

Standards-Aligned Lesson Plan

Middle School Science: Aileron Sculpture (Nashville, TN)

*Developed in partnership with the
Metropolitan Nashville Arts Commission.*

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Planning for a Common Core State Standards Science Lesson

<p>Lesson Topic: The sculptor of <i>Aileron</i> says that the design was inspired by early biplanes and their historical connection with one of Nashville’s earliest airfields, McConnell Field, where McCabe Park now stands. What is the biplane’s place in aviation history, and, as an extension of the learning, how did the technology of the biplane responds to social, political, and economic needs?</p>	<p>CCSS Domain(s): Literacy (Science/Technical Subjects) ELA-Literacy (Writing) ELA-Literacy (Speaking and Listening)</p>	<p>Date:</p>
<p>Note: This lesson can serve as an introduction to Grade 7 Tennessee Science Standards in Embedded Inquiry, Embedded Technology and Engineering, or Flow of Matter and Energy.</p>		

<p>Estimated Time for Lesson: 1 class period; 50 minutes</p>	<p>Grade/Subject: 7th Grade Science</p>
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Standard(s) the lesson addresses		
CCS Standard(s)	Formative Assessment(s)	Summative Assessment(s)
<p>Science/Technical Subjects Grades 6-8: CCSS.ELA-Literacy.RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p>	<p>Students will be formatively assessed through discussion in whole group and small group.</p>	<p>Students will provide evidence of thorough and thoughtful analysis through the use of a text evidence graphic organizer (Text Evidence Chart).</p>
<p>Science/Technical Subjects Grades 6-8: CCSS.ELA-Literacy.RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.</p>	<p>Students will be formatively assessed through discussion in whole group and small group.</p>	<p>Students will construct a holistic picture of the history of the biplane by comparing and contrasting the information gained from the resources and multimedia sources (Text Evidence Chart and Timeline).</p>
<p>Literacy/Writing: CCSS.ELA-Literacy.W.7.1 Write arguments to support claims with clear reasons and relevant evidence.</p>	<p>Students will mark the texts for evidence of their claims and assertions.</p>	<p>Students will create a timeline of the history of biplanes (Timeline) using the Text Evidence Chart.</p>
Tennessee Content Standards	Formative Assessment(s)	Summative Assessment(s)
<p>Science 7th Grade: Embedded Technology and Engineering</p>	<p>Students will be formatively assessed</p>	<p>Students will provide evidence of how the technology of the</p>



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<p>GLE 0707.T/E.1 Explore how technology responds to social, political, and economic needs.</p>	<p>through discussion in whole group and small group.</p>	<p>biplane responded to social, political, and economic needs through the use of the Text Evidence Chart.</p> <p>For the extension of learning, students will write a two page report that defines a specific change in the use, engineering, or development of the biplane that responded to social, political or economic situations.</p>
<p>Clear Learning Targets</p>	<p>“I can” statements:</p> <ul style="list-style-type: none"> • I can describe the artist’s inspiration for <i>Aileron</i> as a monument for the history of McCabe Park. • I can find evidence of the history of the biplane, using a variety of sources including multimedia. • I can give examples of how the technology of the biplane responded to social, political, and economic needs. 	
<p>New Learning</p>	<ul style="list-style-type: none"> • Vocabulary—aileron, biplane • Concepts—how can technology respond to social, political, and economic needs? • Skills—comparing multimedia and print resources, creating a timeline 	
<p>Instructional Strategies</p>	<ul style="list-style-type: none"> • Teacher will model finding evidence in text and multimedia sources. • Students will work in groups to gather evidence from the resources on the history of biplanes and their use to respond to social, political and economic needs. 	
<p>Materials and Resources</p>	<ul style="list-style-type: none"> • Picture of <i>Aileron</i> sculpture (http://www.nashville.gov/Arts-Commission/Public-Art/Find-An-Artwork/Collection/Aileron.aspx) • Organizer for video: Notes on Aileron Video sheet • Metro Nashville video “Aileron: The Making of a Kinetic Sculpture” from beginning to 3:47 • Graphic organizer: Text Evidence Table • Web link to a gallery of photos of biplanes, attached to the article: http://www.airspacemag.com/history-of-flight/biplanes-and-us-462225/ • Web link to <i>The Chronology of Nashville Airports</i> http://www.civicscope.org/nashville-tn/ChronologyNashvilleAirports • Web link to article <i>Golden Age of Aviation History</i>: http://opencockpit.net/biplane.html • Web link to video: http://www.soonerfans.com/forums/showthread.php?64855-Good-Morning-First-US-air-combat-mission-evar • Web link to video: http://www.history.com/this-day-in-history/first-us-air-combat-mission 	



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	<ul style="list-style-type: none"> • Article <i>History of the Biplane</i> • Article <i>The First US Air Force Mission</i> • Manufacturer’s fact sheet on a new biplane • Timeline • Rubric for letter and presentation assessment
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<p>Cross-curricular Connections:</p> <p>There is a strong connection between this science lesson and the following 7th grade Visual Arts Standards:</p> <p>3.2 Demonstrate knowledge of contexts, values, and aesthetics that communicate intended meanings in artworks.</p> <p>3.3 Reflect on the effective use of subject matter, symbols, and ideas.</p>

<p>Framing the Lesson (8 minutes)</p>
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| <ul style="list-style-type: none"> • Project a photo of <i>Aileron</i> for the class. (http://www.nashville.gov/Arts-Commission/Public-Art/Find-An-Artwork/Collection/Aileron.aspx) • Tell students that they are going to view a video with information about the artwork, the symbolism, the artist’s inspiration and an introduction to the process. They will note specific pieces of information on the Notes on Aileron sheet. Show the introduction of the video at http://www.youtube.com/watch?v=GoBYIXloTRw from the beginning to 3:47 into the video. • Facilitate a short discussion using the notes organizer in which students identify particularly the inspiration of the biplanes and the airfield and the importance of having the engineers assist in the development of the plan for the structure. • Announce the purpose of the lesson through the explanation of “I Can” statements. |
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Instruction (1 class period; 50 minutes)	Anticipated learning difficulties*
<ol style="list-style-type: none"> 1. Show students the picture of Aileron. 2. Frame the lesson using video and class discussion. 3. Assign pairs of students to use the sources and resources for text evidence about the history of biplanes and how biplanes responded to social, political, and economic needs. 4. Provide multiple resources on the history and development of the biplane. As much as possible, let students access the information from the web links. 5. Students in pairs read, analyze and mark the documents, using highlighters, underlining, circling text, post-its, making notes. 6. Students complete the graphic organizers (Text Evidence Chart and Timeline). 	<p><i>Anticipated learning difficulties students may have.</i></p>
	Student prompting*
	<i>Ways to help students move through the task.</i>

<p>Set (2 minutes)</p>

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|---|
| <ul style="list-style-type: none"> • Open the photo of McConnell field so all students can see the field and the planes (http://digital.library.nashville.org/cdm/singleitem/collection/nr/id/4987/rec/1). |
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- Tell students that they will first develop a short timeline for the history of the biplane, the inspiration for *Aileron*. As they develop the timeline, they will search for examples of how the technology of the biplane responded to social, political, and economic needs.

Guided practice (5 minutes)

- Teacher will model the process of find text evidence to develop the history of the biplane
- Teacher will guide the process of completing the graphic organizer; using text evidence; consider ways the technology changed according to social, political or economic needs; and explain the use of the text evidence to create the timeline.

Questioning: Illuminating Student Thinking

*Assessing Questions

- *Base closely on the work student has produced;*
- *Clarify what the student has done and what the student understands about what s/he has done;*
- *Provide information to the teacher about what the student understands.*

*Advancing Questions

- *Use what students have produced as a basis for making progress toward target goal;*
- *Move students beyond their current thinking by pressing students to extend what they know to a new situation;*
- *Press students to think about something they are not currently thinking about.*

Independent practice (30 minutes)

1. Assign pairs of students to work together to use the sources and resources for text evidence about the history of biplanes and how biplanes responded to social, political, and economic needs
2. Provide multiple resources on the history, development and use of the biplane
3. Students read, analyze and mark the documents, using highlighters, underlining, circling text, post-its
4. Students complete the graphic organizer (Text Evidence Table and Timeline) using the items they marked.
5. Students complete the exit slip on the artist's inspiration.

Lesson Closure (5 minutes)

- Now that they have researched more about biplanes, students will self-assess their understanding of the artist's rationale for choosing the biplane as his inspiration for *Aileron* by completing the exit slip provided.

Homework

- Individual students may need to complete summative assessments at home.
- As a longer term research assignment, the teacher may choose to assign the following:
 - After researching a variety of teacher-selected texts and websites and student-selected texts and websites, write a two page report that defines a specific change in the use, engineering, or development of the biplane that responded to the social, political or economic situations. Support your discussion with specific evidence items from your research.

*Differentiated Instruction:

- *ELL Modifications: How will I provide access to the academic content and/or make modifications for the student whose primary language is one other than English?*



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- *SPED Modifications How will I provide access to the academic content and/or make modifications for the student who has an IEP?*

***Reflection**

- *Reflection on planning and delivery of lesson- How will I connect tomorrow's instruction with this lesson? How can this discussion lead into other science standards? How should I modify this lesson the next time it is taught?*

*These items will be based on teacher knowledge of students, teacher perceptions, and identified student needs.

Attachments

- Organizer for video: Notes on Aileron Video sheet
- Manufacturer's fact sheet on a new biplane
- Article from *Air & Space/Smithsonian* magazine, May 2011
- Article *History of the Biplane*
- Article *The First US Air Force Mission*
- Graphic organizer: Text Evidence Table
- Timeline
- Exit slips



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Notes on *Aileron* Video

1. An aileron is the surface of what part of an airplane? _____
2. McCabe Park was once one of Nashville's first _____.
3. It was once a stopping point for _____.
4. Two particular features of the sculpture remind us of this:
 - The movement of the _____
 - The forged bronze _____
5. The artist chose sculpture as his art form because he found he likes
_____.
6. The history of the area around McCabe Park led the artist to his proposal which was inspired by _____.
7. The artist designed and built the sculpture. Who reviewed his plans to check the structure for wind loads and develop strategies for building the piece?
_____.



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Teacher Notes on *Aileron* Video

1. An aileron is the surface of what part of an airplane? *The wing*

An aileron is the hinged surface of an airplane wing that is used to control lateral balance.

2. McCabe Park was once one of Nashville's first *airfields* .

3. It was once a stopping point for *biplanes in some of the earliest flights in Nashville* .

4. Two particular features of the sculpture remind us of this:

- The movement of the *wings in the air*
- The forged bronze *pattern of rivets*

5. The artist chose sculpture as his art form because he found he likes

 to work with his hands and build mechanical and engineering pieces .

6. The history of the area around McCabe Park led the artist to his proposal which was inspired by *the biplane of the 1920's and the history of the area as McConnell Airfield, the first airfield in Nashville* .

7. The artist designed and built the sculpture. Who reviewed his plans to check the structure for wind loads and develop strategies for building the piece?

 Professional engineers



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FACT SHEET

U.S. Air Force Fact Sheet

"THE OLD HICKORY SQUADRON"

Roots of the 105th Airlift Squadron (105AS) and the 118th Airlift Wing (118AW) reach to World War I when the 105th Aero Squadron of the American Expeditionary Force was formed at Kelly Field, Texas in 1917. After the war, in 1919, veterans of the 105th Aero Squadron residing in the Nashville area gathered for the purpose of organizing an air element of the Tennessee National Guard.

On December 4, 1921, the unit received "Federal Recognition" and was designated the 136th Observation Squadron, and assigned to the U.S. Army's 30th "Old Hickory" Division. Subsequently dubbed the "Old Hickory" Squadron, our squadron insignia still includes a figure of Andrew Jackson "Old Hickory" on horseback. In March 1922, our squadron received our first four Curtiss JN-6HG airplanes, nicknamed the "Jenny." We would eventually receive eight of these "Jennys" and one lone DeHavilland DH-4B airplane, nicknamed the "Flaming Coffin." Later on 20 July 1923, our squadron was changed from the 136th to the 105th Observation Squadron.

The next fifteen years the Squadron developed strength and stature in Nashville, along with receiving more reliable O-2 Observation airplanes in 1926. Beginning in 1927, flying operations began at our second airfield McConnell Field. McConnell Field, located west of downtown Nashville, was named after 1Lt. Frank B. "Brower" McConnell, a squadron pilot killed during an airplane accident on maneuvers at Langley Field, Virginia.

The years 1928-1938 were characterized by frequent changes in assigned aircraft and the unit would actually be disbanded for a few months from late 1930 to early 1931 due to politics. The unit would fly the Curtiss O-11 Falcon and O-17 in 1928, then the Douglas O-38 in 1931 and Douglas O-25 in 1935 and later the North American O-47 aircraft in 1938. The O-47 was our unit's first operational single wing aircraft.

In 1931, the unit moved to Sky Harbor Airport, near Murfreesboro, where it could share hanger space with Interstate Airways, later American Airways (now American Airlines).

In 1935, construction began for an airport in Nashville. After months of research, the area chosen was a 340-acre site comprised of four adjoining farms located along the Dixie Highway (now Murfreesboro Road). Construction began in 1935, the airport was dedicated in 1936, and officially opened in 1937.

The new airport was named Berry Field in honor of Colonel Harry S. Berry, State Administrator of the Works Progress Administration (WPA). The three-letter identifier: "BNA" stands for Berry Field Nashville. Berry Field became a military base for the 4th



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Ferrying Command during World War II. The military added additional acreage for its operations and in 1946, after the war; returned the 1,500-acre airport to the City of Nashville.

By 1938, the squadron had completed its move to Berry Field. The unit formerly occupied Hangers #1, #2, and #4 between Hanger Lane and present taxiway T4. The southeastern end of the airport still shows remnants of the original Berry Field. The field was used by the Air Transport Command during World War II (W.W.II), then later by the Air Defense Command briefly in the early 1950s. The unit moved to its present facilities on Knapp Blvd. in 1952. Berry Field remains the name of the ANG complex at Nashville IAP.

In 1940, after summer maneuvers in Louisiana, the squadron was called to active duty. It was sent to Ft. Jackson, SC, assigned to the newly organized 65th Observation Group, which was equipped with O-52 "Owl" aircraft. Members of the 105th became a ready source of trained personnel and seasoned pilots as our nation entered World War II.

Members of the 105th were to make history around the globe flying a variety of missions: Observation, antisubmarine patrol, reconnaissance and bombardment. They found themselves switching organizations frequently and flying different aircraft as follows; the twin engine Martin B-10 Bomber, the Vega Ventura B-34, and the North American B-25G Mitchell Bomber. From 1943 to 1945, the men from the 105th performed with distinction in the Pacific Campaign and flew over 100 combat missions flying the B-25G "Mitchell" Bomber against Japanese targets. During the course of the war, we were re-designated the 820 Bomb Squadron and assigned to the 41st Bomb Group, 7th Air Force.

After the war, the Tennessee Guardsman returned to Nashville and the famed 105th was reactivated, reorganized under state control, and granted federal recognition. In 1947, the 118th Fighter Group and the 105th Fighter Squadron were federally reorganized with the 105th Fighter Squadron assigned to the 118th Fighter Group flying the Republic P-47 "Thunderbolt", a high speed World War II fighter. By 1947, the 105th had received 25 of the P-47's and additional support aircraft.

In 1950, the 118th Composite Wing was re-designated 118th Composite Wing and in 1951 the 118th Composite Wing, 118th Composite Group and 105th Fighter Squadron were re-designated the 118th Tactical Reconnaissance Wing (TRW), Group and Squadron respectively.

The 118th TRW was activated for federal service again in 1950. It was re-designated as the 105th Fighter Interceptor Squadron and was activated in place in early 1951. While on active duty, it operated two geographically separated units; Detachment 1 flying P-47 Thunderbolt aircraft, from McGhee-Tyson Airport at Knoxville, TN, providing air defense for the Atomic Energy Commission at Oak Ridge, and Detachment 2 was the 467th Ground Observer Squadron, Smyrna, TN.

In late 1952, the Wing was release from active duty and early 1953 reformed in Nashville as Headquarters, 118th Tactical Reconnaissance Wing and consisted of the 105th Squadron, and



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units at Memphis, Little Rock and Fort Smith, all flying North American P-51 Mustangs from 1953 to 1955. The units flew the Lockheed RF-80C Shooting Star from 1955 -1956, and the Republic RF-84F Thunderflash from 1956 to 1961.

In 1961 the wing converted to the airlift mission flying the Boeing C-97G "Stratofreighter." In 1966 MATS was renamed Military Airlift Command (MAC). As a result, the 118th Air Transport Wing, Group and Squadron were re-designated 118th Military Airlift Wing, Group and Squadron respectively. Six years later the 118th MAW converted to the Douglas C-124C "Globemaster II" transport and received the first of eight of the aircraft in 1967.

In 1971, the Wing converted to the Lockheed C-130A Hercules and became the 118th Tactical Airlift Wing. In 1978 the Wing was recognized for its achievements and was awarded the Air Force Outstanding Unit Award. In 1979, the Wing was enlarged from eight to sixteen C-130A Aircraft.

In 1989, it had been ten years since the unit had acquired the C-130 airframe while supporting a worldwide tactical airlift mission. Participation in exercises such as Brave Shield, Brim Frost and Red Flag were accomplished with some of the oldest aircraft in the inventory (A models were built from 1954 to 1957). Rotations to Panama in support of Operation Volant Oak beginning in 1977 had become routine.

1990 was the start of another conversion process. The 118th received a total of sixteen new C-130H aircraft from Lockheed, replacing the 30 year-old A-models. But, the Iraqi invasion of Kuwait in 1990 was to place the largest demand upon 118th personnel in almost 40 years. The Wing mobilized 462 personnel during 21 deployments for Operation Desert Shield / Desert Storm in southwest Asia and flew a record 7239 flying hours.

In 1992, Military Airlift Command (MAC) reorganized as Air Mobility Command (AMC). The 118th Tactical Airlift Wing became the 118th Airlift Wing. With sixteen C-130H aircraft and 1406 authorized personnel at Nashville, the 118th Airlift Wing was one of the largest flying units in the Air National Guard at that time.

Following "September 11th", our Operational Tempo skyrocketed. Over one-third of the Wing was activated for one year or more to supporting the National Homeland Security Plan (Operation Noble Eagle), which included deploying aircraft and personnel to bases inside the United States for several months, then assigned a home station alert mission. Shortly after the Wing completed the Noble Eagle mission, the Wing was selected to deploy to Southwest Asia in support CENTCOM Operations.

In 2003, the 118th deployed ten C-130's and over 320 personnel to the Middle East in direct support of combat operations at the beginning of Operation Iraqi Freedom. While living in austere conditions in tents, enduring the desert heat and sand storms, the men & women of the 118th supported combat operations into and out of Baghdad and surrounding areas of Iraq. The 118th was the lead wing in establishing a bare base in support of the largest contingent of C-130's ever based in a combat environment, over 46 C-130's located at a single base. The



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unit supported CENTCOM at various locations in Iraq, Kuwait, Oman and Saudi Arabia. The unit returned home at different times in late 2003 as U.S. forces were drawn down and rotated to meet the changing requirements. In late 2003, the Wing again deployed to Uzbekistan supporting Operation Enduring Freedom in Afghanistan. The Wing is now scheduled to support Operation Joint Forge in the near future.

Missions

Since being assigned a transport mission in 1961, we have flown the C-97, C-124, C-130A and C-130H over 200,000 hours and millions of miles of international, as well as stateside, missions in direct support of U.S. Military missions. From 1961 to 1991, the Wing provided airlift support for the Berlin Airlift and Cuban Missile crises, national and state civil disturbances, Vietnam Conflict, Red Flag, Brave Shield, Volant Oak and Coronet Oak, Desert Shield, and Desert Storm. Since 1991, the 118th Airlift Wing has participated in:

Operation Volant & Coronet Oak- airlift support for SOUTHCOM in Central & South America

Operation Brim Frost- airlift support to Alaska in 1985, 1987, 1989

Operation Artic Warrior- airlift support to Alaska, early 1990's

Operation Amalgam Warrior- airlift support to Alaska, late 1990's

Operation Amalgam Virgo- airlift support to Alaska, late 1990's

Operation Creek Resolve: airlift support in Turkey

Operation Desert Shield / Storm- deployments of Forces in support of CENTCOM in Southwest Asia

Operation Distant Haven- humanitarian operations for Haitian refugees in Surinam

Operation Provide Relief- humanitarian airlift into Somalia

Operation Provide Promise- airlift into Sarajevo and airdrops over Bosnia

Operation Support Hope- humanitarian operations in or near Rwanda

Operation Uphold Democracy- supporting military forces in Haiti

Operation Southern Watch- enforcing the no-fly zone over southern Iraq

Operation Joint Guard- supporting peacekeeping operations in Yugoslavia

Operation Joint Endeavor- supporting peacekeeping operations in Bosnia

Operation Noble Eagle- supporting the National Homeland Security Plan

Operation Enduring Freedom- deployments of Forces in support of CENTCOM

Operation Iraqi Freedom- continued deployments of our forces in support of CENTCOM operations in Iraq



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Biplanes and US

Adapted from *Air & Space/Smithsonian* magazine, May 2011

<http://www.airspacemag.com/history-of-flight/Biplanes-and-US.html>

In April 1986, the editors chose a biplane for the cover of the first issue of *Air & Space/Smithsonian* magazine. By the 1940's aircraft designers had almost stopped using the biplane configuration. The cover showed a Great Lakes biplane, a 1931 two-seat, open-cockpit sport plane, that had been restored by the founder of the Old Rhinebeck Aerodrome in upstate New York. Rhinebeck is a center for vintage airplane activity around the world. There, you can still see biplanes fly, some types that first flew 100 years ago.

Why would people still be flying planes with such an old design? One reason is history. Dozens of biplane types are a part of the history of aviation. They were once military trainers for both world wars, corporate aircraft, barnstormers, transport planes, crop dusters, and showplanes. Many biplane owners regard themselves as caretakers, preserving pieces of aviation heritage until the next owner takes over the job. Recently, more airplane fans have spent their money and time restoring vintage aircraft, including biplanes. Many of these restorations are being done for the second and third time on the same plane. Fewer of these planes are now being scrapped due to the increase in their value.

Biplanes are still being restored, and they're also still being manufactured. WACO Classic Aircraft Corporation of Battle Creek, Michigan, started producing Waco YMF models under the original type certificate in 1991 and has sold more than 125 of them. Even these new biplanes have something to teach pilots and passengers about flight in its youth.



BIPLANES.CO.UK

The Biplane Site

Accessed at http://www.biplanes.co.uk/History_of_the_Biplane.htm

History of the Biplane

Before the invention of the biplane man had been trying to fly for centuries with limited success. The biplane (a fixed wing plane with two wings) was most likely first really conceived as a viable option in the late nineteenth century following Octave Chanute's invention of the traditional biplane box strut design. This design was to dominate aviation through the early part of the twentieth century when aircraft really began to take to the skies.

During the first part of the twentieth century most successful aircraft took on a biplane design. For example at this point the Wright Brothers introduced the system of wing warping which enabled them to build a biplane glider incorporating Chanute's strut design and their own inventions. Early biplanes were the plane of choice for many years and were perhaps most famously used to great effect in the First World War.

At the same time that so many aviation inventors were investigating biplane flight, many were also investigating the creation of an effective monoplane option which would potentially increase aircraft speed. For a while biplanes and monoplanes existed in tandem but, as research progressed, the monoplane was to virtually replace the biplane by the 1930s. From this point on biplanes tended to be used solely for specialist use such as crop dusting and spraying, for example. Biplanes are also widely used in organised displays and for tourist/entertainment purposes.



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Air & Space/ Smithsonian

Accessed at <http://blogs.airspacemag.com/daily-planet/2009/03/mexico-march-1916-the-first-us-air-force-mission/?repeat=w3tc>

The Daily Planet

March 19, 2009

Mexico, 1916: The first U.S. air force mission

On this day in 1916, eight Curtiss biplanes from the U.S. Army's 1st Aero Squadron—the country's entire air force—flew into Mexico for their first military action. The target was Pancho Villa, the guerilla leader who had provoked U.S. ire ten days earlier by crossing the border to attack the small town of Columbus, New Mexico. President Woodrow Wilson ordered General John "Black Jack" Pershing to chase Villa down, and to use airplanes (the Army had bought its first Wright Flyer just seven years earlier) as part of the so-called Punitive Expedition.

The 1st Aero Squadron went along strictly as aerial observers and messengers. The JN-3 biplanes weren't even equipped with machine guns, although a few of the pilots did carry pistols and .22 rifles.

Let's just say that things didn't go very well. By the end of April, every one of the airplanes was destroyed. And it wasn't as if the squadron's commander, Capt. Benjamin Foulois, hadn't seen disaster coming. Back at the unit's home base in San Antonio, he had struggled with incessant equipment problems, locked in a battle with the Curtiss company over shoddy workmanship and parts that constantly needed replacing.

Now, flying 100 miles into Mexico after dusk on March 19, he faced another problem. Only one of his pilots had ever flown at night. Halfway to Pershing's camp the airplanes got separated, and cavalry had to be sent out looking for half of them. When the squadron flew its first reconnaissance flight a couple of days later, two airplanes were still missing and a third had already crashed after getting caught in a dust devil, stalling, and falling 50 feet to the ground.

On the first recon flight, Foulois and another pilot made it just 25 miles before getting tossed around by wicked up- and down-drafts in the 10,000-foot Sierra Madre mountains. They turned back.



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And so it went. The squadron flew many successful missions over the next few weeks, scouting the enemy and delivering supplies and messages among Army units on the ground. But mostly, Foulois and crew fought just to keep their airplanes aloft, thwarted as they were by high-altitude flying, rough terrain, dust storms, engine troubles, and broken parts. One by one, the airplanes went out of service. On April 6, Capt. Townsend Dodd ran his into a ditch, destroying its landing gear. Lt. Ira Rader damaged his on April 14 coming down on rough ground. Three of the pilots barely escaped with their lives after landing on the outskirts of Chihuahua City, where an angry mob surrounded the planes and started burning holes in the cloth wings with cigarettes and cutting them with knives.

Despite all the mishaps, the Army learned a lot from the Mexican experience about how *not* to use its fledgling air force. When airmen were sent to join the fighting in France in 1917, they were far better equipped and better prepared. As Foulois wrote years later, “The work of the 1st Aero Squadron proved beyond dispute to the most hardened former soldier and congressman that aviation was no longer experimental or freakish.”

Posted By: Tony Reichhardt



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Text Evidence Table

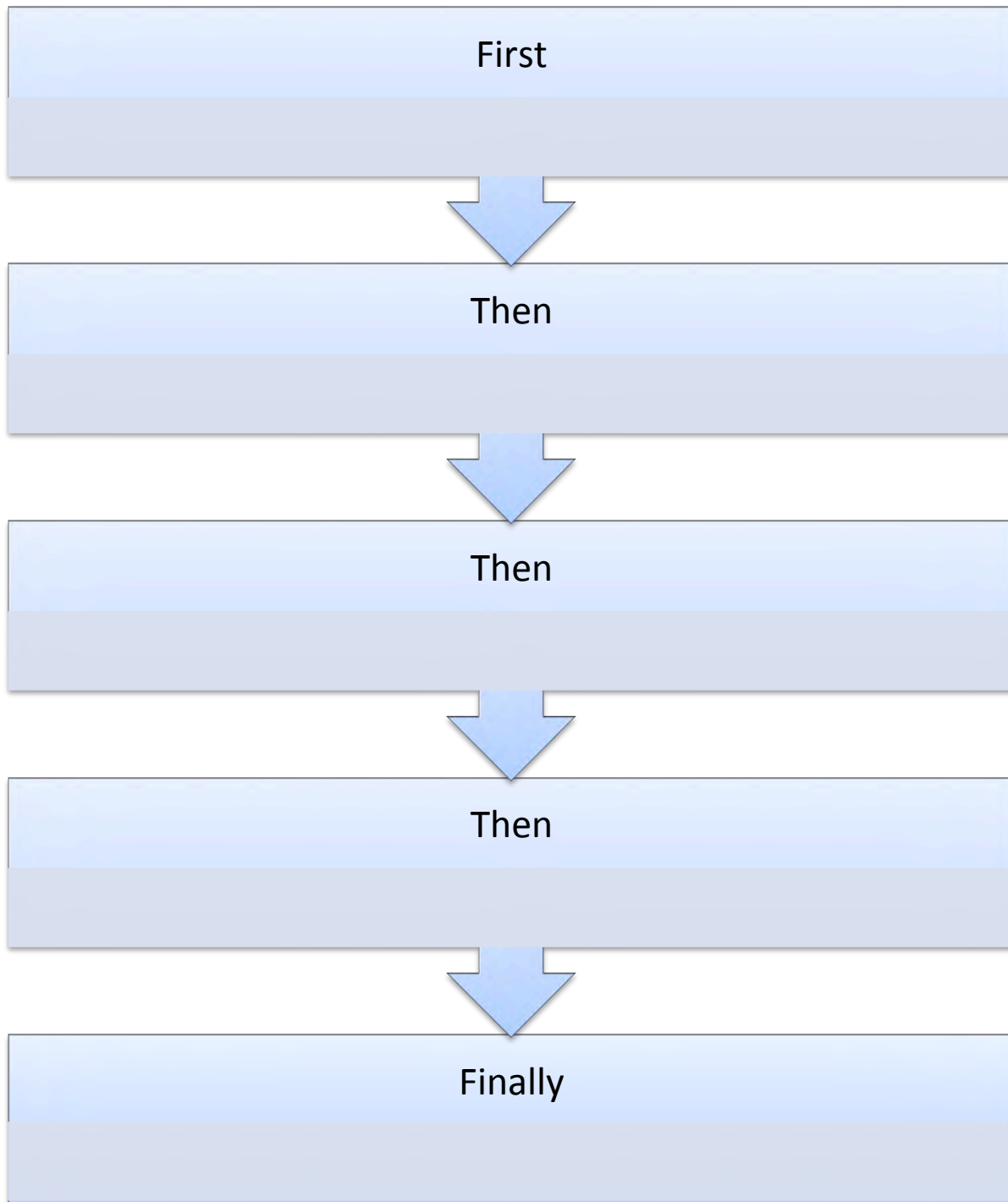
Write the specific examples of text evidence you find about the history of the biplane and how the development of the biplane responded to social, political or economic needs in the column to the left. In the column to the right, make notes on why you chose that text evidence.

SPECIFIC PHRASE OR SENTENCE	SPECIFIC PURPOSE
1.	
2.	
3.	
4.	
5.	

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Timeline

Use up to five items from your text evidence to create a timeline for the biplane. Don't forget to consider how the development and use of the biplane responded to social, political or economic needs.



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Exit Slips

The biplane was an appropriate inspiration for <i>Aileron</i> because.... Name _____	The biplane was an appropriate inspiration for <i>Aileron</i> because.... Name _____
The biplane was an appropriate inspiration for <i>Aileron</i> because.... Name _____	The biplane was an appropriate inspiration for <i>Aileron</i> because.... Name _____
The biplane was an appropriate inspiration for <i>Aileron</i> because.... Name _____	The biplane was an appropriate inspiration for <i>Aileron</i> because.... Name _____
The biplane was an appropriate inspiration for <i>Aileron</i> because.... Name _____	The biplane was an appropriate inspiration for <i>Aileron</i> because.... Name _____





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Aircraft and Accessories

The new WACO YMF-5D offers a seductive combination of performance, style and exclusivity.

Even with this exalted pedigree, the new WACO YMF-5D represents a new pinnacle for the marquee: it has been sharpened, refined and rethought in every detail. The result is an aircraft that offers thrilling levels of performance together with luxurious accommodation for three people. So if you are looking for the enchantment of open-cockpit flying, there's no better place to experience it than in the cockpit of a new WACO D model.

The WACO YMF biplane has and always will represent the essence of true aviation pleasure.

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Phone (269) 565-1000 / Fax (269) 565-1100
FlyWaco@WacoClassic.com
www.WacoClassic.Com



2013 WACO YMF-5D Biplane

AIRCRAFT SPECIFICATIONS

3-place Open Cockpit Land or Sea Biplane

FEATURES

Purchase Includes Factory Pilot Training Program
Deluxe Leather Interior with Heat Front and Rear
New Aircraft, New Tooling, Modern Safety Features
Day Night IFR and Aerobatic Approved
Approved for Commercial Ride Operations
28 volt Electrical System with Modern Avionics Installations

POWERPLANT

Engine

Jacobs R755A2, A2M Engine with New Production Aluminum Cases
Standard - 300 HP @ 2200 RPM, 1400 hr. TBO (1400 hr TBO now standard)

Propellers

Fixed-Pitch (Standard), MT wood / composite, 92 in. dia
Constant Speed (Optional), Hamilton-Standard 2B20-15, 93 in. dia,

DIMENSIONS

Wing Span, upper	30 ft 0 in (9.14 m)
Wing Span, lower	26 ft 10 in (8.18 m)
Length, overall	23 ft 10 in (7.26 m)
Height, overall	8 ft 6 in (2.59 m)

WEIGHTS & LOADINGS

Basic Empty Weight	1985 lb (900 kg) 2100 lb typically equipped
Baggage Capacity	100 lb (45 kg)
Gross Weight	2950 lb (1338 kg)
Useful Load	850 lb typical

PERFORMANCE

Never-exceed speed	214 mph (186 kt)
Cruise speed	122 mph (105 kt)
Stall Speed, power off	59 mph (51 kt)
Fuel	Standard - 48 US gal (182 litres) Optional Long Range Tanks - 72 US gal (273 litres)
Fuel Consumption	15 US gal/hr (typical)
G limits	+5.2 / -2.1 @ 2950 lb.



2013 WACO YMF-5D Super, Standard Equipment price: \$426,250

Standard Installed Equipment

The standard aircraft is very well equipped and approved for day & night IFR & VFR flight. It includes a full leather interior, 3 color paint scheme and accessory package.

Airframe

Rugged 4130 Steel Fuselage Frame
Epoxy Coating Corrosion Proofing
Internal Steel Tube Corrosion Proofing
Forward Fuselage Aluminum Sidewalls (Left & Right Sides)
Front Cockpit Door
Baggage Compartment – Lockable
Wood Fuselage Stringers
Tail Fins - Vertical Stabilizer, Horizontal Stabilizer
Balanced Rudder & Elevator Control Surfaces
Aluminum Ailerons (4)
Steerable Tail Wheel
Shock Spring Landing Gear
Cleveland Wheels & Brakes by Parker Hannifin
Tires, Tube Type (Main 7.50x10, Tail 10x3.50)
Wheel Pants & Spats
Wings - Wood Spar/Rib Frame Structure
4130 Steel Interplane and Cabane Wing Struts
Flying & Landing Wires - Stainless Steel
Hand Formed Metal Fairings
One-Piece Rear Windshield Frame
Front Cockpit Windshield – Removable, storage bag.
Tie Down Rings (2), Tow Lugs (2), Jack Points (2)
Steps - Cabin Entrance and Refueling (improved for 2012)
Adjustable Pilot Seat
Front 2-Place Bench Seat

Finish & Paint

Dacron Fabric Covering, Rib Stitched and Taped
PPG Delta System Polyurethane Paint
3-Color WACO Paint Scheme
Touch up Kit

Controls

Dual Flight Control System
Control Stick & Rudder Pedals - Rear & Front
Seat Belts with Shoulder Harness (Hooker brand)
Second Lap Belt – Rear
Fuel Valves - Left & Right
NEW Elevator Trim System for 2012
Throttle/Mixture /Carb Heat Lever Quadrant – Rear
Throttle Lever – Front
Hydraulic Toe-Operated Brakes – Rear and Front

Additional Equipment

Deluxe Leather Interior: Includes: Leather Seats, Single or Two-tone Leather Sidewalls, Leather Trim, and Premium Carpeting. Customer has choice of all colors. Over 5 hand selected Hides go into each WACO interior
Leather Map Case - Front
Leather Map Case – Rear
Pilots Operating and Service Manuals
Front & Rear Heater
Dual Cockpit cover, water resistant canvas, black.

Power Plant & Accessories

Jacobs R-755 A2, 7-Cylinder Radial Engine
300 HP @ 2200 RPM 1400 Hour TBO
Oil Filtration with 50 hour oil change interval
Propeller - MT Wood, Fixed Pitch, 2-blade
All Metal Bumped Cowling
Oil Tank - 5 US Gal
Electric Starter
Oil Cooler
Induction Air Filter
Fuel Strainer with Quick Drain
Dual Magneto Ignition System
Key Operated Ignition Switch
Exhaust System, Stainless Steel
Carburetor Heat
48 US Gal Fuel Tanks - Upper Wing
Fuel Quantity Indicators
Inner Cowl Venting

Electrical

24 Volt Electric System
50 Amp Alternator
Batteries, Sealed G25S, 12 Volt Lead Acid (2)
Circuit Breakers - Side Panel Mounted
LED Navigation Lights
LED Strobe Lights & LED Beacon
Illuminated Placards (new for 2012)
LED Landing & Taxi Lights - Left Side
Pilot Utility Light - Rear
Cockpit Lighting Controls with Dimmers
Heated Pitot Tube
Ground Start Plug

IFR Instruments & Avionics - Rear Cockpit

JPI EDM 930 Deluxe Engine Analyzer - Color Display
Garmin GMA 340 Audio Panel or PS Eng PMA8000BT
Garmin GTN-650 Touch Screen WAAS GPS
Garmin GTX-32 Remote Transponder
Attitude Indicator (Electric)
Heading Indicator (Electric)
SSD 120-30A Remote Encoder
Altimeter, Sensitive
Turn & Bank Indicator
Vertical Speed Indicator
ELT 406 MHz
Garmin GI-106a VOR/LOC/GS/GPS Indicator
Compass, internally lighted.





Optional Equipment and Upgrades

	Price	Note
Constant Speed Propeller System Includes: Hamilton Standard 2B20 Propeller, Propeller Governor, 4-Lever Throttle Quadrant, Propeller is polished to mirror finish, enlarged cowling	\$16,250	3
Polished Spinner – for constant speed propeller systems only.	\$2,922	1
Extended Range fuel tanks - Left 12.5 US Gallons	\$4,815	1
Extended Range fuel tanks - Right 12.5 US Gallons	\$4,815	1
LED Landing and Taxi light, - Right Side (left is standard)	\$1,750	1
Mirrors (Left or Right) / each	\$190	1
Tail Wheel Fairing	\$675	1
Trim position indicator	\$690	1
Water bottle / cup holder (each)	\$65	1
Front Cockpit Vinyl Cover	\$685	1
Four Color Paint scheme (3 Standard)	\$2700	3
Polished Cowling Bumps	\$1800	1
Banner Kit (includes cockpit release, hook, and two mirror)	\$1,450	1

Pilot Cockpit Avionics Options and Upgrades

Avionics packages and options below are in addition to standard Garmin IFR avionics listed on page one of this price list.

	Price	Note
IFR Plus Package – Complies with NextGen ADS-B out requirements Standard instruments plus a large screen Garmin GTN-750 Touch screen WAAS GPS and upgrade to a Remote GMA-35 Audio Panel and upgrade to Remote GTX-33 mode S Transponder that provides ADS-B out with extended squitter.	\$29,875	1
		
IFR Advanced Package - Complies with NextGen ADS-B out requirements Standard instruments plus a Garmin G500 Advanced Multi-Function Display, Garmin GTN-750 Touch screen WAAS GPS unit, Mid-Continent "SAM" Standby Attitude Module (2" Attitude, Altitude and Airspeed), Remote GMA-35 Audio Panel and Remote GTX-33 mode S Transponder that provides ADS-B out with extended squitter.	\$58,750	1
		
Traffic Package - Garmin GTS 800 Traffic system, Upgraded electric DG with Heading output, 12 mile range, audio call outs and display on GTN Nav / Com and G500.	\$14,950	1
ADS-B – Complies with NextGen ADS-B In & Out requirements - Garmin GDL-88 ADS-B data link transceiver displays ADS-B traffic and Weather data on G500 and GTN nav/com	\$6,250	1,5
Autopilot - S-Tec 55 with AutoTrim and GPSS (requires appropriate heading system or IFR Advanced package)	\$31,950	1,2,5
Sandel SN-3500 (digital HSI) with SG102 AHRS. Full Color HSI with remote heading system for Autopilot (upgrade cost).	\$18,950	1,2,3
Garmin 796 GPS with weather data-link, Air Gizmos Panel Dock, remote antenna in wing.	\$3,895	1
Weather Data-link – Garmin GDL-69 USA and CA only (For GTN 650/750 & G500 systems)	\$5,850	1
Weather Data-link & XM Radio – Garmin GDL-69A, USA and CA only (For GTN 650/750, G500)	\$7,670	1



	Price	Note
GTX-33 Mode S Transponder upgrade – adds ADS-B Out capability to base avionics specification. (GTX-32 Included w / Base Aircraft)	\$3,600	3
Millibar Altimeter (non-USA only) - substitution	\$0	3
Southern Hemisphere Compass – substitution	\$0	3
Garmin SL 40 Com radio	\$2,895	1
L-3 Trilogy Backup System with battery backup (Upgrade price, replaces Midcontinent SAM System in G500 installations)	\$8,950	1
12 Volt plug in Cockpit – automotive style for portable GPS units or Phone Chargers, 1 Amp maximum	\$265	1
“G” Meter, Analog	\$695	1
Wood Grain Instrument panel overlay, center area, Consult factory for wood types / colors.	\$965	1

Front Passenger Cockpit Avionics Options and Upgrades

Garmin Aera 500 GPS, Panel Mounted, installed with remote antenna	\$1175	1
Garmin SL 40 Com radio	\$2,795	1
Engine Display, Remote JPI-930 Engine Analyzer Display	\$5,800	1
Airspeed Indicator	\$685	1
Altimeter 3"	\$1,199	1
Heading Indicator - Electric	\$4,990	1
Attitude Indicator - Electric	\$4,950	3
Turn & Bank 3"	\$911	1
Tachometer, Electronic 3"	\$620	1
Vertical Speed Indicator 3"	\$593	1
Wood Grain Instrument panel overlay, center area, Consult factory for wood types / colors.	\$750	1

Non-Flying Accessories and Options

Trickle charger for batteries, installed harness and temperature sensor.	\$599	1
Tow Bar / Push Bar – Painted to match aircraft with order	\$1,525	6
Aircraft disassembly and crating charge for international shipment in shipping container	\$3,500	7
2 nd Year Extended Warranty (includes first factory annual inspection at Battle Creek)	\$5,995	

WACO Classic Features Equipment as Standard

All prices are in US Dollars, Fly-Away-Factory, Battle Creek, Michigan, USA
Any applicable state, federal, local taxes or VAT are not included.

All prices are subject to change without notice.

Note 1: Installed price when ordered with new Aircraft only.

Note 2: Price is typical and may change slightly depending on avionics installed.

Note 3: Upgrade from standard cost

Note 4: When installed by Engine Manufacturer at time of aircraft purchase.

Note 5: Pending FAA Approval

Note 6: Can be painted to match aircraft for additional charge of \$150 - Safety Yellow is Standard

Note 7: Freight is additional charge and will be billed separately



Change History by Serial Number

Originally produced in 1934/1935 by the WACO Aircraft Company of Troy, Ohio, the WACO YMF was unquestionably regarded as the finest open cockpit sport aircraft. When production was re-established in 1986 with the **WACO YMF Classic**, many updated features were incorporated. Based on constructive input from valued customers all over the world, the **WACO YMF Super** was introduced in 1992. Today's production YMF-5D Super aircraft offers a complete array of updated features making it the finest sport biplane anywhere.

Model: WACO YMF Classic (1985 – 1991)

Serial Numbers: F5001 through F5039 (No longer in production)

Improvements Over the Original 1935 YMF

- 4130 Steel Tubing in-place of Mild Steel
- Internal Corrosion Proofing of Steel Tubing
- Heater Front & Rear Available
- Hydraulic Toe Brakes
- Steerable Tail Wheel (Raised 3 in.)
- Instrument Panel Accepting of IFR Installations
- Deluxe Front & Back Interiors Available
- 24 Volt Electric System with Starter
- Shoulder Harnesses for Pilot & Passengers
- Stainless Steel Firewall
- Stainless Steel Exhaust System
- Fire Resistant Fuel Lines Forward of Firewall
- Steel Tabs Welded to Fuselage Frame to Mount Bulkheads

SIGNIFICANT CHANGES BY SERIAL NUMBER FOR THE WACO YMF CLASSIC

F5010 and Up:

- Engine Horsepower Raised from 245 HP to 275 HP
- Rear Cockpit Seat Moved Aft 3 in.
- Gross Weight Increase From 2650 to 2770 lb.

F5015 and Up:

- Raised Front Seat
- Raised Front Windshield
- Insulated the Firewall
- Increased Ventilation to Front Cockpit

F5021 and Up:

- Lowered the Main Gear 3 in.

F5026 and Up:

- Moved the Rudder Pedals Forward 2 in.



WACO YMF Super (1992 – 2009)

Serial Numbers: F5C040 to F5C120

SIGNIFICANT CHANGES OF THE WACO YMF Super OVER THE WACO YMF Classic

- Increased Gross Weight to 2950 lb.
- Increased Fuselage Length 6 in.
- Increased Cockpit Dimensions
 - Front Cockpit Width +2.5 in. Front Cockpit Length +2.0 in.
 - Rear Cockpit Width +1.0 in. Rear Cockpit Length +4.0 in.
- Increased Passenger Door Size
 - Door Width +4.0 in. Door Height +2.0 in. Lower
- Increased Leg Room in Rear Cockpit 4 to 9 in. (Depending on Serial Number)
- Balanced Rudder and Elevator for Reduced Forces and Greater Authority
- Enlarged Front and Rear Windshields
- Improved Intercom System (1993 models and up)
- Improved Propeller for Increased Climb and Takeoff Performance
- Replaced Fabric with Aluminum Skin on Left Side of Forward Fuselage

WACO YMF Super IMPROVEMENTS F5C068 and Up

- Replaced Fabric with Aluminum Skin on Right Side of Forward Fuselage
- Removable Engine Mount

WACO YMF Super IMPROVEMENTS F5C092 and Up

- External hoses for extended range fuel tank upgraded to braided metal
- Wheel pant access covers added for improved inflation valve access
- New, hand carved wood stick grip
- New, fitted rear cockpit cover available
- WACO scalloped paint schemes available

WACO YMF-5D Super IMPROVEMENTS F5D121 and Up (2010 -)

- More Horsepower – new optional Jacobs R755-A2 300 HP with a 1400 hour TBO
- Garmin GTN-650 Touchscreen GPS and Remote Transponder
- JPI EDM 930-7 Engine instrumentation as standard.
- New Oil cooler design offering improved cooling
- New Oil Filtration system allowing for 50 hour oil change interval (up from 25)
- New MT Taper Tip Propeller (Hamilton-Standard 2B20 constant speed optional)
- Deluxe leather interior now standard
- Improved seals and other enhancements lower front cockpit temperatures in summer and improve heat system performance in winter.
- Front cockpit brakes now standard
- New lightweight wheel pants and wheel pant fairings
- New circuit breaker panel location
- Redesigned one piece instrument panel with vibration isolators
- Standard LED landing and identification lights, new beacon
- Simplified avionics packages featuring all Garmin Avionics
- Relocated ground start plug and redesigned electrical system saves 8 lbs.
- Redesigned landing gear pistons and seals
- New Trim system design (linkage system replaces older cable system)
- New fully adjustable rudder pedals (accommodates larger range of pilot sizes)
- Numerous serviceability enhancements



Air & Space/ Smithsonian

First accessed at <http://blogs.airspacemag.com/daily-planet/2009/03/mexico-march-1916-the-first-us-air-force-mission/?repeat=w3tc> (link no longer available)

The Daily Planet

March 19, 2009

Mexico, 1916: The first U.S. air force mission

On this day in 1916, eight Curtiss biplanes from the U.S. Army's 1st Aero Squadron—the country's entire air force—flew into Mexico for their first military action. The target was Pancho Villa, the guerilla leader who had provoked U.S. ire ten days earlier by crossing the border to attack the small town of Columbus, New Mexico. President Woodrow Wilson ordered General John “Black Jack” Pershing to chase Villa down, and to use airplanes (the Army had bought its first Wright Flyer just seven years earlier) as part of the so-called Punitive Expedition.

The 1st Aero Squadron went along strictly as aerial observers and messengers. The JN-3 biplanes weren't even equipped with machine guns, although a few of the pilots did carry pistols and .22 rifles.

Let's just say that things didn't go very well. By the end of April, every one of the airplanes was destroyed. And it wasn't as if the squadron's commander, Capt. Benjamin Foulois, hadn't seen disaster coming. Back at the unit's home base in San Antonio, he had struggled with incessant equipment problems, locked in a battle with the Curtiss company over shoddy workmanship and parts that constantly needed replacing.

Now, flying 100 miles into Mexico after dusk on March 19, he faced another problem. Only one of his pilots had ever flown at night. Halfway to Pershing's camp the airplanes got separated, and cavalry had to be sent out looking for half of them. When the squadron flew its first reconnaissance flight a couple of days later, two airplanes were still missing and a third had already crashed after getting caught in a dust devil, stalling, and falling 50 feet to the ground.

On the first recon flight, Foulois and another pilot made it just 25 miles before getting tossed around by wicked up- and down-drafts in the 10,000-foot Sierra Madre mountains. They turned back.

And so it went. The squadron flew many successful missions over the next few weeks, scouting the enemy and delivering supplies and messages among Army units on the ground. But mostly, Foulois and crew fought just to keep their airplanes aloft, thwarted as they were by high-altitude flying, rough terrain, dust storms, engine troubles, and broken parts. One by one, the airplanes went out of service. On April 6, Capt. Townsend Dodd ran his into a ditch, destroying its landing gear. Lt. Ira Rader damaged his on April 14 coming down on rough ground. Three of the pilots barely escaped with their lives after landing on the outskirts of Chihuahua City, where an angry mob surrounded the planes and started burning holes in the cloth wings with cigarettes and cutting them with knives.

Despite all the mishaps, the Army learned a lot from the Mexican experience about how *not* to use its fledgling air force. When airmen were sent to join the fighting in France in 1917, they were far better equipped and better prepared. As Foulois wrote years later, “The work of the 1st Aero Squadron proved beyond dispute to the most hardened former soldier and congressman that aviation was no longer experimental or freakish.”

Posted By: [Tony Reichhardt](#)