LESSON 🙎

Military Aircraft Development After World War II

Quick Write

After reading the vignette about Captain Joseph Kittinger, explain what qualities he must have had to be able to make his record-setting jump.

Learn About

- military aviation research after World War II
- significant contributions of test pilots in military aviation
- other significant military aircraft flown at Edwards AFB

S AIRCRAFT FLEW HIGHER AND HIGHER, they began to reach the outer edges of the atmosphere. This created a need for new escape equipment for pilots. When bailing out at high speed, a pilot encountered extreme cold, lack of oxygen, and the tendency to enter a deadly fast spin during freefall.

To protect pilots, the Air Force developed a series of new parachutes that would open in stages with small, medium, and then large parachutes deploying as the pilot fell. This allowed for a safe descent from extraordinary heights.

But someone needed to test the new parachutes. That someone was test pilot Captain Joseph Kittinger Jr. In 1959 and 1960, Captain Kittinger made several jumps from a balloon gondola to test the equipment.

In August 1960, Kittinger rode an Excelsior balloon gondola for an hour and a half to a height of 102,000 feet. That's more than 20 miles high and above more than 99 percent of Earth's atmosphere. A sign outside the gondola read, "This is the highest step in the world." At 40,000 feet, his pressure suit inflated, and he found that his right glove was not working. Not wanting to abort the flight, he decided not to tell mission control. His right hand swelled to twice its normal size, and he couldn't use it during the flight. Stepping from the gondola, he freefell for 4 minutes and 37 seconds, reaching a speed of 614 mph. The parachutes worked perfectly, and Kittinger returned to the ground in a little more than 13 minutes. His jump showed that a person could be protected and escape at the edge of the atmosphere. Today every ejection seat in a fighter aircraft uses a small drone parachute to slow and stabilize the pilot before the main parachute unfolds.

Kittinger went on to serve three tours of duty in the Vietnam War. He was shot down in May 1972 and spent almost a year as a prisoner of war. He was promoted to colonel while a prisoner. After his release, he continued in the Air Force until retiring in 1978 with many honors.

Kittinger's freefall record stood until 2012. He participated as a capsule communicator for the jump that broke the record.

Vocabulary

• playa

- tumble
- Mach
- stealth aircraft
- prototype

Military Aviation Research After World War II

Today every aircraft flown by the US Air Force is first tested and flown at Edwards AFB, California. But Edwards AFB didn't start out this way. The base is located at the edge of Rogers Dry Lakebed in a playa that spreads out over 44 square miles. It's the largest dry lakebed in world. A playa is *a flat-floored bottom of an undrained desert basin that at times can become a shallow lake*. As water from winter rains is swept back and forth by desert winds, it smoothes the lakebed out to an almost glass-like flatness.

Early homesteaders thought of the dry lakebed as a wasteland, but in 1933 then– Lieutenant Colonel "Hap" Arnold saw it as a one-of-a-kind "natural aerodrome" or airfield. This led to him establishing the Muroc Bombing and Gunnery Range. It served Army Air Corps bombers and fighters for several years. By 1942, it was named Muroc Army Air Base.

Development of military aircraft normally took place at Wright Field in Ohio. However, due to the large volume of flight-test work needed during World War II, an alternative location was required. In 1942, a site was found along the north shore of Rogers Dry Lakebed, about six miles from Muroc Army Air Base. The first aircraft tested at Muroc was the Bell XP-59A Airacomet jet fighter, followed by the Lockheed XP-80 Shooting Star. (The *X* indicates the aircraft is experimental.)

In 1949 Muroc was renamed Edwards Air Base in honor of Captain Glen W. Edwards. He was a test pilot and native of California who died in 1948 flying another experimental airplane.



Every Air Force aircraft flown since the end of World War II had its beginning at Edwards AFB. The many decades following the war have seen a revolution in planes that could fly at speeds and to heights the Wright brothers could have hardly imagined.

A series of technology breakthroughs led to new aircraft that could perform as never before. These breakthroughs included powerful jet and rocket engines, swept wings, new fuselage shapes, and new electronics.

Aerial view of Edwards AFB, California. Note the runway markings painted on Rogers Dry Lake. Courtesy US Air Force

Breaking the Sound Barrier

For a while, achieving faster speeds remained a challenge. The government, universities, and private industry all wanted to build faster fighter airplanes. But whenever such planes approached what came to be known as the *sound barrier*—the speed of sound, about 670 miles per hour—they shook badly. Sometimes they fell apart.

In 1945, the Army Air Forces and the National Advisory Committee for Aeronautics (NACA) began testing experimental aircraft for high-speed flight. (The NACA later became NASA.) These aircraft became known as the *X planes*.

The first of these was the Bell X-1. Its fuselage was shaped like a .50-caliber bullet, because experts knew an aircraft that shape would fly straight—it would not tumble, or *roll end over end*, at supersonic speed.

The X-1 had straight, very thin wings. It was powered by a rocket engine and dropped from a B-29 bomber. It also had a new system that allowed the pilot to raise or lower the entire tail a few degrees to allow the plane to fly level at high speed. The success of this design gave American fighter planes a technological advantage over other countries for several years.

The breakthrough occurred on 14 October 1947. Then-Captain Charles "Chuck" Yeager broke the sound barrier with the X-1. He reached 670 mph at 42,000 feet. Supersonic flight was born.

Yeager's feat brought a new word into the aviation dictionary—*Mach*. Mach (pronounced "mock") is *the speed of sound*. (Mach is named after 19th century Austrian physicist Ernst Mach.)

After this breakthrough, aircraft got faster and faster. The X-1A first flew in July 1951. It and the X-1B soon set new records, reaching Mach 2.44 (1,650 mph) and an altitude of 90,440 feet. The Bell X-1E didn't fly as fast, but proved that a very thin wing could be used on a supersonic aircraft. This led to the Lockheed F-104 Starfighter.



The X-1 with its mother ship, a B-29 Courtesy NASA

Reaching Mach 3

The Bell X-2 had a lot of problems in its early development. An explosion while the plane was still aboard the mother ship killed Bell test pilot Jean Ziegler and an observer.

The plane made its first flight in June 1952. It had a more-pointed nose and more powerful rocket engine than the X-1 series. It was designed to reach Mach 3 (2,094 mph). At this speed, friction from the air would heat the plane's skin to high temperatures. So the X-2 had to be made from a heat-resistant steel alloy. This research led to the SR-71 "Blackbird" reconnaissance plane.

On 23 July 1956 test pilot Captain Frank Everest flew the X-2 at 1,900 mph, or Mach 2.87. On 7 September, Captain Iven Kincheloe flew the X-2 up to 126,000 feet. He became the first human to fly higher than 100,000 feet. Twenty days later, Captain Milburn Apt took the X-2 aloft. He reached Mach 3.196, but sadly, the aircraft spun out of control and Captain Apt was killed.

The Douglas X-3 Stiletto was introduced in 1952. While the X-1 and X-2 were rocket-driven, the X-3 was jet-powered. And while the X-1 and X-2 had to be launched like a glider in mid-air, the X-3 took off from the ground.

Engineers built the X-3 to be the first jet aircraft to break Mach 3. But in 20 tries, it failed to do so. So the designers went back to the drawing board. Several more X planes followed.



An X-15 is dropped by a B-52 mother ship for a high-speed flight. Courtesy US Air Force

North American X-15

The most successful X plane was the legendary North American X-15. Only three X-15s were ever built. But the aircraft played an important role in modern aviation and spaceflight history. Like the previous X planes, the X-15 tested two kinds of limits: speed and altitude.

The rocket-propelled X-15 was carried into the air by a B-52 for release. Soon after its initial flight, it was breaking records. The X-15 flew at speeds that exceeded 4,000 miles an hour, more than five times the speed of sound. It soared more than 50 miles into the sky to the edge of space, earning its pilots astronaut wings. In 1967, a slightly modified X-15 reached Mach 6.7. Pilots tested the X-15 in 199 flights from 1959 until 1968. After the rocket plane was dropped from the mother ship, the pilot ignited the X-15 rocket and soared to the upper atmosphere. The plane would then glide without power to land on a dry lakebed. A typical X-15 flight lasted about 10 minutes.

Significant Contributions of Test Pilots in Military Aviation

As technologically advanced as they were at the time, these experimental aircraft would not have achieved anything without the pilots who dared to fly them. One writer has called these flyers "the most competent professional test pilots in history."

Being a test pilot was dangerous work. Many lost their lives. But this small group paved the way for both today's high-speed, high-performance aircraft and the US space program. This section takes a look at just a few of these courageous aviators.

Brigadier General Charles Yeager

Brigadier General Charles "Chuck" Yeager is best known for breaking the sound barrier in 1947. But he already had a long record of service by that time.

He was born in West Virginia in 1923. When he was 18 in 1941, Yeager enlisted as a private in the Army Air Forces. He worked as an aircraft mechanic and pilot. He was accepted for pilot training in 1942 under the "flying sergeant" program. He got his wings and flying officer appointment the following year.

Yeager became an ace in World War II. Between 1943 and 1945, he shot down 13 enemy aircraft, including five in one mission. He even shot down one of the new German Me-262 jets.



Then-Captain Chuck Yeager standing next to the Bell X-1 aircraft in which he broke the sound barrier in 1947 *Courtesy US Air Force*

After the war he became a test pilot. His work led to his selection as pilot of the first experimental rocket aircraft, the X-1. Yeager beat out 125 other pilots to get the job. He broke the sound barrier in October 1941. On 12 December 1953, he became the first pilot to exceed Mach 2 in level flight.

Later, Yeager served in the Vietnam War. He was a wing commander in 1966 and flew more than 120 combat missions. He received many Air Force honors, including the Distinguished Service Medal. He also won several major civilian trophies. He retired from the US Air Force in 1973.

Brigadier General Frank Everest

Frank Everest was born in 1920 and joined the Army Air Forces in November 1941. He shot down two German aircraft in North Africa in 1942 and four Japanese aircraft over China in 1945. His plane was shot down by ground fire in May 1945 and he became a prisoner of war until the war ended in August.



Then–Lieutenant Colonel Frank Everest sitting in the rocket-powered Bell X-2 research aircraft Courtesy US Air Force

In 1946 Everest was assigned to the Air Force Flight Test Center at Wright-Patterson AFB, Ohio. During this time, he took part in testing the X-1, setting a new altitude record of 73,000 feet. He was transferred to Edwards AFB in 1951, where he tested several of the X planes and many new fighters and bombers. In 1953 he set a new world speed record of 755 mph in a YF-100.

Then-Captain Everest flew the X-1B to Mach 2.3 in December 1954, making him at the time the second-fastest man in the world. He became the "fastest man alive" when he flew the X-2 to Mach 2.87 in 1956.

General Everest retired from the Air Force in 1973. He died in 2004.

Colonel Jackie "Jack" Ridley

Jackie "Jack" Ridley was born in 1915. After graduating from high school in Sulphur, Oklahoma, he entered the University of Oklahoma and joined the ROTC program. He graduated in 1939 with a degree in mechanical engineering. Lieutenant Ridley was sent to Flying Training School at Kelly Army Air Base in Texas and earned his pilot's wings in 1942.

The Army Air Corps needed engineer-trained pilots, so instead of sending him to a combat unit, the Army ordered Ridley to the B-24 Liberator plant in Fort Worth, Texas, to conduct acceptance tests on the bomber. After two years, he was sent off to further his education, graduating from the Army Air Forces School of Engineering and later the California Institute of Technology, earning a Master of Science degree in Aeronautical Engineering. Captain Ridley was later named as the project engineer for the Bell X-1 rocket powered airplane, joining test pilots Captain Chuck Yeager and Lieutenant Bob Hoover. Ridley's task was to analyze all of the technical data generated during the X-1 flights as the plane proceeded toward the unexplored region of supersonic flight. It was Ridley's adjustable horizontal stabilizer that allowed the X-1 to maintain control at supersonic speeds, allowing Captain Yeager to be the first man to break the sound barrier.

Colonel Ridley went on to work on many other aircraft test programs from the X-1 through X-5, B-47, F-86, and B-52. He was later promoted to chief, Flight Test Engineering Laboratory.



Captains Charles "Chuck" Yeager (*left*) and Jackie "Jack" Ridley (*right*) stand next to the cockpit of the Bell X-1 and B-29 mother ship. Courtesy US Air Force

Colonel Ridley is credited with creating the Flight Test Center's basic philosophy still in use today. He died in 1957 flying as a co-pilot on a C-47 when the transport crashed into Mount Shirouma, northwest of Tokyo, Japan.

Captain Milburn Apt

A Kansas native, Milburn "Mel" Apt was born in 1924. He joined the Army Air Forces in 1942 and graduated from pilot training in 1944. He graduated from Experimental Flight Test Pilot School at Edwards AFB in 1954 and became a test pilot for new fighters and in the X plane program.

Captain Apt was flying the X-2 for the first time on 27 September 1956 when he became the first person to fly at Mach 3. Up to that point, his flight had gone perfectly. But as he turned back toward Edwards, the plane began to roll out of control to the left. Although Apt tried right the aircraft, it continued to roll and tumble out of control.

The X-2 was the first aircraft equipped with an escape capsule. Thrown around the cockpit, briefly knocked unconscious, and unable to regain control, Apt blasted the escape capsule away from the plane. But he was unable to get out of the capsule and deploy his parachute before the capsule crashed to earth, killing him. The Air Force awarded him the Distinguished Flying Cross after his death.

A. Scott Crossfield

Scott Crossfield was born in 1921 in Berkeley, California. He served in both the Army Air Forces and the Navy during World War II. Following the war, as a member of the Navy Reserve, he piloted FG-1D Corsairs for a Navy acrobatic team.

Crossfield joined NACA at its High Speed Flight Research Station at Edwards AFB in 1950. During the next five years he flew several X planes and new fighters, logging 100 rocket-powered flights. This made him the single most experienced rocket pilot. He became the first pilot to fly at Mach 2 on 20 November 1953 in the D-558-II Skyrocket at 62,000 feet.



Scott Crossfield (*center*) stands with two NACA officials in front of the D-558-II after the first Mach 2 flight. *Courtesy NASA*

Crossfield left NACA in 1955 to join North American Aviation, where he worked on the X-15 program. He was responsible for many of the operational and safety features of the aircraft. He flew its first free flight in 1959 and qualified the first two planes before North American turned them over to NACA and the Air Force.

Crossfield won many aviation awards. He served in a number of civilian aviation jobs until he retired in 1993, including many years as a consultant to the House of Representatives Committee on Science and Technology in Washington. He was a strong supporter of the Civil Air Patrol. Upon his retirement, NASA awarded him the NASA Distinguished Public Service Medal. He died in 2006 when his private plane crashed after entering a thunderstorm over Georgia.

Neil Armstrong

Born in Ohio in 1930, Neil Armstrong served as a Navy pilot from 1949 to 1952. In 1955 he joined NACA. He served that agency and NASA for the next 17 years as an engineer, test pilot, astronaut, and administrator.

As a research pilot at Edwards AFB, he flew the X-15. He transferred to astronaut status in 1962. He was command pilot for the *Gemini 8* space mission, performing the first successful docking of two vehicles in space. As spacecraft commander for the *Apollo 11* mission in 1969, he became the first person to land on the moon and walk on its surface.



Neil Armstrong next to the X-15 *Courtesy NASA*

After returning from the moon, Armstrong held a variety of government and private-sector jobs, including a post as NASA's Deputy Associate Administrator for Aeronautics. He was awarded the Presidential Medal of Freedom, the Congressional Gold Medal, the Congressional Space Medal of Honor, and many other honors. He passed away in 2012 and was buried at sea in a Navy ceremony. In 2015, NASA renamed its flight research center at Edwards AFB the Neil A. Armstrong Flight Research center.

Other Significant Military Aircraft Flown at Edwards AFB

The test pilots who flew the X planes and other experimental aircraft also flew the test versions of the Air Force's new fighters, bombers, and transports. Many of these aircraft went on to play significant parts in the Cold War during the 1960s. Among them were the F-100 Super Sabre, the F-104 Starfighter, the SR-71 Blackbird reconnaissance plane, and the C-130 Hercules.



An F-100F Super Sabre performs at an air show in Ypsilanti, Michigan, in 2010. Darren Brode/Shutterstock



The experimental XF-104 on its first flight in 1954 Courtesy US Air Force

North American F-100 Super Sabre

The F-100 entered Air Force service in 1954. Extensive testing and experience with early versions of the aircraft led to many improvements in the F-100D model. The plane had a high accident rate, however, so a two-seat trainer model, the F-100F, was produced to give pilots better training. Many of these were later converted for the *Wild Weasel* program in Vietnam discovering and attacking enemy radar and anti-aircraft sites.

The F-100 carried two cannon and air-to-air or air-to-surface missiles. It could also carry up to 5,000 lbs. of bombs. Some 2,294 F-100s were built, with production ending in 1959. Besides the Air Force, many NATO countries and other friendly nations flew the aircraft.

Lockheed F-104 Starfighter

The first experimental F-104 took to the air in 1952. It featured technology developed from the X-1E. The aircraft was produced in two major versions: a tactical fighter with a six-barrel cannon, and a day-night interceptor with Sidewinder heat-seeking missiles. An F-104 set a world speed record of 1,404 mph in 1958 and a world altitude record of 103,395 feet in 1959.

The F-104 was known for its straight, stubby wings. Its normal top speed was 1,320 mph, with a range of 1,250 miles. Its rate of climb was an incredible 48,000 feet per minute. The plane took a lot of skill to fly, however, and its accident rate was quite high.

The Air Force bought 300 of the planes, with another 1,700 serving in the air forces of several NATO allies and other friendly countries. Several foreign companies manufactured Starfighters as well. F-104s were in service somewhere in the world until 2004.

Lockheed SR-71

The SR-71 was first developed as the YF-12 in the 1960s. It was to be a high-altitude, Mach 3 interceptor to defend against supersonic bombers. Based on the A-12 reconnaissance aircraft, the YF-12A became the forerunner of the highly sophisticated SR-71 strategic reconnaissance aircraft.

The SR-71 was the fastest (2,193 mph) and could reach the highest altitudes (85,068 feet) of all reconnaissance planes. Known unofficially as the Blackbird, it first flew in December 1964. From an altitude of 80,000 feet, it could take pictures of 100,000 square miles of the earth's surface every hour. The SR-71 had a range of 2,900 miles.

Lockheed developed the SR-71 after a U-2 spy plane piloted by Francis Gary Powers was shot down by the Soviets in 1960. President Dwight Eisenhower asked the company for a plane that enemy aircraft and missiles couldn't reach. Lockheed engineers had to develop a plane that could fly continuously at top speed, which would generate great heat. At the same time, the air temperature around the plane would be -60 degrees F. Lessons learned from the X planes helped here. Part of the solution was to build the plane from titanium. Another part was to paint it black, because black paint both absorbs and emits heat.

The Blackbird was an early attempt to build a stealth aircraft *an aircraft that can't be detected by radar*. The builders succeeded in reducing radar's ability to track the plane by 90 percent. Although SR-71s were fired on many times, none was ever hit—it merely outflew the missile.

The Air Force retired its fleet of SR-71s in 1990 as budgets were cut, but brought them back from 1995 to 1997. NASA flew two others until 1999.



SR-71 Blackbird Technical Sergeant Michael Haggerty/Courtesy US Air Force

Lockheed C-130 Hercules

Lockheed designed the C-130 as an assault transport that could land and take off from unpaved airstrips. It first flew in 1954. Since then, the Air Force has used the versatile plane for a variety of additional missions: medical evacuation; midair refueling of helicopters; search, rescue, and recovery; reconnaissance; and as a gunship. If the landing strip is inadequate, the C-130 can deliver cargo by parachute or using a low-altitude ground cable.



A US Air Force HC-130P lands at Royal Air Force Base Mildenhall in Great Britain. This long-range version of the C-130 is used for search and rescue or helicopter refueling. IanC66/Shutterstock One special version of the plane, the AC-130 Spectre, operated as a gunship in Vietnam and later conflicts. Instead of cargo, it carried an array of machine guns, cannon, anti-tank missiles and other weapons along one side of the plane. (Some versions carried conventional or precision bombs.) This created a devastating ground-attack aircraft.

More than 2,300 C-130s in various versions have been built. The workhorse was still in use as this book was written, both with the Air Force and many foreign countries. It will certainly fly for many years to come.

The C-130 carries a crew of five. Its cargo area can hold six pallets or 74 litters, or 92 combat troops or 62 paratroops, or any combination up to 42,000 lbs. Its maximum speed is 380 mph, with a range of 2,500 miles.

Northrop YB-49 Flying Wing

The Northrop YB-49 was a jet-powered heavy bomber developed shortly after World War II. (The *Y* designation indicates aircraft was a prototype.) A prototype is *an original or first model that is used for what comes later*. The flying wing design was never put into production. It was passed over in favor of more conventional bomber designs.

The first flight of the YB-49 took place on 21 October 1947, when the aircraft was flown from Hawthorne, California, to Muroc Army Airfield. Only two YB-49s were delivered to the Air Force. The aircraft was intended to be a high altitude, long-range bomber with lower drag characteristics, allowing the aircraft to have a greater range than conventional bombers of the day. The first YB-49 crashed in 1948, killing all crew members on board, including Captain Glenn Edwards, for whom the base was named a year later.

The YB-49 was a very unstable aircraft to fly, requiring the pilot to work continuously to maintain controlled flight. When the first YB-49 crashed during a test, it was speculated that after the aircraft left controlled flight it broke apart when the crew tried to recover. The second YB-49 caught fire and was destroyed when the nose gear collapsed during a high-speed taxi test.

The YB-49 Flying Wing program was cancelled in 1950. Although the flying wing concept appeared to be a failure, it was brought back decades later and would lead to the development of the B-2 stealth bomber being flown today. You'll read more about the B-2 in a later lesson.



Northrop YB-49 Flying Wing bomber at the Northrop facility, Hawthorne, California, 23 December 1948

Courtesy US Air Force

North American XB-70 Valkyrie

The futuristic XB-70A was originally conceived in the 1950s as a high-altitude, nuclear strike bomber that could fly at three times the speed of sound—any potential enemy would have been unable to defend against such a bomber.

By the early 1960s, however, new surface-to-air missiles (SAMs) threatened the survivability of high-speed, high-altitude bombers. Less costly, nuclear-armed missiles were also entering service. As a result, in 1961 the expensive B-70 bomber program was canceled before any Valkyries had been completed or flown.

Even so, the Air Force bought two XB-70As to test aerodynamics, propulsion, and other characteristics of large supersonic aircraft.

The first XB-70A flew in September 1964, and it achieved Mach 3 flight in October 1965. The second Valkyrie first flew in July 1965, but in June 1966 it crashed after an accidental mid-air collision. The third Valkyrie was not completed.

The first XB-70A airplane continued to fly and generate valuable test data in the research program until 1969.

While aircraft testing was under way in the late 1940s and early 1950s, the Cold War continued. Although the Western Allies won a peaceful victory with the successful end of the Berlin Airlift, a shooting war was about to begin in Korea. That war would teach the newly independent Air Force and its civilian superiors some hard lessons.



North American XB-70 Valkyrie being towed to its display location at the National Museum of the US Air Force Courtesy US Air Force

CHECKPOINTS

Lesson 2 Review

Using complete sentences, answer the following questions on a sheet of paper.

- **1.** Where did every US Air Force aircraft flown since World War II have its beginning?
- 2. Who broke the sound barrier, and in what plane?
- 3. How long did a typical X-15 flight last?
- **4.** What did Captain Ridley develop that allowed Chuck Yeager to break the sound barrier?
- 5. Who was the first pilot to fly at Mach 3?
- 6. Which test pilot became the first person to walk on the moon?
- 7. Which records did the F-104 Starfighter set in 1958 and 1959?
- 8. The SR-71 Blackbird was an early attempt to do what?
- 9. For which types of missions has the Air Force used the C-130?
- **10.** Which aircraft led to development of the B-2 bomber?

APPLYING YOUR LEARNING

11. Based on the backgrounds of the pilots discussed in this lesson, what was the most important quality you found in test pilots of the post–World War II decades?