different because they focused on bringing more control to the flying experience. They started with designing a control system and then added wings and motors to it, whereas other inventors focused primarily on building stronger engines or ship-like rudders.