Name: _____ Date: _____

How Did Two Bicycle Makers Learn to Fly?

Reading level 10 (6th grade) · 1088 words

How do two people who run a bicycle shop learn to fly? They do it one question at a time. The National Park Service says Wilbur and Orville Wright were more than lucky mechanics. It says they reached the world's first powered, controlled flight in a heavier-than-air machine by study and experiment. Their longest flight on December 17, 1903, lasted 59 seconds and went 852 feet. Getting there took years of tests, and many of them failed first.

The brothers started with what they knew. Their Dayton shop opened in 1892 and sold and repaired bicycles. By 1900 it had built about 300 of its own. The Wrights made their own wheel hubs, with bearing cups that could be adjusted and felt washers to keep dust out and oil in. In 1898 they designed a coaster brake with a machinist named Charley Taylor. A bicycle has to be light, strong and balanced, and a rider has to steer it. A flying machine has those needs too.

In 1899 Wilbur wrote to the Smithsonian to ask what was already known about flying. He got technical papers in reply. In his letter he called birds the most perfectly trained gymnasts in the world. The brothers also watched buzzards over the Great Miami River. They saw that a bird rolls by changing the angle of its wings. Their first plans for a glider with moving parts were too complex and too heavy. They needed a simpler way to do what a bird does.

The simpler way was wing warping. The tips of a biplane's wings are twisted in opposite ways. The side twisted up gets more lift and rises. The other side sinks, and the aircraft rolls. A story often told says the idea came from an empty inner-tube box that Wilbur twisted in the shop. Whatever its start, the brothers tested the idea on a kite in late July 1899. Lines held by a person on the ground twisted the wing tips, and the kite moved from side to side.

A kite on a field is one thing. A glider that carries a pilot needs wind and a soft place to land. In 1900 the brothers chose Kitty Hawk, North Carolina, on the Outer Banks. Winds blow in from the sea there, and sand dunes cushion a landing. Their 1900 glider spanned about 17 feet. They flew it mostly as a kite. Wilbur also flew it as a glider a few times, enough to see that wing warping could control a roll.

The 1901 glider was bigger, with a 22-foot span. The National Park Service says its best flight went 389 feet. But NASA reports that it gave only about one-third of the lift its design had predicted. The brothers had designed it with a formula and tables of numbers worked out by earlier researchers. They had followed the method with care. If the glider lifted so much less than the formula said, then some number in the formula was wrong.

The numbers came from two sources. Otto Lilienthal, an earlier glider pioneer, had published tables of lift for wing shapes. John Smeaton, an engineer of the 1700s, had supplied a

number for how hard air pushes on a flat plate. On September 18, 1901, in Chicago, Wilbur told the Western Society of Engineers that Lilienthal's tables might be somewhat in error. Afterward the brothers put a flat plate and a curved wing on a bicycle wheel laid on its side. The wheel turned, and drag was greater than lift.

The wheel could not give exact answers. So the brothers built a wind tunnel and tested small wing models at 45 different angles to the moving air. The tunnel pointed to Smeaton's number as the main error. It also showed that Lilienthal's tables fit Lilienthal's wings but not the long, thin wings the Wrights used. A wing curved like a parabola gave more lift than a circular curve. The Centennial of Flight Commission says they chose to trust their own numbers. They used them to design the next glider.

The 1902 glider was built from the new numbers. Its span was 32 feet. It flew almost 1,000 times in September and October, and the Park Service says Wilbur's best glide went 622 feet in 26 seconds. In October the brothers made the rudder movable. They linked it to the pilot's hip cradle, which also warped the wings. NASA calls it the first aircraft with active control on all three axes: roll, pitch and yaw. A pilot could now steer instead of drifting with the wind.

A glider needs a hill and a wind. A flying machine needs an engine. In December 1902, Wilbur wrote to ten engine makers asking for a light gasoline motor, and every maker said no. So the brothers built one with Charlie Taylor, who machined it in six weeks. The engine alone weighed about 200 pounds, and it had no throttle. It first ran on February 12, 1903, and it overheated and seized. The brothers rebuilt it, and by May it ran smoothly.

Nothing published explained how to design a propeller. So the brothers reasoned that a propeller is a wing that turns in a spiral path. They used what they had learned about wings. They carved two propellers, each 8 and a half feet long, from layers of spruce. A test showed 66 percent efficiency, which means about two-thirds of the engine's work became thrust. Their own formula had predicted it to within 1 percent.

The Flyer, a wood-and-muslin biplane that weighed 605 pounds empty, was shipped in pieces to Kitty Hawk. On December 14, 1903, Wilbur made an unsuccessful try that slightly damaged it. On December 17 it slid down a 60-foot rail and made four flights, two by each brother. Orville made the first, and Wilbur made the last. They lasted 12, 12, 15 and 59 seconds. They went 120, 175, 200 and 852 feet. On the third flight a gust lifted a wing, and wing warping brought it back down.

Two years later, on October 5, 1905, Wilbur flew a closed course in the brothers' third powered airplane. The Smithsonian's museum says the flight lasted about 39 minutes and covered 24.5 miles. Between 1900 and 1905 the brothers had built three gliders and three powered aircraft. The long flight grew out of the same habit as the rest: ask a question, run a test, change the machine. Wilbur Wright died on May 30, 1912, and Orville Wright died on January 30, 1948.

Questions

1. In the story often told, what did the box do when two opposite corners were pressed?

A. The box folded itself flat on the table
B. The other two corners moved oppositely
C. The box turned into a perfect circle

2. Why did the brothers test the old numbers themselves?

A. A museum had asked them to prove it to everyone
B. Their bicycle customers needed new parts
C. Their glider lifted far less than predicted

3. Why did the brothers build their own engine?

A. No maker would supply what they asked for
B. A famous inventor told them to do so
C. Engines were free at the bicycle shop

4. In "wing warping," what does warping mean?

A. Painting with a brush
B. Twisting a shape
C. Weighing on a scale

5. Which came last?

A. The 1899 kite
B. The tunnel tests of 1901
C. Wilbur's 1905 flight

Words to know

warping: twisting
glider: engineless airplane
propeller: spinning blade
rudder: steering surface
efficiency: useful share

Answer key: How Did Two Bicycle Makers Learn to Fly?

1. B. The other two corners moved oppositely
2. C. Their glider lifted far less than predicted
3. A. No maker would supply what they asked for
4. B. Twisting a shape
5. C. Wilbur's 1905 flight