

*The Palm Springs Air Museum – no matter how often you visit, there is always something new and exciting to experience.* 

## Welcome to The Palm Springs Air Museum

A Beginner's Guide for Future Aviators is filled with fun, informative activities for the whole family. It makes a perfect gift for a future aviator in your family, a friend, or an educator. While it is designed for visitors to use during or following a visit to the Palm Springs Air Museum, it is not necessary to visit the museum to complete the activity projects.

If you are a novice airplane enthusiast, check out "How to Read an Airplane" and follow that with the "Types of World War II Planes at the Palm Springs Air Museum" and the "Who's Who and What's What" section. By the time you finish these, you'll know enough about flying to impress even the most serious aviator. Keep on "flying" through the guide and you'll find many more activities and lots of information about our historic aircraft from Korea to Vietnam and beyond.

Our five climate-controlled hangars include one of the world's largest flying World War II airplane collections. Refer to the last page of this guide for more information about each of the hangars. Also, the museum has computer flight simulators and an extensive library. It's an awesome walk-through history that has visitors returning for more.

If you are visiting the museum in person, we recommend you schedule a minimum of two hours for your visit. Before you begin, we suggest you review the "Highlights of Your Tour" featured on the next page. Select some of the "highlights" to look for during your visit. Not every plane in our collection is featured in this publication. Plan a visit to the museum to view our entire collection.

Teachers may use the guide either as a unit based on the museum or as a source for individual lessons and enrichment projects independent of the museum. To schedule a group tour of the museum, contact our Youth Education Program Director at (760) 482-1839.

Visit our YouTube channel frequently to view videos about our exhibits and events, <u>https://www.youtube.com/@PalmSpringsAirMuseum</u>

For membership information, refer to our website to learn about the many benefits of becoming a member of the museum <u>www.palmspringsairmuseum.org./membership/</u>

## **Highlights of Your Tour**

Some World War II European Theater of Operations things to look for in the Donald and Peggy Cravens Hangar:

- The B-25 Mitchell Bomber, P-40 Warhawk, P-47 Thunderbolt, the flying Red Tail P-51 Mustang, P-63 King Cobra, and Spitfire. Look for the information signs provided for each aircraft that tell when the plane was built, by whom, and its specifications.
- Tuskegee Airmen Wall Mural
- Large wall European Map, the Women in Aviation exhibit, and the Norman Sirota Gliders

Some things to look for in the B-17 Thomas L. Phillips Hangar:

- The B-17G "Miss Angela" Flying Fortress
- Berger Youth Exploration Center, F-16 Flight Simulator, the General Ken Miles Aviation Science Center
- Enjoy a bite to eat at the Victory Canteen.

Some World War II Pacific Theater of Operations things to look for in the Robert J. Pond Hangar:

- Pearl Harbor diorama with narration by Tom Brokaw, large wall Pacific Map
- The Avenger, Corsair, Dauntless, Grumman "Cats," the Invader, and more. Look for the information signs that tell when the plane was built, by whom, and its specifications.
- Ship models, uniforms, weapon display cabinets, and the Bob Hope Stage
- Display case with artifacts from Walt Disney's private plane
- Photo of General MacArthur signing the Surrender Documents

Some Korean War and Vietnam War things to look for in the General Ken Miles Hangar:

- Aircraft used during the Korean and Vietnam War
- Edward and Mona Sher POW Bracelet exhibit, Ken Mart's "Presidents Who Served" Display, Frederick Noble Engine Display
- Top Gun Display
- This hangar hosts Saturday Programs and major events.

Some things to look for in the F-117A Jim Houston Hangar:

- The spectacular F-117A Nighthawk "Black Devil"
- History of Skunkworks mural by Stan Stokes, "Brotherhood of Stealth" display, and the F-117A cutaway
- Global War on Terror (GWOT) Timeline, GWOT memorial brick display

Many of our volunteers are combat veterans who are willing to share their experiences and sacrifices for the education of future generations. While visiting the Palm Springs Air Museum, interview your tour guide about some of the topics listed below:

- Their personal experiences related to the Armed Services
- Advantages and limitations of various airplanes during warfare
- Advances made in the aerospace and defense industries during and since World War II

Note: The Palm Springs Air Museum is a "working museum." This means the planes and exhibits are frequently moved to new locations.

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### Acknowledgments

### A Beginner's Guide for Future Aviators

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### Overview

This Activity Guide makes a perfect gift for a future aviator in your family, a friend, or an educator. While it is designed for visitors to use during or following a visit to the Palm Springs Air Museum, it is not necessary to visit the museum to complete the projects.

There is always something new at the Palm Springs Air Museum, which is home to one of the world's largest collections of static & flyable aircraft from WWII through the War on Terror. Unlike many other museums, our air-conditioned hangars have no ropes to keep you from interacting with our exhibits. In addition to our aircraft, our exhibits allow visitors of all ages to gain a fresh perspective on the history of US Military operations over the last 100 years.

Visit <u>https://www.youtube.com/@PalmSpringsAirMuseum</u> frequently to view videos on our YouTube channel to learn about our aircraft, history, exhibits and events.

This Activity Guide could not have been created without the generous support of the donors to the Palm Springs Air Museum.

Permission is hereby granted to reproduce and distribute the handouts in this publication for educational and research purposes.

## How to READ an Airplane

#### Pick a propeller airplane in the museum. Let's learn how to "read" it.

(If you are not at the museum, refer to the aircraft on pages 9 to 12)

1. How many **engines** does your airplane have?

Face the nose or front of the airplane. A single-engine plane has one engine. A twin-engine has two engines. Some of our airplanes at the museum have up to 4 engines. The type of engine and the shape of the airplane help to determine the range or how far the airplane can go, the speed of the airplane or how fast it can go, and the altitude of the airplane or how high it can go.

2. On your airplane, how many blades does the **propeller** have?

Many of the aircraft in our museum are called prop-planes because the engines have propellers. (The jet engine was not in common use until after World War II.) The propeller helps to propel or thrust the plane through the air. The propeller is usually mounted in front of the engine housing. Usually, propellers have two, three, or four blades that spin.



3. Find the **fuselage** and the **cockpit**.

How many seats does the cockpit have?

Face the fuselage or the main body of the airplane. The fuselage holds the crew and sometimes cargo or passengers. The pilot controls the aircraft from the cockpit, an area on the top or at the front of the fuselage.

4. Find the plane's landing gear. How many wheels do you see?

Does your plane have a tail wheel or a nose wheel?

The landing gear is found under the wings or under the fuselage of the airplane. Usually, there are two main landing gear wheels (struts) located near the middle of the aircraft. They usually support about 90% of the plane's weight. A smaller tail strut or a smaller nose strut supports the rest of the aircraft. Most of our planes are taildraggers with two wheels near the middle and one wheel under the tail.

5. On the picture of the P-51 on the next page, label the wings, ailerons and the flaps.

Look at the wings of the airplane. **Ailerons** are movable flaps attached to the trailing edge or back of the wing. Some airplanes have ailerons extending only half the distance of the wing beginning at the tip of the wing. The ailerons are used to control the plane's rolling and banking movements. To turn the aircraft to the left, a pilot must raise the left aileron (to decrease the lift of the plane) and lower the right aileron (to increase the lift).

The other part on the trailing (back) edge of a wing is called a **flap**. It is closer to the fuselage than the aileron. The flaps move along metal tracks built into the wings. Moving the flaps aft (toward the tail) increases the wing area. Turning the flap downward increases the lift of the airplane. In addition, the large area of the flap increases the drag of the aircraft. This helps the airplane slow down for landing.

6. On the picture of the P-51 on the next page, label the vertical stabilizer and the rudder.

Look at the tail or back of the airplane. At the rear of the fuselage of most aircraft, you can find a vertical stabilizer and a rudder. The vertical stabilizer provides stability for the aircraft, to keep it flying straight. The vertical stabilizer prevents the side-to-side, or yawing, motion of the aircraft nose. The rudder is the small moving section at the rear of the stabilizer that is attached by hinges to the stabilizer. Landing a taildragger can be difficult since the pilot must line up his/her approach very carefully while making constant rudder adjustments to keep the plane on a straight path until it comes to a stop.

## 7. On the picture of the P-51 on the next page, label the **horizontal stabilizer** and the **elevator**.

At the rear of the fuselage of most aircraft, you can find a horizontal stabilizer and an elevator. The horizontal stabilizer prevents the up-and-down, or pitching, motion of the aircraft nose. The elevator is the small moving section at the rear of the stabilizer that is attached to the fixed sections by hinges. There is an elevator attached to each side of the fuselage.



### Label the P-51



propeller	fuselage	ailerons	vertical stabilizer
wings	cockpit	flaps	rudder
elevators	nose	tail	horizontal stabilizer

Write Your Name\_\_\_\_\_

### Lexicon Recon... as in a Dictionary Reconnaissance

You have a special mission to conduct a reconnaissance trip around the vocabulary words. Match them with their definition. Write the number of the definition next to its word.

\_\_\_\_fuselage \_\_\_\_cockpit \_\_\_\_ailerons \_\_\_\_flaps \_\_\_\_vertical stabilizer \_\_\_\_rudder \_\_\_\_rudder \_\_\_\_horizontal stabilizer \_\_\_\_elevators \_\_\_\_propellers \_\_\_\_wings



- 1. main body of the airplane
- 2. movable flaps attached to the trailing edge or backside of the wing that help to control the plane's rolling and banking movements
- 3. an area on the top or at the front of the airplane; where the pilot controls that aircraft
- 4. turning this downward increases the lift of the plane; it can also help slow the airplane down for landing
- 5. small moving section attached to the rear of the horizontal stabilizer by hinges
- 6. prevents side-to-side, or yawing, motion of the aircraft
- 7. located on each side of an aircraft; provides lift
- 8. a power-driven shaft with blades that provides thrust for an airplane
- 9. a small moving section at the rear of the vertical stabilizer that is attached by hinges
- 10. prevents up-and-down, or pitching motion of the aircraft

### Types of World War II Airplanes at the Museum "Where History Flies Through the Skies"

World War II airplanes come in many different shapes and sizes depending on the mission of the aircraft. Many of our airplanes are World War II **fighter planes**. They usually have single-engines with only one pilot. They were used for aerial combat and to support the troops on the ground. This airplane on the right is a **Warhawk P-40N** (AAC) Curtiss. Warhawk is the name of the aircraft and P-40N is the model. AAC stands for Army Air Corp and Curtiss is the manufacturer of the aircraft. The Warhawk P-40 was America's first fighter when the United States entered World War II.



How many of our WW II fighter planes can you find? Check them off when you find them.

- \_Corsair FG1D (Navy) Goodyear
- \_ Bearcat F8F (Navy) Grumman
- \_ Hellcat F6F (Navy) Grumman
- \_ Tigercat F7F (Navy) Grumman
- \_ Wildcat FM-2 (Navy) Grumman



- \_ Kingcobra P63A (AAC) Bell
- \_ Warhawk P40N (AAC) Curtiss
- \_ Thunderbolt P-47D (AAC) Republic
- \_ Spitfire MkXIV (British) Supermarine

**Dive bombers** are about the same size or a little larger than fighter planes. They usually have a crew of two and carry one bomb. They have two machine guns in the wings or nose and usually one or two at the rear of the cockpit so the gunner can shoot behind the plane. This plane is a **Dauntless SBD**. It was the Navy's smallest and most widely used bomber. SBD stands for Scout Bomber Douglass (manufacturer). It would scout ahead of an aircraft carrier formation for enemy threats and radio back information. It can dive out of the sky at 70 degrees and release a bomb over a moving target.

**Torpedo bombers** are single-engine planes, but they are larger, heavier, and slower than dive bombers. They usually carry a crew of three. Torpedo bombers were used only by the Navy. A torpedo is a powered bomb that is dropped by a plane and goes through the water to hit a naval vessel or ship. This aircraft is a **Grumman TBF/TBM Avenger**. TB stands for torpedo bomber. F stands for Grumman, the manufacturer. Grumman was busy building



the F6F Hellcat fighter, so production was subcontracted with Eastern Aircraft which had the M manufacturer designation. The TBF/TBM Avenger was the largest airplane to regularly operate from the deck of an aircraft carrier. Its wings can be folded up to make space aboard the carrier. With a cruising speed of 147 miles per hour and a fuel capacity of 335 gallons, the aircraft has a range of 260 miles while carrying torpedoes.



Medium bombers are twoengine planes that carry 1,400-4,000 pounds of bombs. This aircraft is a North American **B-25** Mitchell. North American was the manufacturer in Inglewood, California. The B stands for the bomber. It was named the Mitchell in honor of General William "Billy" Mitchell, pioneer in the development of an American Air Force in the 1920s and 1930s. The B-25 has a range of 1,350 miles and a speed of 275 miles per hour.

No other bomber during the war carried as many guns, eight in the nose, four under the cockpit, two in the upper turret, two in the waist, and two in the tail. Medium bombers usually flew in formation or groups of planes. They could take off from fairly small airfields, which made the B-25 useful as the ground Army advanced. The B-25 won fame in the April 1942 "Doolittle Raid" on Japan just 6 months after the attack on Pearl Harbor.

Heavy bombers are the giant four engine planes that can carry 6,000-20,000 pounds of bombs. This plane is a Boeing **B-17 Flying Fortress**. Boeing was the manufacturer and the B stood for bomber. The B-17 has a crew of 10 men including a pilot, co-pilot, navigator, flight engineer, bombardier, radio operator, ball-turret gunner, two waist gunners and a tail gunner. The B-17s flew in squadrons of many planes and had an effective range



(how far an airplane can fly with a reasonable payload of passengers, bombs, and some reserve fuel) of 2,000 miles. They flew far into enemy territory to bomb factories, large railroad centers, oilfields, and power plants. These long-range bombers needed fighter escorts for protection. They had to fight off enemy fighter planes and anti-aircraft fire from the ground.



This aircraft Patrol Boats. is а Consolidated **PBY Catalina**. PB stood for Patrol Boat and Y stood for Consolidated. the manufacturer. The PBY Catalina is amphibious which means it can take off and land from both runways and water. It was one of the few aircraft that was capable of rescuing downed airmen or sailors at sea. Flying at a cruising speed of 117 miles per hour, this flying boat had twin engines mounted high on the wing to avoid getting splashed by seawater. The

large wing gave the Catalina great lift to carry the aircraft in the air much like the large wing on a glider. Also, the wing carries all the fuel necessary for long-range patrols which could exceed 10 hours in time and 2,500 miles without refueling.

**Trainers**. This aircraft is the Boeing/Stearman Kaydet **PT-17** (N2S Navy). The Kaydet is a two-seater biplane introduced by the Stearman Aircraft Division of Boeing. Its simple, rugged construction made it ideal as a trainer for novice pilots during World War II. After the war, their slow, low-flying capabilities made them well-suited for crop dusting and spraying.



### **More World War II Airplanes**



#### **Grumman F6F Hellcat**

The Navy's answer to the P-47 Thunderbolt had the power and armament to run down and shred the lightly built Mitsubishi Zero. With a kill ratio of 19 to 1, Hellcat pilots swept the skies of the enemy at the Battle of the Philippine Sea, called the Mariana Turkey Shoot, and elsewhere.



#### **Douglas DC-3/C47**

The wartime modifications to this airplane are numerous. They were used in all theaters and performed beyond all expectations in virtually all weather, altitude, and airfield conditions. They pulled gliders and hauled freight, passengers, wounded, gasoline, VIPs, weapons, animals, and jeeps. They hauled gasoline and freight "over the Hump" in the China-Burma-India (CBI) Theater.



#### North American P-51 Mustang

German Reichsmarshall Hermann Goering knew the war was lost when he saw the first P-51s over Berlin in 1944. Faster, more maneuverable, rugged, and more heavily armed than Axis fighters of the period, the P-51 Mustang turned the tide in the strategic bombing campaign that brought Germany to its knees.



#### **Douglas A-26 Invader**

Faster and more maneuverable than some of the enemy planes of its day, this light bomber entered service in the Ninth Air Force campaigns supporting the Normandy Invasion. The A-26 served in Korea. It was retired after slugging it out with the Vietcong in Southeast Asia 25 years later! This airplane was used in the Richard Dreyfus film. *Always*.

## Who's Who and What's What?

#### Let's Go on a Wild Goose Chase to Seek & Find some FUN things at the Museum

(If you are not at the museum, use the planes on pages 9 to 12, and information on the next page.)

Look for:	Write the name here:
Dive bomber	
Fighter plane	
Heavy bomber	
Medium bomber	
Patrol or scout plane	
Torpedo bomber	
Trainer plane	
Also, look for:	Check out the museum to find the following:
American flag	Write the year (if given) and tell how many stars it has.
Classic car or motorcycle	Write the model and year.
Nose Art	Write the model of plane and sketch the nose art. See the next page.
Flying Tiger	See the next page.
Women in Aviation Display	Write the name of a woman aviator. See page 15.
Ship Models	Write the name of one of the ships
Poster of WW II	Write the title of the poster. See page 16.
Tuskegee Airman	Write the name of a Tuskegee Airman.

Other things to look for at the museum... place a check next to each one you find.

\_\_Airborne Troop Carrier \_\_Aircraft Engine display \_\_Axis and Allied Maps \_\_Bob Hope stage \_\_Bombs \_\_Cross section of a wing Flight Simulators Model airplane collection Surrender documents Uniforms of WW II Weapons of WW II Women in the Armed Services

### What is Nose Art?

Nose Art is a decorative painting or design on the fuselage of an aircraft, usually on the front fuselage.

Curtiss P40 was used by the First American Volunteer group, the *Flying Tigers*, in China. The *Flying Tigers* use of shark teeth is perhaps the most recognizable piece of nose art to be displayed on fighter aircraft.



Curtiss P-40 Warhawk

You can view a Curtiss P-40 Warhawk at the Palm Springs Air Museum.

## **Flying Tigers**

The First American Volunteer Group (AVG) of the Republic of China Air Force, nicknamed the **Flying Tigers**, was formed to help oppose the Japanese invasion of China. Operating in 1941–1942, it was composed of pilots from the United States Army Air Corps, Navy, and Marine Corps, and was commanded by Claire Lee Chennault. Their Curtiss P-40B Warhawk aircraft, marked with Chinese colors, flew under American control. The group consisted of three fighter squadrons of around 30 aircraft each that trained in Burma before the American entry into World War II to defend the Republic of China against Japanese forces.



During your visit to the Palm Springs Air Museum, be sure to view the "History of Our Flag" exhibit in the B-17 Hangar. Also, look for the "Flag of Honor." It contains the names of all who perished in the 9/11 attacks.



The Palms Springs Air Museum Library is located on the 2nd floor of the museum. Many books, videos, and original magazines of the World War II era are in the Palm Springs Air Museum library.



While on the 2nd floor of the museum, test your skills with one of the flight simulators. Docents are available to help you learn the basics of flying your own plane.



**Interesting Trivia:** In 1962, the U.S. Navy began using a uniform aircraft designation system.

*First Letter*: the basic mission or type of aircraft *Number*: its place in the series of that type of aircraft *Second Letter*: its place in the series of changes in its basic design

### Women in the Military During World War II

In July 1942, President Franklin Roosevelt signed into law authorization for women's units in all branches of the armed services. The Navy bill established the Navy Women's Reserve (WAVES). It specified that women would be restricted "to the performance of shore duty within the



continental United States only and shall not be assigned to duty on board vessels of the Navy or in combat aircraft."

The same law authorized the Coast Guard and the Marine Corps to establish women's units. The Coast Guard set up a women's reserve called the SPARS, an acronym using letters of the Coast Guard motto, Semper Paratus-Always Ready. The Leadership in the Marine Corps opposed setting up a women's reserve and held back for several months. With the high number of Marine casualties in the Pacific war, the Marine Commandant relented, and the Marine Corps Women's Reserve (MCWR) was established.

Over 150,000 women served as the Women's Army Corps (WAC) offering vital assistance to the Army and Army Air Force. One of the first duties was to serve at Aircraft Warning Service stations. Almost half of their volunteers served with the Army Air Force and worked as aircraft mechanics. Some WACs volunteered as flight nurses, a strenuous job that could take them into the range of enemy fire.

The Women's Auxiliary Ferrying Squadron (WAFS) delivered aircraft from factories to air training bases. What began as flying light aircraft soon developed into ferrying fighter planes,

bombers, and large air transport carriers. Famed pilot, Jacqueline Cochran, created the Women's Flying Training Detachment (WFTD) to meet a critical need for more trained pilots to fly the increasing number of planes being produced in American factories. Women pilots were needed to tow targets and test-fly new aircraft. In 1943 the WAFS and WFTD merged to form the Women Airforce Service Pilots (WASP). The program had marked success.



Famed aviator, Jacqueline Cochran





We Can Do It! by J. Howard Miller, 1942. Of all the images of working women during World War II, the image of women in factories predominates. War work – uniforms, tools, and lunch pails – were incorporated into the revised image of the ideal woman.

### **Women in Industry**

As millions of able-bodied men went into military service, new sources of workers entered the job force. During the war, many women went to work outside the home for the first time. They worked in factories, steel mills, shipyards, and offices. They also ran family businesses and farms. Between 1940 and 1944, more than 6 million additional women joined the workforce. Many of them worked in non-traditional factory jobs in the aircraft and shipbuilding



Longing Won`t Bring Him Back Sooner...Get a War Job! by Lawrence Wilbur, 1944

industries. To meet the need for war planes, aviation companies hired more than 200,000 new workers.

As in other industries, many workers in the aviation factories were women. Although the women performed the same work as men in the factories, their wages were not as high as the men's salaries. Men still held most of the supervisory and managerial positions. The women were thought of as temporary substitute workers until the men returned home.

What is the Home Front? The Home Front refers to the people who stay in a country and work while that country's soldiers are fighting in a war in a foreign country.

#### **QUESTIONS:**

- 1. How many states comprise the United States today?
- 2. How many of these are contiguous? \*
- 3. Which states are not contiguous?
- 4. When did Hawaii enter the Union?
- 5. Was Hawaii considered to be the home front in 1941? Why or why not?

\*Contiguous means sharing an edge or a boundary; touching.

#### ANSWERS

- 1. 50 states
- 2. 48 states
- 3. Alaska and Hawaii
- 4. August 21, 1959, as the 50th state
- 5. In 1941, Hawaii was a territory, not a state.

## How Does an Airplane Fly?

For any airplane to fly, you must lift the weight of the airplane itself, the fuel, the passengers, and the cargo. There are four forces needed for flight: lift, gravity, thrust and drag. The wings generate most of the **lift** to hold the plane in the air. **Gravity** is a force that causes any object in the air to come back to the ground. With airplanes, gravity works against lift by pulling the airplane toward the ground. The airplane must be pushed or thrust forward through the air to generate lift. Without thrust, planes cannot produce lift. Most of the airplanes at our museum use propellers for thrust. Jet planes have engines located under the wing or in the fuselage, providing the thrust to push the airplane forward through the air. The air resists the forward motion in the form of **drag**.

There are many possible aircraft configurations (shapes), but all configurations must provide for the four forces needed for flight. Lift and thrust help to keep an airplane flying. Gravity and drag work against it. We can't do anything to change gravity, but we can try to minimize drag and increase lift and thrust.



To control and maneuver the aircraft, smaller wings are located at the tail of the plane. The tail usually has a fixed horizontal piece (called **the horizontal stabilizer**) and a fixed vertical piece (called the **vertical stabilizer**). The stabilizers' job is to provide stability for the aircraft, to keep it flying straight. The vertical stabilizer keeps the nose of the plane from swinging from side to side, while the horizontal stabilizer prevents an up-and-down motion of the nose.

At the rear of the wings and stabilizers are small moving sections attached to the fixed sections by hinges. The hinged part of the vertical stabilizer is called the **rudder**. The hinged part of the horizontal stabilizer is called the **elevator**; it is used to deflect the tail up and down.

The hinged part of the wing is called the **aileron**; it is used to roll the aircraft from side to side. The wings have additional hinged, rear sections near the body that are called **flaps**. Flaps are deployed downward on takeoff and landing to increase the amount of lift produced by the wing. The next time you fly on an airplane, notice how the wing shape changes during takeoff and landing. The **fuselage** or body of the airplane holds all the pieces together. The pilots sit in the cockpit on top of or at the front of the fuselage. Passengers and cargo are carried in the rear of the fuselage. Some aircraft carry fuel in the fuselage; others carry it in the wings.

The wings of the airplane produce lift because of **air pressure**. Air usually presses equally on all sides of an object. Notice that the wing is flat on the bottom and curved on the top. This shape is called an airfoil. Airfoils are specifically designed to produce lift.

**Bernoulli's Principle** (named after Swiss Physicist Daniel Bernoulli). When the moving propeller pulls the airplane forward, air starts moving over the surfaces of the wing, both on top and bottom. As the wind moves past the wing, the approaching air splits up when it hits the leading (front) edge of the wing and rejoins at the trailing (back) edge of the wing. The air pressure is reduced on the top of the wing because it is curved. This allows the pressure on the bottom to push the airplane up. The faster the airplane goes, the greater the difference in pressure between the bottom and the top of the wing. As the plane rises, there is less and less pressure on the top of the wing must move faster. When air speeds up, its pressure gets lower. Since the air pressure on the top of the wing is lower than the air pressure on the bottom of the wing, the wing produces lift.



**Propeller-Produced Thrust** For the forty years following the first flight of the Wright brothers, airplanes used internal combustion engines to turn **propellers** to generate thrust. Today, most general aviation or private airplanes are still powered by propellers and internal combustion engines, much like your automobile engine. The engine takes air from the surroundings, mixes it with fuel, burns the fuel to release the energy in the fuel, and uses the heated gas exhaust to move a piston that is attached to a crankshaft. In the automobile, the shaft is used to turn the wheels of the car. In an airplane, the shaft is connected to a propeller.

### A Beginner's Reference for Flight Terms

What is Lift?	Lift comes from air moving over the wings. The air under the wings pushes up more than the air on top of the wing pushes down. The pressure that is pushing the airplane up creates a force called lift in the upwards direction.
What is Thrust?	Thrust, caused by the airplane's engines, is the force that moves the airplane forward. If the plane did not move forward, the air would stop moving over and under the wings, the wings could not create lift and the plane would start falling back towards the ground.
What is Drag?	Drag is the force that tries to slow down a moving object. Airplanes are made to be aerodynamic or streamlined to reduce the amount of drag they feel. Drag is caused by air friction and is the force that opposes thrust.
What are two ways to reduce drag on an airplane?	<ul><li>(1) make sure the surface is structurally smooth (aerodynamic) and</li><li>(2) keep the airplane very clean.</li></ul>
What is Weight?	Weight is a force caused by gravity. An airplane's weight also pulls downward on it - directly opposite to the lift force that is pulling the airplane up. For level flight, lift and weight must balance each other out.
What is Gravity?	Gravity is the force that causes objects to fall to earth.
How does a propeller create thrust?	Propeller blades are shaped like wings - flat side to the back, curved side to the front. Changes in air pressure over this airfoil create thrust.
What is Bernoulli's Principle (Law)?	Moving air has lesser pressure than air that is not moving. Bernoulli's principle demonstrates lift as one of the forces of flight.

## **Rate the Aircraft**

This chart lists the specifications of five World War II fighter aircraft, one from each of five nations. Rate each of the aircraft on a scale of 1 (least effective) to 5 (most effective). Write the rating in the box to the left of each aircraft.

Base your rating on the effectiveness of the fighter aircraft on the following criteria:

- supports ground forces
- escorts bombers attacking enemy targets
- aerial combat with enemy fighters, "dog fighting"
- protects naval vessels
- attacks enemy land and naval targets

Rating	Aircraft	Туре	Crew	Maximum Speed in MPH	Maximum Range in Miles	Armaments (MG=Machine Gun) (C=Cannon)
	Messerschmitt Bf 109 (German)	Fighter	1	350	528	4 MG 1 C in nose
	Supermarine Spitfire (British)	Fighter	1	378	1,140	8 MG
	Mitsubishi A6M Zero (Japanese)	Fighter	1	331	1,200	2 MG 2 C
	North American P-51D Mustang (American)	Fighter	1	437	2,080 with Drop Tanks 1,306 without Tanks	6 MG
	YakovlevYak-3 (Russian)	Fighter	1	401	340	2 MG 1 C front

Explain the reasons for your ratings:

Note: Specifications for the planes vary according to the model. The specifications in this table were typical near the beginning of World War II.

### The Game of Naval Attack

The naval Battle of the Coral Sea in May 1942, combined with the Battle of Midway a month later, marked a turning point in the Allies' War against Japan. After Midway, the Japanese made no more advances; instead, they began a slow and steady retreat that ended with their unconditional surrender more than three years later.

The Coral Sea (May 7-8, 1942) and Midway (June 4, 1942) were historic in another way. These battles were the first in history in which the opposing ships never came within sight of each other. The battles were fought almost entirely by warplanes launched from American and Japanese aircraft carriers.

The game of Naval Attack is not unlike the battles of the Coral Sea and Midway as each player attempts to "sink" an enemy fleet without knowing where any of the "ships" are located.

<u>Materials needed</u>: 4 sheets of plain paper or graph paper; ruler, 2 pencils; copy machine, if available; and 2 players

- Step 1: On plain paper or graph paper, use a ruler and pencil to make a grid of 144 squares, 12 squares across and 12 squares down. If you are using plain paper, begin by drawing a 6-inch square. Mark dots every 1/2 inch on all four sides of the square, then connect the dots to form a perfect grid.
- Step 2: Write the letters A to L down the side of the grid, and the numbers 1 to 12 across the top.
- Step 3: Copy the grid on separate sheets so that each player has two copies. If you have access to a copy machine, you can run off multiple copies for future games.
- Step 4: For each player, label one sheet the Defense Grid and the other sheet the Attack Grid.
- Step 5: Each player has five ships, which are placed anywhere on the Defense Grid, making sure the opponent doesn't see those locations. The five ships are:
  - two aircraft carriers (shade in 4 squares for each);
  - one heavy cruiser (shade in 3 squares); and,
  - two destroyers (shade in 2 squares for each).

The ships can be placed horizontally, vertically, or diagonally.

Step 6: The goal of the game is to sink all your opponent's ships. By any method you wish, determine which player will attack first.

Player One fires a "shot" by calling out a square - "C-10," for example.

- Player Two checks his or her Defense Grid. If no part of a ship is on C-10, Player Two says, "It's a miss!" If the shot hits one of Player Two's ships, he or she then says, "It's a hit!" and marks an X on that square on the Defense Grid.
- Player One marks his or her Attack Grid for every shot fired, with a dot for a miss and an X for a hit.

	1	2	3	4	5	6	7 8	8 9	91	01	1	12
А												
В												
С												
D												
E												
F												
G												
Н												
Ι												
J												
Κ												
L												

- Step 7: Player One calls out 9 more shots the same way a total of 10 shots. A ship is sunk only when all its squares have been hit. A player who scores a hit, therefore, should concentrate the next shots in the same area until the ship is sunk. When a player's ship is sunk, the player announces, "It's a hit and one of my destroyers has been sunk!"
- Step 8: After Player One has fired 10 shots, it's Player Two's turn to attack with 10 shots.
- Step 9: Players continue taking turns. But, once a player has lost a ship, he or she fires two fewer shots in the next round for each ship lost. If a player has lost two ships, for example, his or her attack will consist of only 6 shots. If three ships have been lost, his or her next attack will consist of only 4 shots.
- Step 10: The battle is over when one player has sunk all his or her opponent's ships.

Ships participating at the Battle of the Coral Sea were the carriers *Yorktown* and *Lexington* along with their respective task force. Both *Lexington* and *Yorktown* were attacked by Japanese planes. *Yorktown* 

was hit once by a bomb, but it failed to impede the ability of the carrier to function. The *Lexington* was hit by torpedoes and bombs - one of which hit a supply of ammunition. At 12:47, the carrier was shaken by a huge internal explosion when fuel vapors were ignited. A series of other explosions occurred and by 15:00 'Lady Lex' was beyond help. At 16:30, the crew prepared to abandon ship. Various ships were called up to assist the evacuation which was disciplined and orderly - even the ship's dog was brought off. The ship's commander was the

Task Force 17	Task Force 11
<u>Yorktown</u> (carrier)	Lexington (carrier)
Astoria (heavy cruiser)	Minneapolis (heavy cruiser)
Chester (heavy cruiser)	New Orleans (heavy cruiser)
Portland (heavy cruiser)	
Hammann (destroyer)	Phelps (destroyer)
Anderson (destroyer)	Dewey (destroyer)
Russell (destroyer)	Farragut (destroyer)
Walke (destroyer)	Aylwin (destroyer)
Morris (destroyer)	Monaghan (destroyer)
Sims (destroyer)	

last to leave. The destroyer *Phelps* was ordered to finish off the *Lexington*, which it duly did with five torpedoes. The *Lexington* sank at 20:00.

Douglas Dauntless dive-bombers, Douglas TBD Devastator torpedo planes, and the Grumman F4F Wildcats made up the U.S. air strike force during the battle. The Japanese lost 43 planes to the Americans 33. The battle is seen as an American victory simply because it stopped Japan from doing what it had set out to do - capture Port Moresby and isolate Australia. In this sense, it was a strategic victory for America.

The Battle of Midway was to do the Japanese far more damage. Considered one of the most decisive battles of World War II, the Battle of Midway effectively destroyed Japan's naval strength when the Americans destroyed four of its aircraft carriers. Japan's navy never recovered from its mauling at Midway and it was on the defensive after this battle.

For additional information: The Battle of the Coral Sea 1942: The First Aircraft Carrier Battle in History - YouTube



The Battle of Midway 1942: Told from the Japanese Perspective https://youtu.be/Bd8\_vO5zrjo

## Gliders

**Military gliders** (similar to common gliders) have been used for carrying troops (glider infantry) and heavy equipment to a combat zone, mainly during the Second World War.

These aircraft have no engines. They were towed into the air and most of the way to their target by military transport planes. Troops landing by glider were called *airlanding* as opposed to paratroops. Landing by parachute caused the troops to be spread over a large drop-zone, but gliders could land troops and equipment at the precise target landing area. The glider was effectively silent and difficult for the enemy to identify. Larger gliders were developed to land heavy equipment like anti-tank guns, anti-aircraft guns, small vehicles, such as jeeps, and also light tanks.

By the time of the Korean War, helicopters had largely replaced gliders. Helicopters have the advantage of being able to extract soldiers, in addition to delivering them to the battlefield with more precision. After the widespread use of radar in the military, the silence of gliders is no longer sufficient for concealment.



While at the museum, view the Norman Sirota Glider exhibit in the European (Army) Hangar.



Part of the D-Day display talks about paratroopers, and there is half of a glider with paratroopers in it for display.



18 Fold & Fly Aeroplanes with Full Instructions

Visit the Palm Springs Air Museum Store in person or online at <u>https://palmspringsairmuseum.org/store/</u>. Many different gliders are available for purchase.



Military Jet Gliders

You will also find a Catapult Glider and a Retro Glider 4 Pack with Spinning Propellors. Not all gliders are always available. Check the Gift Shop website to see the latest gliders under the Toys/Games section.

Or, better yet, go to the next activity and build your own gliders.

## Let's Fly an Airplane

Download any of the free paper airplanes listed below and let's get flying!

#### http://www.foldnfly.com



Templates are available for easy planes such as The Basic, Basic Dart, and The Stable. Medium, Hard, and Expert templates are also available.

Just print out the template onto standard 8.5" X 11" printer paper. The fold and cut lines are clearly printed right onto the template, and each design has easy-to-follow instructions. You will need Adobe Reader to view these files. If you don't have Adobe, click on the link provided to download it free from the Adobe website.

Flying Tips to get the best performance out of your models are available on the website.

**Folding Technique** – The folding technique is very important for successful flights. Make each of the folds carefully and accurately according to the instructions. Creases should be made by applying pressure to the fold with the edge of your thumbnail. This is best achieved by holding your thumbnail on the fold, applying pressure, and pulling your thumb along the fold line toward you. This will produce clean, crisp folds that will allow for accurate paper planes. If you make a mistake on a fold that you cannot correct, don't be discouraged! Just print another template.

Line Types – There are two main types of lines referenced by the instructions: fold lines and cut lines. Fold lines are dashed and cut lines are dotted.

————— Fold Line

----- Cut Line

**Model Adjustments** – No matter what anyone tells you, EVERY paper airplane needs finetuning to achieve its best performance. There are several things you should keep in mind while adjusting your plane.

Dihedral – Dihedral is a slight upward tilt of the wing tips with respect to the fuselage or body of the airplane. This produces a slight V-shape to the wings when viewed from the front of the plane. Dihedral provides aerodynamic stability to your models by making them want to self-center during flight. Paper airplanes have no intelligent flight controls after they leave your hand, so the plane needs to be naturally stable or else it will crash. All designs on this site perform better when some dihedral is added to the wings.



**Elevator** – Elevator is the aeronautical term for the hinged flap at the tail section of a plane that causes it to either climb (gain altitude) or dive (lose altitude). In paper airplanes these flaps are generally located on the trailing edge of the wings themselves since there is rarely a separate tail. They are formed by making parallel cuts about 1 inch apart. This produces a small flap that can be folded slightly up or down. Tilting the elevator flaps up will cause the plane to climb. Tilting them down will make the plane want to dive. If you find that your models are heading nose-down toward the ground shortly after launch, you may need to add some up elevator. Likewise, if they are looping up too quickly or stalling, you may need to add some down elevator. Adding slightly more elevator to one wing than the other will cause the plane to either turn to the right or left.



### **Paper Airplane Contest – Data Sheet**

Step 1: Get together with up to 4 buddies. Each person in your group makes an airplane. Or, you can do this contest alone and make several different plane designs. Write your NAME and PLANE NUMBER on your airplane.

Step 2: Job Assignments for Group Experiment. Write your name and circle your job assignment.

Plane Number	Group Members (First Names)	Job Assignment Throw 1	Job Assignment Throw 2
1		Thrower Measurer Data Recorder	Thrower Measurer Data Recorder
2		Thrower Measurer Data Recorder	Thrower Measurer Data Recorder
3		Thrower Measurer Data Recorder	Thrower Measurer Data Recorder
4		Thrower Measurer Data Recorder	Thrower Measurer Data Recorder
5		Thrower Measurer Data Recorder	Thrower Measurer Data Recorder

Step 3: Make a Prediction. Which plane design do you think will fly the farthest?

Step 1. Conduct the Experiment. The wyour planes, and concer your data in the dole of w	Step 4:	Conduct the Experiment	. Throw your plan	nes, and collect your	data in the table below
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Plane Number	Throw 1: Distance in centimeters	Throw 2: Distance in centimeters
1		
2		
3		
4		
5		

Step 5: Analyze the Results. Compare the distance your plane flew to that of the other plane designs. Name two independent variables that you could change on your plane design that might make it fly farther.

## Mickey Mouse One – Walt Disney

Walt Disney acquired this iconic *Gulfstream* I (Grumman) in 1963. It would be known as *The Mouse*. The interior of the plane was initially designed with the creative input of both Walt Disney and his wife Lillian. It could seat up to 15 passengers and had a galley kitchen, two restrooms, two couches, a desk, and nods to the mouse who started it all. This included matchbooks and stationery that were adorned with a silhouette of Mickey Mouse. In 1967, Mickey's initials were included in the tail number of the plane as N234MM.

The plane was in the service of The Walt Disney Company for 28 years. During this



Mickey Mouse One is on display at the Palm Springs Air Museum.

time, it flew over 20,000 hours and transported approximately 83,000 passengers before being grounded.

The return of Walt's plane to the West Coast marks the first time it has been on this side of the country since it landed on World Drive in Orlando, Florida at Disney-MGM Studios on October 8, 1992. It stayed there until 2014 as a part of the Studio Backlot Tour.

The refurbishment of the outside of the plane and the cross-country move for the plane was made possible with the collaboration and support of Walt Disney Imagineering.

After a stop at D23 Expo 2022, Walt's Plane, also known as *The Mouse*, was moved to the Palm Springs Air Museum where it is now on display.

### **From Props to Jets**

When jets replaced propeller planes in the 1950s, it was considered a great leap forward in aviation. A jet engine reaches its maximum efficiency at speeds close to or even far faster than the speed of sound. On the other hand, the engines used for propellerpowered aircraft typically reach their maximum efficiency at far lower speeds and altitudes. This makes prop engines more fuel efficient than jet engines. They are also well suited for taking off from shorter runways. This is because thrust in these engines is created by torque rather than burning fuel.

A turboprop aircraft, which is short for turbo propeller aircraft, is a more recent invention than the jet. It uses a turbine engine to drive an aircraft propeller. Instead of relying on jet exhaust, a turboprop aircraft uses gas power to drive a propeller and generate thrust. Turboprop planes are most efficient at an altitude between 25,000 and 30,000 feet because they work best at a particular density of air and going higher makes it more difficult for turboprops to efficiently provide thrust.

The first turbojets were built by Frank Whittle in Britain and Hans von Ohain in Germany. In 1939, one of von Ohain's engines was used to power the Heinkel He 178, the first operational jet aircraft.



When did the US get their first jet? On October 1, 1942, the first US jet, the Bell P-59 Airacomet fighter, made its maiden flight. Ordered on September 4, 1941, this project was conducted under great secrecy, with General Electric producing the engine and Bell building the airplane itself.

The giant airships of the 1930s remain the largest aircraft ever constructed, while the Hughes H-4 "Spruce Goose" of 1947 had the largest wingspan of any fixed-wing type. The Hybrid Air Vehicles Airlander 10 hybrid airship is the largest aircraft flying today.

**Did You Know?** Jets & Props is a renowned airplane set and props studio. Located in North Hollywood, it has serviced both the motion picture and television industry for over twenty years. They offer realistic interior and exterior sets for filming. Jets & Prop delivers unparalleled airplane sets to the Hollywood community. Services also include transporting sets to studios like Warner Bros, Disney, Universal, Paramount, FOX, or the entire East Coast. Jets & Props offers stunning realism with which to tell a story.

### Planes of the Korean War at the Museum



Lockheed T-33 Shooting Star

This is the first jet plane a pilot flew before he/she was qualified to fly any other airplane. It was developed from the Lockheed P-80/F-80 by lengthening the fuselage and adding a second seat, instrumentation and flight controls. Some T-33s retain two machine guns for gunnery training. In some countries, the T-33 was even used as a combat aircraft.



**Grumman F9F Panther** 

The Panther is a jet fighter and ground attack aircraft used in the Korean War. Grumman's first jet fighter, it is one of the U.S. Navy's first successful carrier-based jets. Future astronaut Neil Armstrong flew the F9F extensively in Korea as did Astronaut John Glenn and Red Socks baseball player Ted Williams. From 1949 to late 1954, the Panther was the first jet aircraft used by the flying team, the Blue Angels.



#### North American F-86 Sabre Jet

The Sabre Jet is the primary air-to-air jet fighter used by the Americans in the Korean War. Its major adversary in high-speed dogfights was the Soviet MiG-15. Both countries introduced the swept-wing fighter design. The MiG can outclimb the Sabre at a high altitude whereas the F-86 is faster at a lower level. 9,860 F-86 Sabres were built.



Mikoyan-Gurevich MiG-15

The MiG is a single-seat, single-engine Soviet jet fighter first flown in 1947. Soviet MiG-15 squadrons operated in big groups, but the basic formation was a six-aircraft group, divided into three pairs, each composed of a leader and a wingman. The main mission of the MiG-15 was not to dogfight the F-86 but to counter the USAF's Boeing B-29 bombers.





#### North American F-100 Super Sabre

The F-100 was originally designed as a higher performance follow-on to the F-86 Sabre air superiority fighter. This first supersonic jet fighter served with the US Air Force from 1954 to 1971. It holds a crew of one and has a 17,000-pound thrust afterburning turbojet engine. Maximum speed at 35,000 feet is 864 mph (Mach 1.3). Its ceiling is 46,000 feet with a range of 600 miles.

#### **Grumman A-6 Intruder**

This American twin jet engine, mid-wing attack aircraft was built by Grumman Aerospace. In service between 1963 and 1997, the Intruder was designed as an all- weather replacement for the piston-engined A-1 Skyraider medium attack aircraft. The A-6 was slated for retirement when its precision strike mission was taken over by the Grumman F-14 Tomcat.



#### **Bell 47 Helicopter**

The Bell 47 Helicopter is a two-bladed, singleengine, light helicopter. The H-13 Sioux was the Army's designation, and throughout the course of the Korean War, it operated as a reconnaissance helicopter, as well as a search and rescue (SAR) helicopter and medevac. It has a maximum speed of 105 mph and a cruise speed of 84 mph. The rate of climb is 860 feet per minute.



#### Sikorsky H-34 Helicopter

The Sikorsky H-34 is a piston-engined military helicopter. It first flew on March 8, 1954, as an anti-submarine warfare aircraft for the US Navy. The Army and Marine Corp. ordered it in 1955 and 1957. The Army also called it Choctaw.

## The Speed of Sound

The **speed of sound** is about 761 mph on a standard day at sea level. **Mach I** is the same as the speed of sound. Mach 10 would be flying at 10 times the speed of sound. **Supersonic planes**, by definition, travel faster than the speed of sound.

A **sonic boom** is the noise created by an aircraft or some other object when it surpasses the speed of sound. Sonic booms are typically 110 decibels, about as loud as thunder or an explosion.

Pilots don't hear sonic booms. They can see the pressure waves around the plane, but people on board the airplane can't hear the sonic boom. Like the wake of a ship, the boom carpet unrolls behind the airplane.

The **Concorde** was a supersonic passenger-carrying commercial airplane. Built in the 1960s as part of a joint venture between the United Kingdom and France, the Concorde was the first commercial aircraft of its kind. Only 14 Concorde aircraft went into service before it was retired by both countries in 2003.

In the 1950s and '60s, Americans citizens filed some 40,000 claims against the Air Force, whose supersonic jets were making sonic boom noise over land. Then in 1973, the FAA banned overland supersonic commercial flights because of sonic booms—a prohibition that remains in effect today.

NASA is aiming to end the 50-year ban on civilian supersonic aircraft over land in the United States. If the ban is lifted, new commercial cargo and passenger markets would open up, dramatically reducing travel time. The goal of NASA's Quesst mission is designing and building NASA's X-59 research aircraft with technology that reduces the loudness of a sonic boom. Instead of hearing a sonic boom, people would hear sonic "thumps", if anything at all. The goal is for updated standards that focus on the sound an aircraft creates, rather than a speed limit. The supersonic aircraft is designed to fly Mach 1.4. In comparison, a typical commercial jet flies around 460-575 mph.

Supersonic airliners are still being developed. Boom Supersonic's **Overture Jet** is expected to travel with a cruising speed of 1,227 mph. Key details were revealed at the 2023 Paris Air Show, including engine milestones, supplier partners, advances on its Symphony engine, sustainable aviation fuel (SAF) compatibility, triple-redundant hydraulics, and landing gear compatibility on over 600 routes worldwide.



#### North American T-28 Trojan

This piston-engine military trainer aircraft was used beginning in the 1950s. It replaced the T-6 Texan trainers. It was also a counterinsurgency (COIN) aircraft, primarily during the Vietnam War. The max speed is 343 mph, with a range of 1,060 miles and a ceiling of 35,500 ft. 2,232 were built.



#### **Convair F-102 Delta Dagger**

Known as the DEUCE, the F-102 delta-wing interceptor served in Vietnam flying fighter patrols and serving as bomber escorts. George W. Bush flew the F-102 as part of his Texas Air National Guard service from 1968 to 1972. The max. speed is 825 mph with a ceiling of 55,000 ft. 1,000 were built.



**Douglas A-4 Skyhawk** (Aggressor colors)

The A-4 Skyhawk is a light attack and ground support aircraft with a turbojet engine. This subsonic aircraft is known for striking accuracy against ground targets. 2,096 were built over 25 years. It has a cantilever low wing with a stubby fuselage and a large vertical tail. Max speed is 673 mph with a ceiling of just over 40,000 ft. John McCain was shot down flying this type of aircraft in 1967, taken prisoner, and not released until 1973.



#### Lockheed F-104G Starfighter

The supersonic F-104G at PSAM is a "tribute aircraft" to all the units that flew it in Vietnam. It has a thin, straight, mid-mounted, trapezoidal wing that required fuel tanks and landing gear to be placed in the fuselage. 2,578 were built. It has a max speed of 1,328 mph and a ceiling of 50,000 ft. The museum's Starfighter was built by Fokker Aircraft in the Netherlands.



#### **Republic F-105D Thunderchief**

The U.S. Air Force used this supersonic, fighterbomber aircraft for strike-bomber missions during the early years of the Vietnam War. It is the largest ever single-seat, single-engine combat aircraft, weighing 50,000 lbs. It can reach Mach 2 at high altitudes although it was designed for its low-altitude Mach 1 speed, an asset when dealing with enemy aircraft.



#### **Convair F-106 Delta Dart**

This all-weather, missile-armed interceptor of the Air Force from 1959 through 1988 replaced the F-102 Delta Dagger. Rather than its official Delta Dart name, the aircraft was known as "The Six." Designed without a gun or provision for carrying bombs, its missiles were carried in an internal weapons bay for clean supersonic flights. The Delta Dart has a max. speed of 1,525 mph and a ceiling of 53,000 ft.



McDonnell-Douglas F-4B "Phantom II"

The F-4 Phantom II is a two-seat, twin-engine, all-weather, long-range supersonic interceptor fighter bomber. It was used extensively by all the services during the Vietnam War, serving as the principal air superiority fighter and in ground attack and reconnaissance roles. Max speed of 1,485 and ceiling of 62,50 ft. Over 5,000 were built in its 35-year service.



Ling-Temco Voight A-7 Corsair II

To support troops in South Vietnam, a subsonic, close air support fixed-wing aircraft was needed. The A-7D was a version of the Corsair II that included a computerized navigation weapons delivery system with radar and a headup display. The A-7s speed of 690 mph at sea level was detrimental for escorting the helicopters but its high endurance and durability were an asset. Ceiling of 42,000 ft.

### Helicopters

In 1952, the U.S. Army identified a requirement for a new helicopter. Current helicopters were too large, underpowered, or too complex to maintain easily. The **Bell UH-1 Iroquois** (nicknamed "**Huey**") is a utility military helicopter designed and produced by the American aerospace company Bell Helicopter. It is the first member of the prolific Huey family, as well as the first turbine-powered helicopter in service with the United States military.



Bell UH-1 Iroquois

The Iroquois was first used in combat operations during the Vietnam War, beginning in March 1962. It was used for various purposes, including conducting general support, air assault, cargo transport, aeromedical evacuation, search and rescue, electronic warfare, and ground attack missions. Armed Iroquois gunships carried a variety of weapons, including rockets, grenade launchers, and machine guns, and were often modified in the field to suit specific operations. In total, around 7,000 Iroquois were deployed in the Vietnam theatre, over 3,300 of which were believed to be destroyed.

**Bell AH-1 Huey Cobra** is a single-engine attack helicopter. It has a metal fuselage with tubular landing skids and two rotor blades on the main rotor. During its Vietnam War



AH-1 Huey Cobra - Bell

service, AH-1s tasked with ground attacks or armed escorts were outfitted with rocket launchers, grenade launchers, and machine guns. AH-1 is also referred to as Huey Cobra or Snake. They were in use by the Army during the Tet Offensive in 1968 through the end of the Vietnam War. Huey Cobras provided fire support for ground forces, escorted transport helicopters, and other roles.

Helicopter Craft: This website has easy helicopter crafts for kids to play with and discover the beginnings of flight. <u>https://www.momsandcrafters.com/helicopter</u>



## Words Are Words, but What Do They Mean?

**medevac** – medical evacuation, referred to as medevac, is the timely and efficient and enroute emergency care provided by medical personnel to wounded being evacuated from the battlefield to a treatment facility. Helicopters used for this procedure are often called medevacs.

**reconnaissance** – observation of a region by military aircraft to gain information, locate an enemy, or to view certain strategic features of an area. This is generally done by surveillance aircraft. They usually carry no or very little defensive armament. Lockheed Martin's U-2 spy plane is the go-to-jet for high altitude reconnaissance. U-2s have been around since the 1950s.

**piston** – a short tube that moves back and forth inside a cylinder. It is used in internal combustion engines to drive motion. Pistons are commonly found in gasoline/diesel engines, pumps and compressors. Piston airplanes have one or more piston-powered engines connected to a propellor to provide thrust to move the aircraft along the ground and through the air. Piston powered aircraft commonly use 100 octane low-leaded fuel and fly at altitudes below 15,000 feet for 300 miles or less. Turboprops tend to fly larger aircraft and fly distances up to 1,000 miles.

**thrust** – push something suddenly or violently in the specified direction. It can mean the propulsive force of a jet or rocket engine.

**Soviet** – a citizen of the former Soviet Union. The Soviet Union, officially the Union of Soviet Socialist Republics (USSR) was a transcontinental country that spanned much of Eurasia from 1922 to 1991. During the collapse of the former Soviet Union, the republic's official name was changed to the Russian Federation, which it remains to this day.

**Korean War** – The Korean War was fought between North Korea and South Korea from 1950 to 1953. The northern zone received support from the Soviet Union and intervention from China while the southern zone received support and intervention from the United States led United Nations (UN) forces. Communist countries and capitalist countries around the world went against each other. Some 1,780,000 American served in the war with 37,574 killed, 103,284 wounded, and over 7,100 prisoners of war. The aftermath of the war set the tone for Cold War tensions between all the superpowers. The Korean War was the first war in which the United Nations became a powerful organization for helping to keep world peace.

## **Military Dog Tags**

As early as the American Civil War, name tags came into use so that the wounded or killed could be identified. By the outbreak of World War II, the practice had been adopted for all members of the U.S. armed forces. Nicknamed "dog tags" because of their resemblance to similar dog IDs, the version issued to American military personnel came in pairs.

In the event of death, one of the tags is buried with the individual and the other goes with the paperwork of the deceased. Typically, the standard military dog tags contain all the information to identify a soldier and provide emergency information.



Follow this format to create your own dog tag:

1st line, Last Name

On the 2nd line, First Name/Middle Initial

On the 3rd line, Service Number (Social Security Number)

On the 4th line, Bloodtype

On the 5th line, Religious Preference

The main purpose of the military dog tags is to identify soldiers who are wounded or killed while they are in action. These dog tags are allotted to the soldiers as a replacement of the plastic printed identity cards because of their resistance to harsh weather conditions and durability.

The Department of the Army has developed and is currently testing a new tag, which will hold 80% of a soldier's medical and dental data on a microchip. Known as the Individually Carried Record (ICR), it is not intended to replace the present tag, but rather to augment it as part of the "paperless battlefield" concept. This development is in keeping with the Army's dedication to positively identifying each and every fallen soldier. The yellow TacMedCS being tested by the Marines uses radio frequency technology, electronics, and global-positioning systems to pinpoint wounded.

## The Vietnam War and Beyond

Please note: The following description does not do service to the heroism and the sacrifice endured by members of our military service. It is designed to provide a snapshot of the war.

The Vietnam War was a conflict that occurred in Vietnam, Laos, and Cambodia from November 1, 1955 to the fall of Saigon on April 30, 1975. It was fought between North Vietnam—supported by communist allies such as the Soviet Union and China—and the government of South Vietnam—supported by the United States and other anticommunist allies. The Vietnam War was caused by several factors including the spread of communism in Southeast Asia, the policy of containment, and the desire of North Vietnam to unify Vietnam under communist rule. During the war, more than 58,000 U.S. military members lost their lives and 153,000 were wounded. There were 766 prisoners of war, 114 of whom died in captivity. President Richard M. Nixon officially ended the war by presidential proclamation on May 7, 1975.



TOP GUN Patch

### **TOP GUN**

During the first half of the Vietnam War, the US Navy was suffering unacceptable losses. Navy F-4s had a kill ratio of 2:1 against North Vietnamese MiG Fighters, far below the ratios in WW II and Korea. An investigation highlighted many performance deficiencies and their root causes. With the introduction of air-to-air missiles, the art of "dog-fighting" had been lost. The result was the Navy Fighter Weapons School in March of 1969, also known as TOP GUN. The school's mission

was, and is, to train fighter aircrews in all aspects of fighter weapons systems. More than 2000 pilots and weapons systems officers have graduated from TOP GUN, receiving the coveted TOP GUN patch.

Tom Cruise, being the action star, flew his own P-51 Mustang fighter jet in the climax scene of Top Gun: Maverick.

**Project: Design a Patch** If you were to oversee a tactical weapons system, what would you name it? Design a patch for the members of your crew to wear.

A Beginner's Guide ★  $\star$  $\star$  $\star$  $\star$  $\star$  $\star$   $\star$   $\star$  Palm Springs Air Museum  $\rightarrow$ **.**, + $\rightarrow$ ÷.  $\rightarrow$ +++

Please note: The following descriptions do not do service to the heroism and the sacrifice endured by members of our military service. They are designed to provide a snapshot of each conflict.

### The Cold War

The Cold War was a period of geopolitical tension between the United States and the Soviet Union and their respective allies, the Western Bloc and the Eastern Bloc. It began in 1947 and ended in 1991. The term "cold war" is used because there was no large-scale fighting directly between the two superpowers, but they each supported opposing sides in major regional conflicts known as proxy wars. The conflict was based on the ideological and geopolitical struggle for global influence by these two superpowers. A **proxy war** is one supported by major powers which don't themselves engage in combat. During the Cold War, both the USA and USSR engaged in proxy wars and international conflicts to support their political ideology. In the 1980s and early 1990s, Afghanistan was a proxy battleground for the Cold War between the United States and the Soviet Union.

### **Gulf War and Iraq War**

The Gulf War (Desert Strom) was largely fought from the air and sea, and by tank while the Iraq War was an infantry war, with very different tactics. While the first Gulf War was over in 42 days, the Iraq War lasted for almost a decade. The Iraq War was a protracted armed conflict in Iraq that lasted from 2003 to 2011. It began with the occupation of Iraq by the United States-led coalition that overthrew the government of President Saddam Hussein in April 2003. The United States based most of its rationale for the invasion on claims that Iraq had weapons of mass destruction (WMD) program and posed a threat to the United States and its allies. The Iraq War is considered a *domino effect* of the subsequent War in Iraq (2013–2017).

### The Afghanistan War

On September 11, 2001, al-Qaeda terrorists attacked the United States. They were able to plan and execute such an attack because their Taliban hosts had given them a safe haven in Afghanistan. The United States went to Afghanistan in 2001 to prevent Afghanistan from becoming a safe haven or sanctuary for al-Qaeda, and to make sure al-Qaeda was not there in Afghanistan, and, therefore, a destabilizing force in the region. The Taliban surged back to power two decades after U.S.-led forces toppled their regime in what led to the United States' longest war. The U.S. hastily withdrew troops on September 11, 2021. Facing little resistance, Taliban fighters overran the capital, Kabul, and took over the presidential palace. The takeover followed the Taliban's rapid advance, during which they captured all but two of Afghanistan's provincial capitals and seized border crossings.



#### Northrup Grumman EA-6B Prowler

The EA-6B is a twin-engine, mid-wing electronic warfare aircraft derived from the A-6 Intruder airframe. It carries a crew of four (one pilot, three electronic countermeasure officers). It is the US's only dedicated radar jammer aircraft. The max speed is 651 mp with a cruise speed of 481 mph and a ceiling of 37,600 ft. The EA-6B has been flown in almost every American combat operation since 1972.



#### **Grumman F-14A Tomcat**

The F-14 is a supersonic variable wing, twoseater, twin-engine aircraft. The Navy's premier shipboard fighter of the post-Vietnam era was made famous in the film *Top Gun*. It has a max speed of 1,544 mph (Mach 2.34) with a ceiling of 56,000 ft. (over 9 miles). This nonflying example, loaned by the Navy to Palm Springs Air Museum in December, 1996, was flown in the Gulf War in 1991.



#### **General Dynamics F-16 Fighting Falcon**

The F-16 was designed as a lightweight fighter, it evolved into a successful multirole fighter. The max speed is 1,350 mph (Mach 2.05 at 40,000 ft.) with a ceiling over 50,000 ft. The Falcon's versatility has proven a success on the export market, having been selected to serve in the air forces of 25 countries. The U.S. will provide Ukraine with Mid-Life Updates (MLU) F-16s that will combine with NATO's ground-based airdefense radars, such as the Patriot.



#### **McDonnell Douglas F-18 Hornet**

This all-weather carrier-capable multirole fighter was designed to attack both ground and aerial targets. Its primary missions are fighter escort, fleet air defense, suppression of enemy air defenses (SEAD), interdiction, close air support and reconnaissance. The Hornet is used by the air forces of several other nations. It has been the aerial demonstration aircraft for the U.S. Navy's Blue Angels since 1986.

## Lockheed F-117A Nighthawk

The F-117A Nighthawk is a semi-retired American single-seat stealth attack aircraft that was developed after the Vietnam War by Lockheed's secretive Skunk Works division under the code name "Have Blue." The F-117, operated by the United States Air Force (USAF), was a black project, an ultra-secret program for much of its life.

**Stealth aircraft** are designed to avoid detection using a variety of technologies that reduce reflection/emission of radar, infrared, visible light, radio frequency (RF) spectrum, and audio, collectively known as stealth technology

The F-117A was one of the first aircraft to be designed around stealth technology. It is shaped to deflect radar signals with its multifaceted-angle surfaces that provide a significant reduction in its radar signature. While no aircraft is totally invisible to radar, stealth aircraft make it more difficult for conventional radar to detect or track the aircraft effectively, increasing the odds of an aircraft avoiding detection by enemy radar and/or avoiding being successfully targeted by radar guided weapons. To do this, it is necessary to reduce thermal infra-red emissions from the engine and its exhaust wake and reduce radar reflections from the airframe using radar-absorbent materials (RAM) or radar-transparent materials such as plastics. It is also necessary to reduce radar detection from exposed internal surfaces such as the cockpit, weapons bay, and engine intake ducting.



QR Code for the F-117A Nighthawk "Black Devil" on display at the Palm Springs Air Museum

The F-117A has a max speed of 684 mph, a range of 1070 miles and ceiling of 45,000 ft. The cockpit is quite spacious, with ergonomic display and controls, but the field of view is somewhat obstructed with a large blind spot to the rear. Stealth aircraft are still vulnerable to detection while and immediately after using their weaponry.

The Nighthawk's pilots called themselves "Bandits." Each of the 558 Air Force Pilots who have flown the F-117 has a Bandit number, such as "Bandit 52," that indicates the sequential order of their first flight in the F-117. Because the aircraft was so

secretive, pilots told friends and families that they flew the Northrup F-5 in aggressor squadrons against Tactical Air Command.

During the Gulf War in 1991, the F-117 flew approximately 1,300 sorties and scored direct hits on 1,600 high value targets in Iraq over 6,905 flight hours. That was 43 nights of sorties with zero losses or damage to an F-117 aircraft. The F-117 repeatedly flew through intense anti-aircraft artillery and surface to air missile fire. The 37<sup>th</sup> Tactical Fighter Wing flying F-117As compiled a record that is unparalleled in air warfare.

### **Become Invisible**

Ever wish you could become invisible? Invisibility cloaks are very rare, but Harry Potter received one for Christmas in his first year at Hogwarts School of Witchcraft and Wizardry. The cloak was originally the property of Harry's father and was given to Harry by Professor Dumbledore.

But how do you make something as large as a stealth fighter plane invisible? To become invisible, an object must do two things: it must be able to bend light around itself, so that it casts no shadow, and it must produce no reflection.

The F-117 Nighthawk was developed in response to the need for a jet fighter that could

operate completely undetected by the enemy. The F-117's unique design enabled it to reflect radar waves. With its angular panels bolstered by an external coating of radar-absorbent material, <u>the</u> <u>aircraft was nearly invisible to</u> <u>radar</u>.

The F-117 was based on the Have Blue technology demonstrator. The Nighthawk's maiden flight took place in 1981 at Groom Lake, Nevada, and the aircraft achieved initial operating



capability status in 1983. The F-117 was not revealed publicly until April 1990, four months after its combat debut in the Panama invasion.

The F-prefix in F-117 suggests it operates like a fighter jet, but in truth, it is an attack aircraft-meaning its official designation should have been A-117 instead. The F-117 was widely publicized for its role in the Gulf War of 1991. It took part in the conflict in Yugoslavia where one was shot down by a surface-to-air-missile (SAM). The U.S. Air Force retired the F-117 in April 2008, although a portion of the fleet has been kept in airworthy condition.

**PROJECT:** You may not be able to make yourself invisible, but you can make invisible ink. <u>https://www.nationalarchives.gov.uk/education/families/celebrating-british-science-week/how-to-make-invisible-ink/invisible-ink-recipe/</u>

### What is Next for Aviators?

Why has the U.S. opted for a "blast from the past" attack aircraft? While the United States military has largely shifted its focus away from the Global War on Terror and back toward deterring near-peer competitors like China and Russia, American troops continue to support counter-extremist operations and partner forces the world over.

These operations often take place in remote environments well removed from American air bases and the infrastructure required to support many of America's more advanced aircraft. This is where the AT-802U Sky Warden from



AT-802U Sky Warden

L3Harris Technologies comes in. This low-cost platform is based on the Air Tractor AT-802 that is used for crop dusting and firefighting. It can take off and land on small airstrips and fly without much logistical support. The Sky Warden contract will provide at least 75 prop-driven platforms to U.S. Special Operations Command (SOCOM) to serve in air support, armed reconnaissance, and strike roles.

The Sky Warden may *look* like a World War II plane, but it is quite sophisticated. According to L3 Harris, the AT-802U Sky Warden offers a "robust suite of radios and datalinks" to provide multiple means of line-of-sight and beyond-line-of-sight communications, as well as the ability to carry a variety of specialized sensors, including Electro-Optical/Infra-Red and Intelligence, Surveillance, and Reconnaissance (ISR) suites, making it well suited to support special operations in the field.

The Palm Springs Air Museum does not own a Sky Warden. We can only imagine what their next state-of-the-art airplane will be. Perhaps, it will be one of your designs.

**Project**: What would a modern propeller fighter plane look like? Draw your version of this modern propeller fighter plane and explain the features it will have, such as miles per hour (mph), speed, ceiling, armament, number of propellors and engines, mission.

Here is what the ChatGPT AI bot says about this project: A modern propeller fighter plane would likely have a sleek, aerodynamic design with advanced technology such as radar-evading materials and high-powered engines. It would likely have a combination of traditional propellors and jet propulsion for increased speed and maneuverability. Additionally, it would likely have state-of-the-art avionics and weapons systems for increased effectiveness in combat.

### Learn to Fly

Now that you have learned a lot about planes, are you ready to learn to fly? There is technically no age limit before you can begin taking flying lessons. The main restrictions is you must be at least 16 years old before being allowed to take a solo flight and 17 years old before you can obtain a private pilot's license. There's nothing stopping you, and the younger you start the more competent an aviator you'll eventually become!



Cessna 152

What is the easiest plane to fly? The Cessna 150/152 is a good plane for beginner pilots. It is easy to handle, and it is comfortable and roomy.

The FAA requires 40 hours, but most people complete 60-75 hours of training. Depending on how many hours you spend in flight school training, you could spend \$8,000-\$12,000. That's because it costs \$100 an hour to rent a plane.

Training typically takes six to 12 months with a minimum of 40 logged flying hours. Private pilots learn to maneuver a single-engine airplane without assistance from a flight instructor.

The following website has a detailed description of the steps for learning how to fly:

Seven Steps to Beginning to Fly https://leaviation.com/7-steps-to-flight-2/



**Flight Schools** In your browser, type in "Flight Schools near me" Try "Coachella Valley, California" for a list of local flight schools or type in the name of the community where you live.



While on the 2nd floor of the Palm Springs Air Museum, test your skills with one of the flight simulators. Docents are available to help you learn the basics of flying your own plane.

### **Inspiration One**

#### Ronald M. Auen Learning Center First Flight Experience Palm Springs Air Museum

**Who can participate?** Local youth 12 to 17 years of age with a serious interest in becoming a pilot or to be in a program on a flight track.

**When** Five individuals will be selected in the active program months. There is a high demand to participate in the program and space is limited.

#### **The Experience**

- Each aspiring pilot will receive an introduction to the Palm Springs Air Museum and receive a *First Flight* shirt and flight log.
- Next, participants will be introduced to the Cessna 182 Skylane, Inspiration One, and the pilot.
- Then they will board, taxi and take off for an approximately 30-minute flight next to the pilot.
- After landing, participants will receive a certificate commemorating their flight.



Cessna 180 Skyland

### **Young Science Professionals Scholarship**

The Young Science Professionals Scholarship Fund was created to provide technical career-minded individuals the opportunity to develop professionally, civically, and socially. The Palm Springs Air Museum Scholarship Fund Committee selects the scholarship recipient.

#### In order to apply for this scholarship, a candidate must:

- Be a full-time undergraduate or graduate student currently applied/attending a fouryear college.
- Be 18-years of age or older.
- Have a grade point average of 3.0 or better (on a 4.0 scale).
- Have verifiable volunteer experience within the past two years.
- Have membership and/or leadership experience in campus or professional Organizations.
- Complete an application and include a one-page essay explaining how you envision your involvement in the Sciences or Aerospace.

Interested? To access this page and the Application Guidelines for the Young Science Professional Scholarship Fund (YSPSF), scan the barcode below or log on to the website of the Palm Springs Air Museum and pull down the Education tab. You can also view the 2023 YSPSF recipients.



Young Science Professionals Scholarship Fund



## **Living History – Conduct an Oral History**

By asking people questions, you can learn a lot of information. To learn more about the role of citizens in the armed services, interview a member of the U.S. armed services who is currently serving or who has served in the past.

Before the interview, do some research. What are the different branches of the armed services? What is meant by the term "rank"? What ranks are found in the different services? What is the difference between commissioned officers and enlisted personnel?

Plan some sample questions, such as:

- In which branch of the armed services did you serve?
- What dates did you serve? Where did you serve?
- What was your job?
- Why did you join the armed services?
- What were some of your experiences in the armed services?

Here are some suggestions for planning, conducting, and reporting on your interview:

Before the Interview:

- 1. Write, telephone, or email the person.
- 2. Tell him or her who you are and why you would like an interview.
- 3. Ask the person to set a time and place to meet.
- 4. Make a complete list of questions to ask during your interview. Try to think of questions that will lead to interesting answers.

During the Interview:

- 1. Listen carefully. Make eye contact. Look interested. Do not interrupt the person.
- 2. Take notes as you talk with the person. If you want to use an audio recorder or video recording, ask the person first.
- 3. Read back or review with the person all the answers you have recorded. In that way, you make sure your answers are accurate and acceptable to your guest.

After the Interview:

- 1. Before you leave, thank the person.
- 2. Follow up by writing a thank-you note or making a call.
- 3. Summarize the major ideas from your interview.

## Hangars of the Palm Springs Air Museum

#### **Robert J. Pond PACIFIC (NAVY) HANGAR**

This Hangar includes exhibits and aircraft used by the Navy in the Pacific Theater during World War II. Highlights include the Pearl Harbor diorama narrated by NBC journalist and author Tom Brokaw, the Grumman "cats"; the Avenger, Corsair, Dauntless, and Invader. The PBY Catalina Flying Boat is usually on the Tarmac. Ship models, uniforms, and weapon display cabinets complement the large wall Pacific Map and the aviation art by Stan Stokes and Robert Taylor.

#### **Donald and Peggy Cravens EUROPEAN (ARMY) HANGAR**

This Hangar features aircraft used by the Army in the European Theater during World War II. Highlights of this hangar include the B-25 Mitchell Bomber, P-47 Thunderbolt, P40 Warhawk, the flying Red Tail P-51 Mustang, P-63 King Cobra, and Spitfire. Other highlights include the Tuskegee Airmen mural, the large wall European Map, the Women in Aviation exhibit, and the Norman Sirota Gliders.

#### Thomas L. Phillips B-17 HANGAR

This Hangar includes exhibits regarding the B-17, including housing our B-17G "Miss Angela," which visitors can tour. Highlights also include the Berger Youth Exploration Center with fun, interactive activities for young people, F-16 Flight Simulator, and the Gen. Ken Miles Aviation Science Center. Visitors can grab a bite at the Victory Canteen.

#### General Ken Miles KOREA & VIETNAM HANGAR

This Hangar includes exhibits and aircraft used during the Korean and Vietnam wars. Highlights include the Korean War Remembrance Wall, Edward and Mona Sher POW Bracelet exhibit, Presidential Experience Display (including Ken Marts' "Presidents Who Served" display), and the Frederick Noble Engine Display. This hangar hosts our Saturday Programs and is the primary hangar used for events.

#### Jim Houston F-117A HANGAR

This state-of-the-art Hangar houses our brand-new F-117A Nighthawk "Black Devil." The hangar also houses numerous displays centered around the F-117A and the War on Terror, including the "History of the Skunkworks" mural by Stan Stokes, Global War on Terror (GWOT) Timeline, GWOT memorial brick display, "Brotherhood of Stealth" display, and the F-117A cutaway.