



PROGRAM OVERVIEW

NOVA interweaves the story of Louis Blériot's historic flight across the English Channel in 1909 with his grandson's attempt to recreate it.



The program:

- previews Blériot's early life, including his burgeoning passion for flight and his design of an acetylene-fueled light that allowed cars to travel at night.
- presents Blériot's same-named grandson, who hopes to recreate his grandfather's voyage in an original Blériot XI.
- reviews Orville and Wilbur Wright's early experiments with airplanes and the duo's success in understanding the importance of wing shape and control surfaces to flight.
- compares Blériot's design process, based on trial and error, to the methodical methods used by the Wright Brothers.
- traces the development and testing of Blériot's aircraft designs, from the early ornithopter (an aircraft propelled by flapping wings) to the monoplane.
- discusses Blériot's contributions to flight, including his development of modern aircraft controls, such as the stick and rudder pedals.
- notes that many components and methods used in the first airplanes had been developed for other uses, including the technique of trussing the wooden frames, the lightweight tension wheels used for landing, the 25-horsepower engines used to power the planes, and the propeller designs.
- chronicles the attempt by Blériot's grandson to recreate his grandfather's famous flight.
- relates Wilbur Wright's demonstration of his airplane in France and Blériot's discussion with Wright about wing warping, the final piece of the puzzle in Blériot's airplane design.
- relates Blériot's grandson's failed attempt to cross the English Channel.
- recreates through Blériot's own words the experience of the first flight across the English Channel.

Taping Rights: Can be used up to one year after the program is taped off the air.



BEFORE WATCHING

- 1 Help students locate Calais, France; Dover, England; and the English Channel on a map. Trace Blériot's famous Channel crossing. Use the map's scale to determine the distance across the English Channel. (It is about 39 kilometers, and Blériot took 36 minutes to cross.) Have students calculate Blériot's average speed for the trip. (It was about 60 km/hr.)
- 2 As students watch, have them collect information for the "Blériot's Inventions" activity on page 2.

AFTER WATCHING

- 1 Ask students to contrast Blériot's experimental method with that of the Wright Brothers. What was Blériot's approach? (He built and tested a variety of planes.) What allowed him to pursue this method? (He had the necessary funding to build multiple planes.) How did the Wright Brothers design their planes? (They methodically tested and refined their ideas.)
- 2 Have students compare what it was like flying early aircraft like the Blériot models to today's aircraft. (In early models, pilots were completely exposed to the elements, had no electronic controls, had no ground communication, and used unsteady wing warping to control roll. Today's pilots fly in enclosed cockpits, have sophisticated navigation systems, use radio and are tracked by radar, and rely on stable ailerons to control roll.)

CLASSROOM ACTIVITY

Objective

To analyze the evolution of designs that led up to the invention of the Blériot XI, the first plane to cross the English Channel.

Materials for each team

- copy of the "Blériot's Inventions" student handout
- access to print and Internet resources (optional)

Procedure

- While not as methodical in his approach to airplane design as the Wright Brothers, Louis Blériot tried to learn something from each of his designs as he sought to make an airplane that would stay aloft. In this activity, students will be taking a look at each of Blériot's designs to try to understand how his thinking evolved.
- 2 Using the illustration on the student handout, first review with students the parts of the Blériot XI, including the wings, tail, engines, and the control surfaces (elevator, rudder, and wing warping). Students will need to know these parts of the plane as they take notes while watching the program. You may also want to discuss how lift works (a demonstration of lift can be found at www.pbs.org/wgbh/nova/teachers/activities/2412_barrier.html) and review with students how the rudder and ailerons work on modern planes. Knowing these concepts will better help students identify each plane's control surfaces.
- 3 Organize students into three teams. Distribute one copy of each student handout to each team. Assign each team to track three of the following Blériot models: 1) I, II, III; 2) IV, V, VI; and 3) VII, VIII, XI. (Note that the program does not cover models IX and X. The Blériot XI design is a direct descendant of the Blériot VIII.) Each team will describe, draw a picture, and take notes on each of its three planes and note how each plane performed. Review the activity handout instructions with students.
- 4 Play the video. Pause the video after each plane model is shown so that teams can better take notes and draw each plane design.
- 5 After students have watched the program, have each team compare its notes before reporting to the class. If you would like, you can have students do additional research on the models. Close-up pictures of each of Blériot's 11 aircraft can be found at www.pbs.org/nova/bleriot/imagination.html

STANDARDS CONNECTION

The "Blériot's Inventions" activity aligns with the following National Science Education Standards.

GRADES 5-8

Science Standard G:

History and Nature of Science

Historical perspectives

 Many individuals have contributed to the traditions of science. Studying some of these individuals provides further understanding of scientific inquiry, science as a human endeavor, the nature of science, and the relationships between science and society.

GRADES 9-12

Science Standard G:

History and Nature of Science

Historical perspectives

• Usually, changes in science occur as small modifications in extant knowledge. The daily work of science and engineering results in incremental advances in our understanding of the world and our ability to meet human needs and aspirations. Much can be learned about the internal workings of science and the nature of science from study of individual scientists, their daily work, and their efforts to advance scientific knowledge in their area of study.

Video is required for this activity.

Classroom Activity Author

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CLASSROOM ACTIVITY (CONT.)

- 6 To conclude, have each team report what it has learned. Make a chart on the board and fill in students' notes. Tape the drawings next to the description of each plane. Hold a class discussion about how the Blériot designs evolved over time. You may want to use the following questions as a guide (see Activity Answer on page 4 for answers):
 - Why do you think that early aircraft designers used the box and elliptical wing arrangements?
 - Why might the Blériot VI have had such a large rudder?
 - What would be the advantage of a tandem wing design like that in the Blériot VI?
 - How did the shape, size, and placement of the wings or tail change over time? What might be some reasons for any changes seen?
 - Why might Blériot's planes have evolved from a biplane to a monoplane design?
- 7 As an extension, have students research the planes built by the Wright Brothers from 1900–1903 (four aircraft were built during that time), noting how each plane evolved. Have students compare the Wright Brothers' airplanes to Blériot's designs. What are some similarities? Differences?

ACTIVITY ANSWER

Program Notes Chart

Aircraft	Description	Information	Result
Blériot I: ornithopter	two large mechanical wings, intended to fly like a bird by flapping wings; motor powered	modeled after birds	elaborate heavy machinery keeps it mostly earthbound
Blériot II: glider	floatplane glider; two rectangular double wings forward and rear of the plane; rudder in front; no propeller	modified with curved wings for greater lift	crashes in water
Blériot III: biplane	two oval wings front and rear of the plane; two propellers in front powered by two gasoline engines	first "flying machine" powered by two gasoline engines	races wildly about but refuses to fly
Blériot IV: biplane	two engines, same size as Blériot III; two wings—back oval, front rectangular double wing	Blériot III modified by splicing rectangular wings onto oval tail	unable to fly; seriously damaged crossing a ditch
Blériot V: monoplane	engine behind; tail in front with elevator and rudder; side wings curve at tips	one of first monoplanes with a single set of wings, like a bird	barely hops; suffers series of discouraging crashes
Blériot VI: monoplane	engine and propeller forward; rudder behind; two sets of side wings—one in front, one in back	deletes elevator; controls pitch (up and down) with movable seat	achieves flight for first time; plane flies less than 100 yards; plane only survives a few months
Blériot VII: monoplane	engine and propeller forward; rudder behind; two sets of side wings—one in front, one in back	plane has control problems	flies low and slow; doesn't last much longer than the Blériot VI
Blériot VIII: monoplane	engine and propeller forward; rudder and elevator behind; wings feature ailerons	adds ailerons to the ends of lengthened wings; moves rudder and elevator to the tail	successfully flies, allowing Blériot to gain flying experience
Blériot XI: monoplane	one set of wings equipped with wing warping; engine and propeller forward; control surfaces on back	replaces ailerons with wing warping to solve the final piece of the puzzle	can remain aloft for a half hour or more

ACTIVITY ANSWER

Blériot began his work in 1900–1901 with Blériot I, an ornithopter design that he soon abandoned. (Ornithopters are aircraft propelled by flapping wings.)

Blériots II, III, and IV date from 1905–1906 and were pontoon craft. The elliptical wing design of Blériot II and Blériot III was finally shown to be unsuitable, as was his attempt to synchronize two Antoinette engines in Blériot IV. Blériot experimented with both the pusher and tractor arrangements for the position of the propellers. (In a pusher configuration, the propeller is behind the engine and the propeller's thrust pushes the airplane forward. In a tractor configuration, the engine and the propeller are located the front of the aircraft where the thrust draws or pulls the airplane forward.)

The Blériot V (1907) was a return to a tail-first monoplane using a canard. Blériot placed the main wing at the rear of the craft and a smaller wing (the canard) at the front of the fuselage. The design was not stable, and the plane flew only briefly before crashing.

The Blériot VI (1907)—Libellule ("Dragonfly")—was another attempt to use the tandem wing design, where the tail is a wing as large as the main wing. In the Blériot VI, Blériot settled on a tractor position for the propeller.

In the Blériot VII (1907), Blériot reduced the size of the tail design. The rudder was much smaller. The low cantilever wings were an innovation on which Blériot would later capitalize. The plane reached 80 km/hr in tests.

The Blériot VIII (1908) was a tail-first type with a 50-hp Antoinette engine. This design included an instrument layout that is the model for what is still used today. In this model Blériot used the modern control system, in which the control stick is linked directly to the ailerons. Pulling back on the stick caused the plane to rise, pushing to the right caused it to bank right, and so on.

The Blériot IX (1908) crashed. The Blériot X (1908) was a short-lived biplane experiment that was never completed. Blériot was near bankruptcy.

Famed for the crossing of the English Channel, the Blériot XI first flew on January 23, 1909. With this model Blériot returned to his monoplane design. It incorporated many features taken for granted in later planes: monoplane wings, a tractor propeller directly attached to the crankshaft, a hinged tilting stick and rudder pedal controls, and a covered fuselage.

Early aircraft designers first used box and elliptical wing designs because they were very common among glider and kite enthusiasts. The shape is stable in flight, but is difficult for a pilot to turn in new directions.

ACTIVITY ANSWER

The tendency of an airplane to roll because of the torque of the engine was a constant problem. The Blériot VI might have used a large rudder to help to keep the plane from rolling. (Ailerons and rudder control as they are known today were still in their infancy at the time Blériot was building this craft.) A larger tail would seem to be natural solution.

Thomas Walker proposed the tandem wing design in 1831 and greatly influenced the work of Samuel Langley, who was sponsored by the Smithsonian to build a successful airplane. The tandem wing design provides a large amount of lift at slow speed, a characteristic that made it popular among glider builders. Since engines of the time were relatively weak and heavy, increasing the lifting power of a wing was an important issue.

Blériot tried a wide variety of wing shapes and placements, including box, elliptical, and gull. However, all of these variations depended on one major factor: where the engine was placed. The weight of the engine requires that the main wing be placed close by along the fuse-lage. When an airplane lifts off, the craft needs to maintain its balance at its center of gravity (the point where pitch, yaw, and roll intersect). Until the Blériot XI, Blériot could not control all of these factors successfully and consistently.

Blériot's various wing designs are a clear indication that he was not interested in pure experimentation for the sake of design, as were the Wrights. If a configuration did not work, Blériot tried something new, even radically different. While he was not a pioneer in regards to the monoplane layout, the simplicity of the design made the Blériot XI easily replicable and saved him financially.

The accidents that Blériot experienced trying various designs finally convinced him that the monoplane configuration was the best in terms of speed (a result of less drag). Engines of the time had limited power. A monoplane would fly faster with the same engine than a similarly-equipped biplane.

Blériot had experimented with the monoplane design earlier but had crashed. Indeed, there was a much higher mortality rate among fliers of monoplanes than biplanes. Monoplanes of the time had a reputation

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for folding up their wings and fluttering back to the ground. Blériot solved the problem by installing bracing wires above and below the wings.

LINKS AND BOOKS

Links

NOVA Online—A Daring Flight www.pbs.org/nova/Bleriot/
Provides program-related article, interview, interactive activity, slide show, and resources.

Blériot Monoplane

www.powerhousemuseum.com/opac/ L611.asp

Describes the Blériot XI and its use during World War I.

Early Flight

www.nasm.si.edu/exhibitions/gal107/gal107/html

Provides photos and descriptions of the early history of the airplane.

Louis Blériot: Developer of Commercial and Military Aircraft www.centennialofflight.gov/essay/
Aerospace/Bleriot/Aero47.htm
Relates Blériot's life and the aircraft that led to the development of the Blériot XI.

The Pioneers

www.ctie.monash.edu.au/hargrave/ Bleriot.html

Recounts Blériot's life and includes archival photos of all of his plane models.

Books

Almond, Peter.

Aviation: The Early Years: The Hutton Getty Picture Collection.

London: Konemann, 1998.
Chronicles the first years of human-powered flight in photographs, from the end of the last century to the era of the Zeppelins.

Crouch, Tom D.

The Blériot XI: The Story of a Classic Aircraft

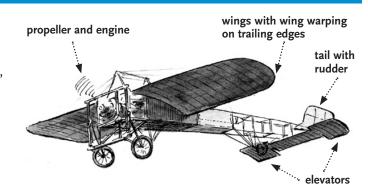
Washington: Smithsonian Institution Press, 1982.

Covers the reconstruction of a Blériot XI and presents information about the plane's flying characteristics.



Blériot's Inventions

Louis Blériot became interested in flight at about the same time the Wright Brothers were experimenting with airplanes. Just six years after the Wright Brothers' historic first flight, Blériot's final aircraft design—the Blériot XI—would hold most of the world's flying records in speed, altitude, and distance. In this activity, you will trace the evolution of Blériot's designs.



Procedure

- Your teacher will assign you to one of three teams that will cover three of Blériot's plane designs. Make a chart like the one below for your three planes. Draw a picture of your assigned planes on a separate sheet of paper.
- **2** When you describe and draw the planes, you should note as many features about the planes as you can see in the program, including:
 - shape, number, and placement of the wings
 - placement of propellers, tails, and engines
 - control surfaces, such as rudders, elevators, ailerons, or wing warping

3 When you have finished watching the program, compare notes with your team members. You will report what you learned to the class. Choose one drawing of each plane to share with the class. Label the drawings with as many parts as possible.

Sample Program Notes Chart

Aircraft	Description	Information	Result
Blériot I: ornithopter			
Blériot II: glider			
Blériot III: biplane			