Private Pilot (ASEL) Ground School Course

Lesson 01 | Introduction Into Aviation

Course Overview

Course Objectives:

- Obtain the knowledge necessary for the Private Pilot – Airplane Knowledge Exam (PAR) and to be a knowledgeable airman.

Course Completion Standards:

- Students will demonstrate satisfactory knowledge of the knowledge areas necessary for the Private Pilot – Airplane Knowledge Exam (PAR).
- Students will meet minimum grading requirements.

Lesson Overview

Lesson Objectives:

- Introduce student into the ground training course and training process.
- Increase the student's understanding of the FAA's role in the certification process.
- Develop an understanding of the major components and structure of an airplane.
- Develop an understanding of how an airplane can fly.

Lesson Completion Standards:

- Student is aware of the training process and outcomes by obtaining a course enrollment certificate.
- Student demonstrates satisfactory knowledge of airplane construction and basic lift theory by answering questions and actively participating in classroom discussions.

Course Elements

- This course is designed to teach you how to be a knowledgeable pilot.
- The ultimate goal is to take the FAA Private Pilot Airplane (PAR) knowledge exam.
- OR to become a more knowledgeable pilot.

Course Elements

- This course is comprised of two (2) stages and 30 lessons.
- A Quiz is a multiple-choice written knowledge exam designed to measure a student's progress towards the completion of a stage. The minimum passing score is 70%.
- The Mid-Term Exam is a 60-question multiple-choice written exam designed to validate a student's learning during Stage 1. The minimum passing score is 70%.
- The Final Exam is a 60-question multiple-choice written exam designed to validate a student's learning throughout the entire course. The minimum passing score is 80%.

Syllabus Review

Stage	Lesson	Lesson Title	Total Training Time
1	1	Introduction Into Aviation	2.0 Hours
1	2	Aerodynamics of Flight - Lift and Stability	2.0 Hours
1	3	Aerodynamics of Flight - Stalls and the Propeller	2.0 Hours
1	4	Aircraft Flight Control and Systems - Flight Controls, Electrical, and Hydraulic	2.0 Hours
1	5	Aircraft Flight Control and Systems - Powerplant	2.0 Hours
1	6	Aircraft Flight Control and Systems - Fuel and Engine Controls	2.0 Hours
1	7	Aircraft Flight Instruments - Pitot-Static	2.0 Hours
1	8	Aircraft Flight Instruments - Gyroscopic, Compass, and Modern Avionics	2.0 Hours
1	9	Aircraft Documents and Maintenance (*Quiz*)	2.0 Hours
1	10	Weight and Balance	2.0 Hours
1	11	Aircraft Performance Charts	2.0 Hours
1	12	Airport Operations - Data, Signs, Markings, and Lighting	2.0 Hours
1	13	Airport Operations - Traffic Pattern and ATC Communication	2.0 Hours
1	14	Federal Aviation Regulations (FARs) / AIM	2.0 Hours
1	15	Mid-Term Exam	2.0 Hours
2	16	Weather Theory - Structure and Global Wind Patterns	2.0 Hours
2	17	Weather Theory - Stability and Saturation	2.0 Hours
2	18	Weather Theory - Air Masses and Hazards	2.0 Hours
2	19	Weather Products	2.0 Hours
2	20	National Airspace System	2.0 Hours
2	21	Sectional Charts and Associated Publications	2.0 Hours
2	22	Electronic (VOR) Navigation	2.0 Hours
2	23	Electronic (GPS) and Visual Navigation	2.0 Hours
2	24	Cross-Country Flight Planning (*Quiz*)	2.0 Hours
2	25	Night Flying	2.0 Hours
2	26	Aeronautical Decision Making (ADM)	2.0 Hours
2	27	Aeromedical and Human Factors	2.0 Hours
2	28	FAA Knowledge Exam Prep	2.0 Hours
2	29	FAA Knowledge Exam Prep	2.0 Hours
2	30	Final Exam	2.0 Hours
		Total Training Time:	**60.0 Hours**

Course Materials

- Required text can be furnished in a digital or physical fashion so long as the student has suitable access to the text. These are required texts:
  - FAA 8083-25B Pilots Handbook of Aeronautical Knowledge
  - FAA 8083-3C Airplane Flying Handbook
  - FAA 8082-28 Aviation Weather Handbook
  - FAA-CT-8080-2H Computer Testing Supplement
  - Training Aircraft POH/PIM/AFM
  - FAA Aeronautical Chart Users Guide

Attendance

- Attendance to classes is key for consistency of learning and success in the course.
- Students who are absent to a class must watch the missed class recording and email an instructor to update their grade.
- Partial attendance is not permitted.

Enrollment and Graduation

- The Federal Aviation Administration has a minimum age of **15 years of age** to take the Private Pilot Airman Knowledge Exam (PAR).
- Students may not be permitted to enroll in the class unless by the scheduled end of that class the student has reached their 15th birthday.

Enrollment and Graduation

- At completion of this course, the student will receive a graduation certificate certified by the school's course administrator. This does not authorize the student to take the FAA PAR knowledge exam; a separate endorsement must be given from the school to take the PAR knowledge exam.
- The FAA PAR knowledge exam must be taken within 90 days of graduation.

Grading

A minimum passing score of “C” in the overall course and a minimum of “B” on the final exam is necessary to pass the course and receive the graduation certificate. All items found deficient must be reviewed from the course instructor. The overall grading is as follow:

- 90-100% = “A”
- 80-89% = “B”
- 70-79% = “C”
- 0-69% = “F”

- Course Participation = 20 %
- Quiz 1 = 15%
- Quiz 2 = 15%
- Midterm = 20%
- Final Exam = 30%

Course/Instructor Contacts

Nicholas McBride, *Director Of Training*

- Phone: (610)-930-6068
- Email: nmcbride@chestercountyaviation.com

Garret Hooper, *Ground Instructor*

- Phone:
- Email: garret.hooper4@gmail.com

Mackenzie Harrison, *Instructor Pilot*

- Phone:
- Email: kenzie.harrison@emu.edu

Len Razzi Jr., *Lead Ground Instructor*

- Phone:
- Email: lenaviation@verizon.net

Colby Stahl, *Instructor Pilot*

- Phone:
- Email: stahl.226@buckeyemail.osu.edu

Kevin Jenkins, *Instructor Pilot*

- Phone:
- Email: kjenkinsvmi85@verizon.net

Course Success

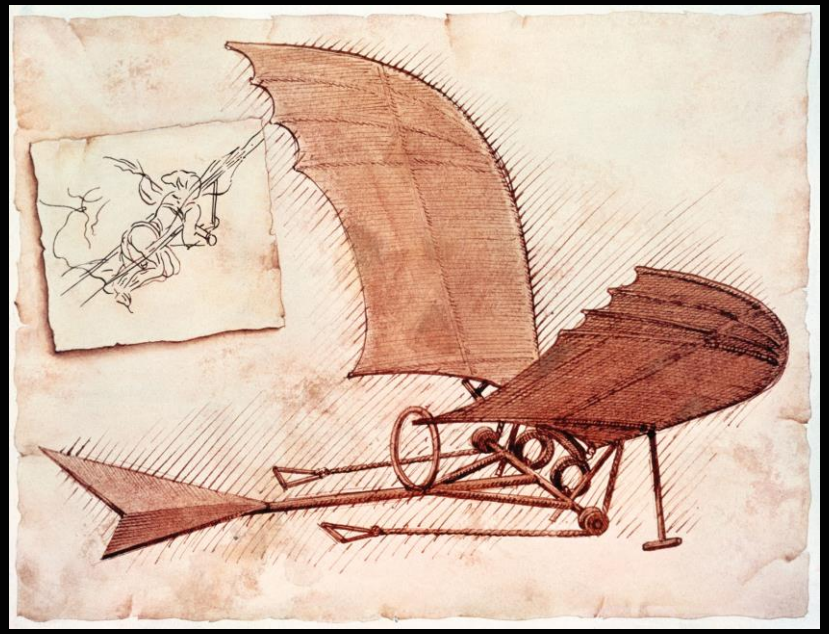
- This is a challenging course that requires you to apply yourself.
- Key to Success:
  - READ the books (Required Reading)
  - Take notes from the readings and classes
  - Use the study guide
  - Review your notes, PowerPoints, and tests.
  - Take FAA practice exams to build comfort with questions

Introduction Into Aviation

Introduction Into Aviation

Aviation's Early Dreams

- During the 1500s, **Leonardo da Vinci** filled pages of his notebooks with sketches of proposed flying machines, but most of his ideas were flawed because he clung to the idea of birdlike wings.



- By 1655, mathematician, physicist, and inventor **Robert Hooke** concluded that the human body does not possess the strength to power artificial wings. He believed human flight would require some form of artificial propulsion.

Aviation’s Early Dreams

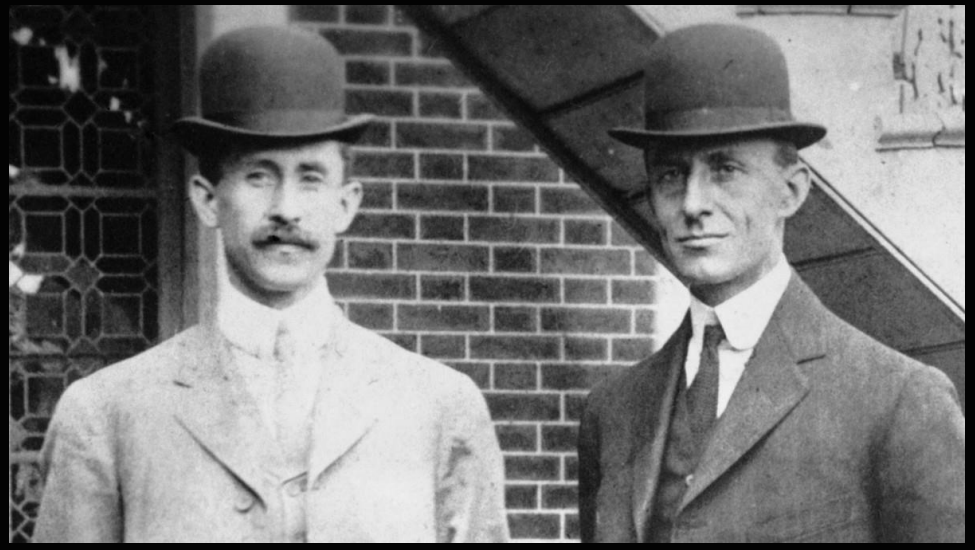
- In 1783, the **first manned hot air balloon**, crafted by Joseph and Etienne Montgolfier, flew for 23 minutes. Ten days later, Professor Jacques Charles flew the first gas balloon

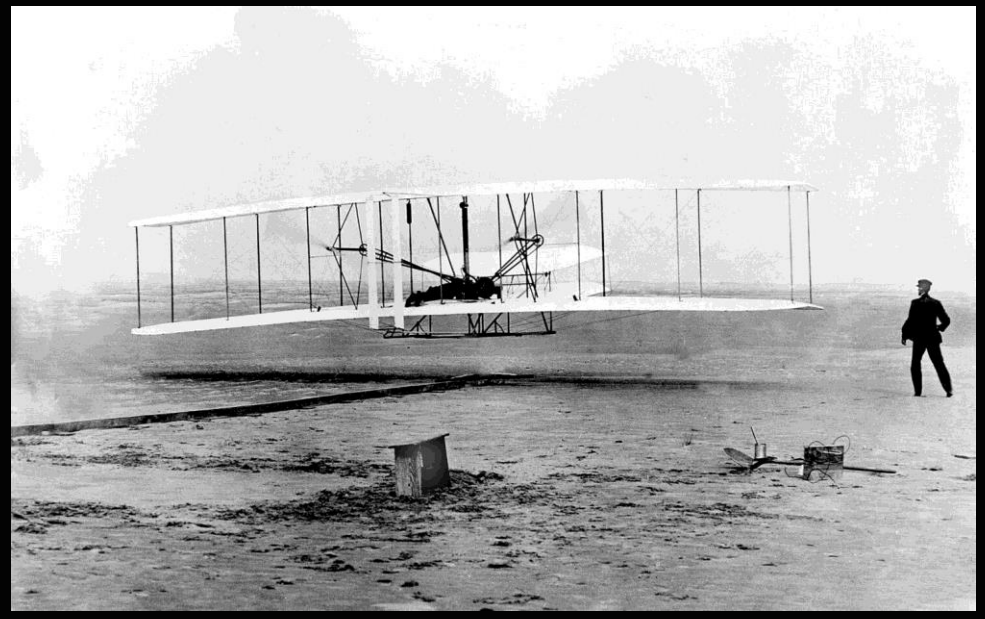
- Sir George Cayley, the “Father of Aerial Navigation,” Cayley discovered the basic principles on which the modern science of aeronautics is founded; built what is recognized as the first successful flying model; and tested the first full-size man-carrying airplane. This was the first glider.

First Manned Flight (Heavier-than-Air)- 1853

First Powered Flight (Heavier-Than-Air) - 1903

- The bicycle-building Wright brothers of Dayton, Ohio, had experimented for 4 years with kites, their own homemade wind tunnel, and different engines to power their biplane. By the afternoon of December 17th, the Wright brothers had flown a total of 98 seconds on four flights. The age of flight had arrived.





First Powered Flight (Heavier-Than-Air) - 1903

First Jet Airplane - 1939

- WWII pushed development of more efficient airplanes to assist the war effort. The German Heinkel He 178 was the first aircraft to utilize a turbojet engine.

First Jet Airliner - 1949

- Between 1930 and 1950 military aircraft design advanced from propeller driven biplanes to jet powered planes. Civil aviation remained dominated by large propeller driven aircraft until 1949 when de Havilland introduced the world to the age of the jet airliner with the Comet.

Space Travel - 1961

First Supersonic Airliner - 1969

- Concorde, the first supersonic passenger-carrying commercial airplane (or supersonic transport, SST), built jointly by aircraft manufacturers in Great Britain and France.

Today


787
N787ZA
DREAMLINER
BOEING


unbeatable fuel efficiency
A321 AIRBUS

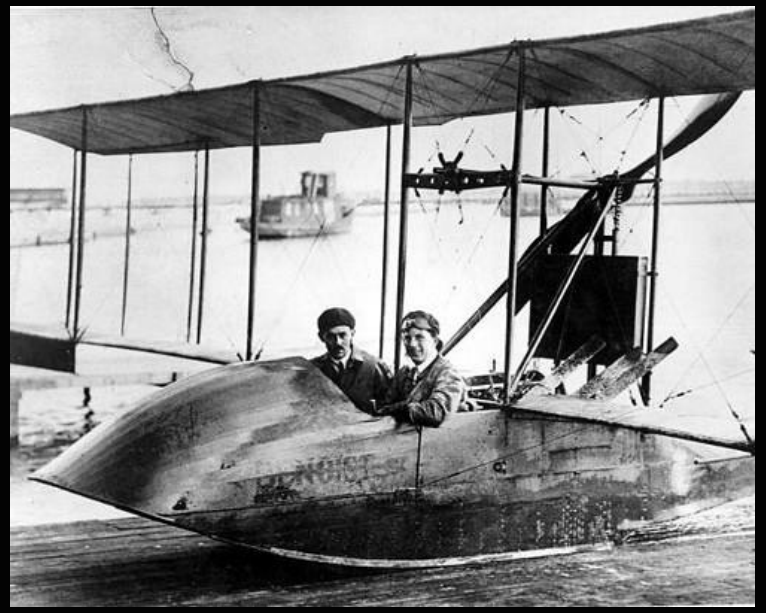

Southwest

History of Regulation

- During the early years of manned flight, aviation was a free for all because no government body was in place to establish policies or regulate and enforce safety standards.
- P. E. Fansler, a Florida businessman living in St. Petersburg, approached Tom Benoist of the Benoist Aircraft Company in St. Louis, Missouri about flying. Benoist suggested using his “Safety First” airboat and the two men signed an agreement for what would become the first scheduled airline in the United States. The first aircraft was delivered to St. Petersburg and made the first test flight on December 31, 1913

History of Regulation

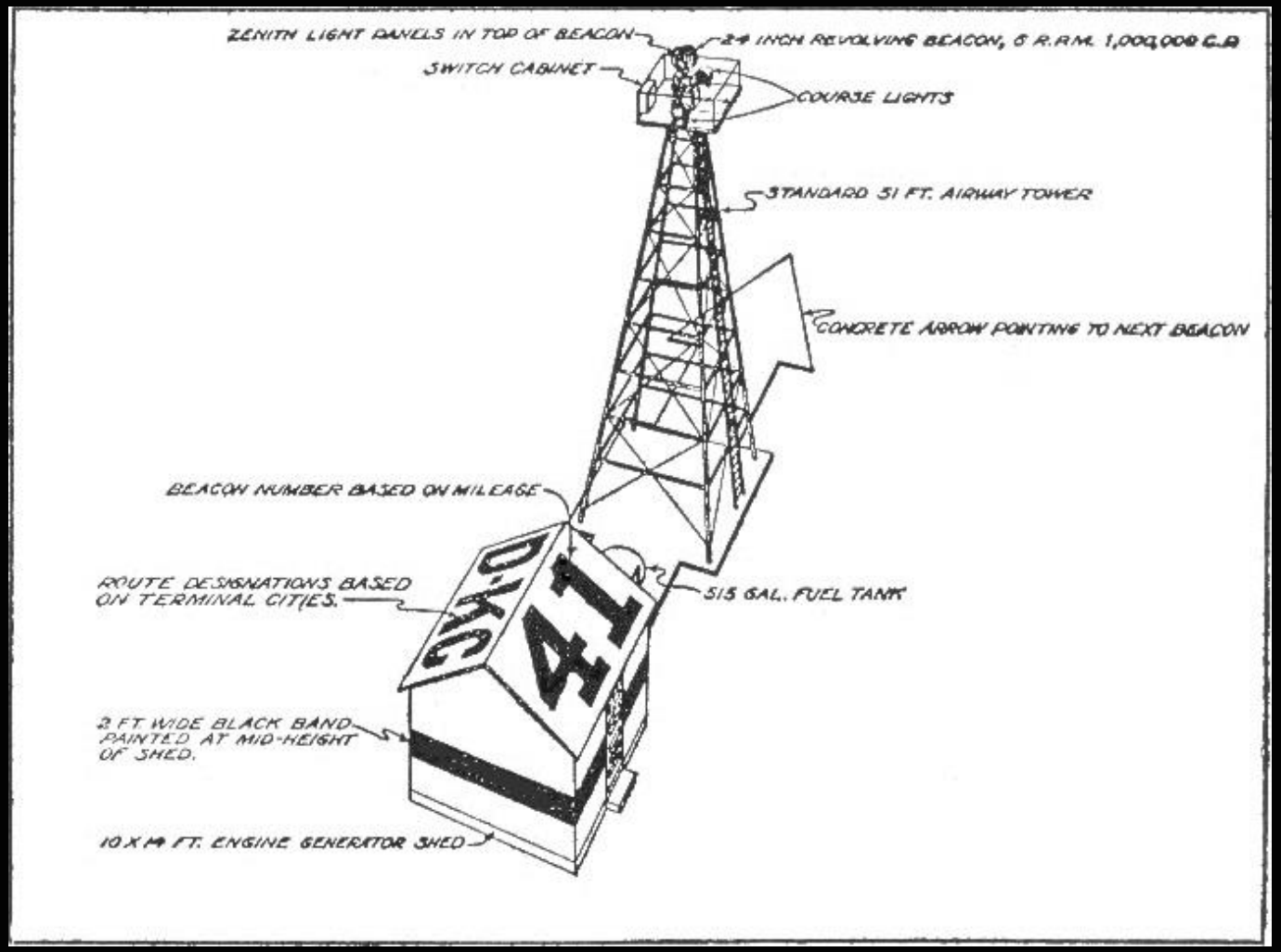
- The airline operated for only 4 months, but 1,205 passengers were carried without injury. This experiment proved commercial passenger airline travel was viable.



History of Regulation

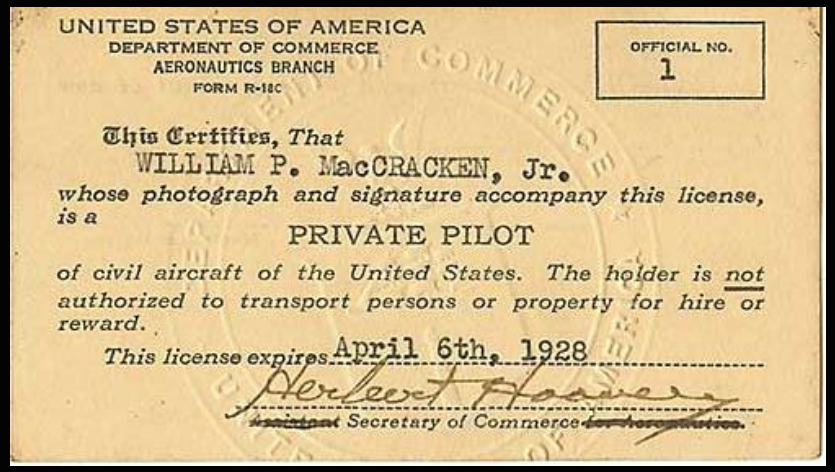
- Aviation advocates continued to look for ways to use airplanes. Airmail service was a popular idea, but the war prevented the Postal Service from having access to airplanes. The War Department and Postal Service reached an agreement in 1918. The Army would use the mail service to train its pilots in flying cross-country. The first airmail flight was conducted on May 15, 1918, between New York and Washington, DC

History of Regulation



History of Regulation

- The Aeronautics Branch of the Department of Commerce began pilot certification with the first license issued on April 6, 1927. The recipient was the Chief of the Aeronautics Branch, William P. MacCracken, Jr. (Orville Wright, who was no longer an active flier, had declined the honor.)



UNITED STATES OF AMERICA
DEPARTMENT OF COMMERCE
AERONAUTICS BRANCH
FORM R-18C

OFFICIAL NO. 1

This Certifies, That
WILLIAM P. MacCRACKEN, Jr.
whose photograph and signature accompany this license, is a
PRIVATE PILOT
of civil aircraft of the United States. The holder is not authorized to transport persons or property for hire or reward.
This license expires April 6th, 1928
Herbert Hoover
~~Assistant~~ Secretary of Commerce ~~for Aeronautics~~.

UNITED STATES OF AMERICA
DEPARTMENT OF COMMERCE
AERONAUTICS BRANCH

PILOT'S IDENTIFICATION CARD

This Identification Card, issued on the 6th day of April, 1927, accompanies Pilot's License No. 1
Age 38
Weight 200 Color hair Brown
Height 6' 1½" Color eyes Blue

Wm P. MacCracken Jr.
Pilot's Signature.

FORM R-19
GOVERNMENT PRINTING OFFICE

History of Regulation

- In 1938, the Civil Aeronautics Act transferred the civil aviation responsibilities to a newly created, independent body, named the Civil Aeronautics Authority (CAA). This Act empowered the CAA to regulate airfares and establish new routes for the airlines to service.
- President Franklin Roosevelt split the CAA into two agencies—the Civil Aeronautics Administration (CAA) and the Civil Aeronautics Board (CAB) .
- CAB = Regulation; CAA= Facilitate ATC

History of Regulation

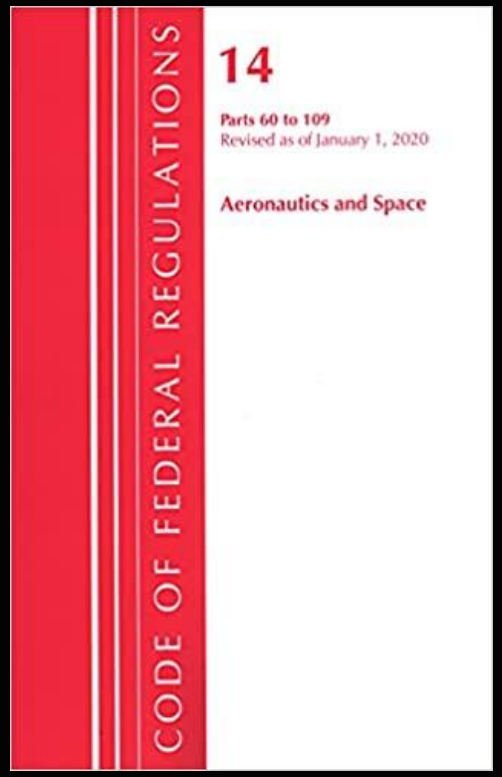
- The Federal Aviation Act of 1958 established a new independent body that assumed the roles of the CAA and transferred the rule making authority of the CAB to the newly created **Federal Aviation Agency (FAA).** The man who was given the honor of being the first Administrator of the FAA was former Air Force General Elwood Richard “Pete” Quesada. He served as the administrator from 1959–1961.

History of Regulation

- On October 15, 1966, Congress established the Department of Transportation (DOT), which was given oversight of the transportation industry within the United States. At this same time, the Federal Aviation Agency was renamed to the Federal Aviation Administration (FAA).
- The role of the CAB was assumed by the newly created National Transportation Safety Board (NTSB).

Role of the FAA

- The FAA is empowered by regulations to promote aviation safety and establish safety standards for civil aviation.



Code of Federal Regulations				
Title	**Volume**	**Chapter**	**Subchapters**	
Title 14 Aeronautics and Space	1	I	A	Definitions and Abbreviations
			B	Procedural Rules
			C	Aircraft
	2		D	Airmen
			E	Airspace
			F	Air Traffic and General Rules
	3		G	Air Carriers and Operators for Compensation or Hire: Certification and Operations
			H	Schools and Other Certified Agencies
			I	Airports
			J	Navigational Facilities
			K	Administrative Regulations
			L–M	Reserved
			N	War Risk Insurance
	4	II	A	Economic Regulations
			B	Procedural Regulations
			C	Reserved
			D	Special Regulations
			E	Organization
			F	Policy Statements
		III	A	General
			B	Procedure
			C	Licensing
	5	V		
		VI	A	Office of Management and Budget
			B	Air Transportation Stabilization Board

Role of the FAA

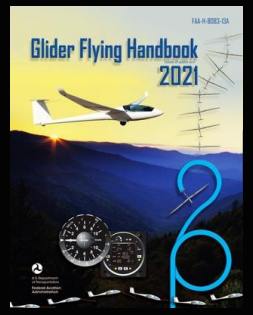
- The FAA's main office is in Washington D.C. Local "Field Offices" or Flight Standard District Offices are located throughout the country. The FAA has approximately 80 FSDOs

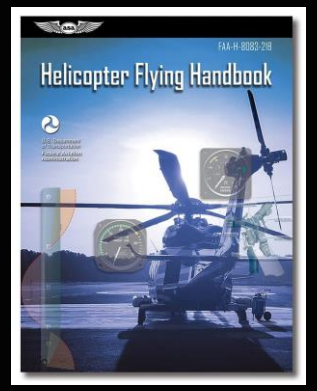
Role of the FAA

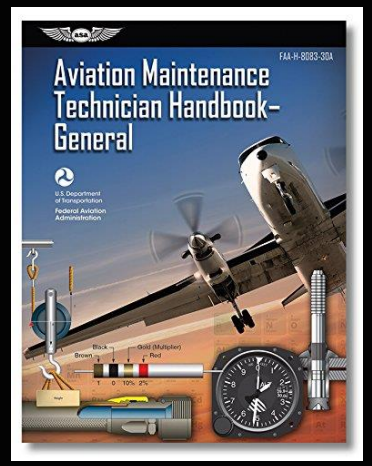
- In addition to accident investigation and the enforcement of aviation regulations, the FSDO is also responsible for the certification and surveillance of air carriers, air operators, flight schools/training centers, and airmen including pilots and flight instructors. Each FSDO is staffed by Aviation Safety Inspectors (ASIs) who play a key role in making the nation's aviation system safe.
- FAA Safety Team (FAAST)

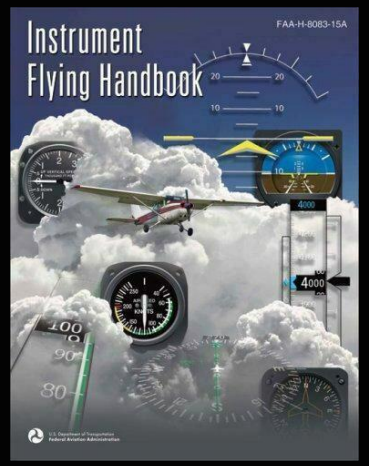
Role of the FAA

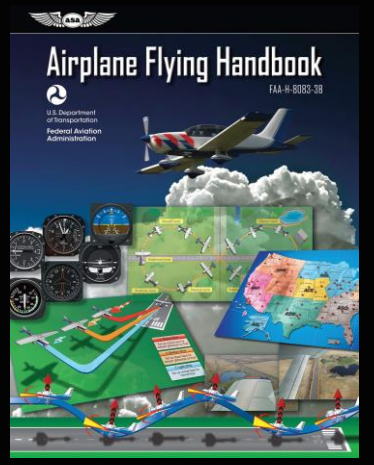
- Handbooks are developed to provide specific information about a particular topic that enhances training or understanding. The FAA publishes a variety of handbooks that generally fall into three categories: aircraft, aviation, and examiners and inspectors

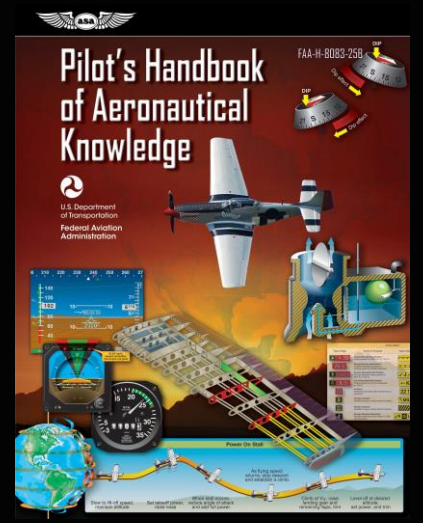






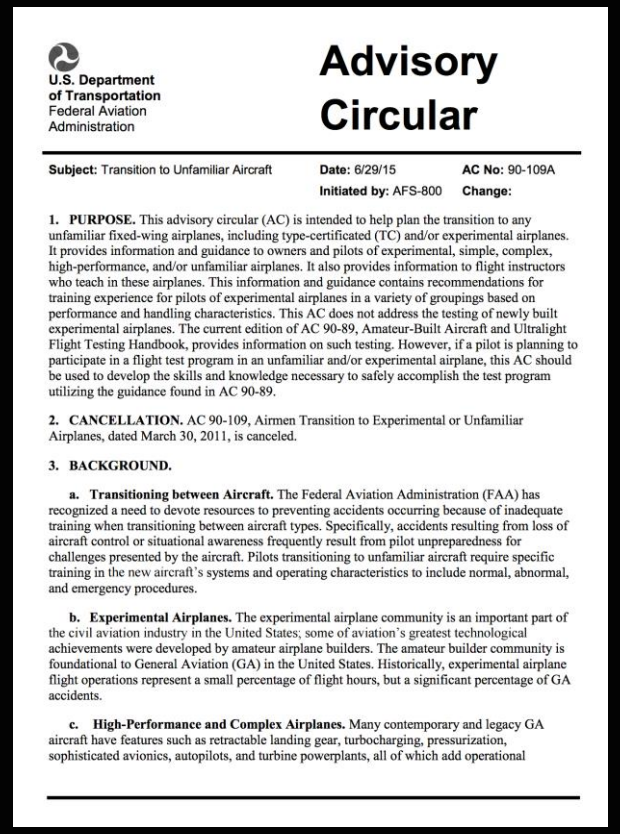






Role of the FAA

- An Advisory Circular (AC)is an informational document that the FAA wants to distribute to the aviation community.
- AC's titles have meaning
  - 1st Identifies the subject matter (14 CFR)
  - 2nd Identifies the sequence
  - 3rd Identifies a letter assigned by the author
  - AC 61-65H



U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Transition to Unfamiliar Aircraft **Date:** 6/29/15 **AC No:** 90-109A
Initiated by: AFS-800 **Change:**

1. PURPOSE. This advisory circular (AC) is intended to help plan the transition to any unfamiliar fixed-wing airplanes, including type-certificated (TC) and/or experimental airplanes. It provides information and guidance to owners and pilots of experimental, simple, complex, high-performance, and/or unfamiliar airplanes. It also provides information to flight instructors who teach in these airplanes. This information and guidance contains recommendations for training experience for pilots of experimental airplanes in a variety of groupings based on performance and handling characteristics. This AC does not address the testing of newly built experimental airplanes. The current edition of AC 90-89, Amateur-Built Aircraft and Ultralight Flight Testing Handbook, provides information on such testing. However, if a pilot is planning to participate in a flight test program in an unfamiliar and/or experimental airplane, this AC should be used to develop the skills and knowledge necessary to safely accomplish the test program utilizing the guidance found in AC 90-89.

2. CANCELLATION. AC 90-109, Airmen Transition to Experimental or Unfamiliar Airplanes, dated March 30, 2011, is canceled.

3. BACKGROUND.

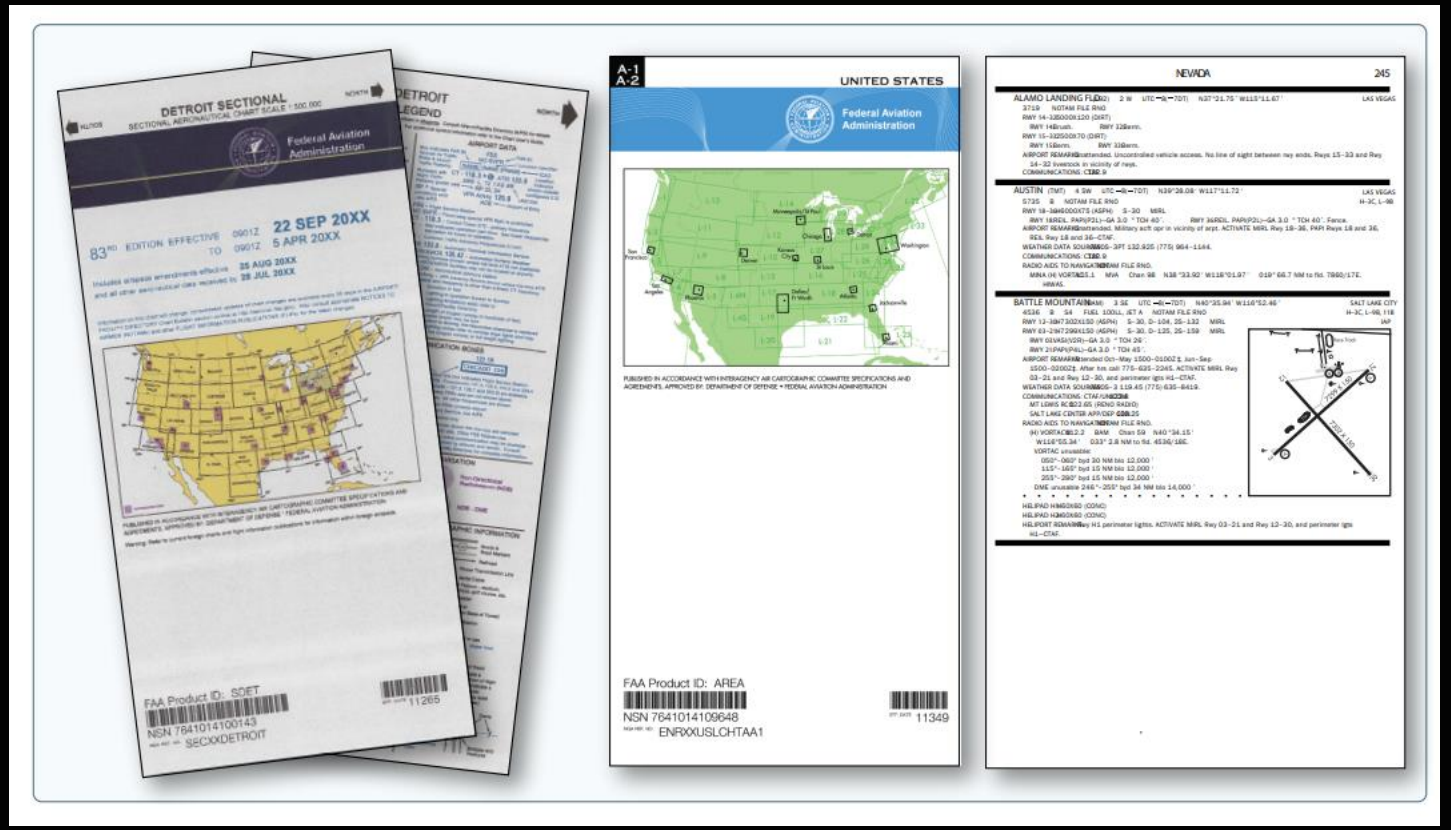
a. Transitioning between Aircraft. The Federal Aviation Administration (FAA) has recognized a need to devote resources to preventing accidents occurring because of inadequate training when transitioning between aircraft types. Specifically, accidents resulting from loss of aircraft control or situational awareness frequently result from pilot unpreparedness for challenges presented by the aircraft. Pilots transitioning to unfamiliar aircraft require specific training in the new aircraft's systems and operating characteristics to include normal, abnormal, and emergency procedures.

b. Experimental Airplanes. The experimental airplane community is an important part of the civil aviation industry in the United States; some of aviation's greatest technological achievements were developed by amateur airplane builders. The amateur builder community is foundational to General Aviation (GA) in the United States. Historically, experimental airplane flight operations represent a small percentage of flight hours, but a significant percentage of GA accidents.

c. High-Performance and Complex Airplanes. Many contemporary and legacy GA aircraft have features such as retractable landing gear, turbocharging, pressurization, sophisticated avionics, autopilots, and turbine powerplants, all of which add operational

Role of the FAA

- The FAA is also responsible for maintaining navigational publications.

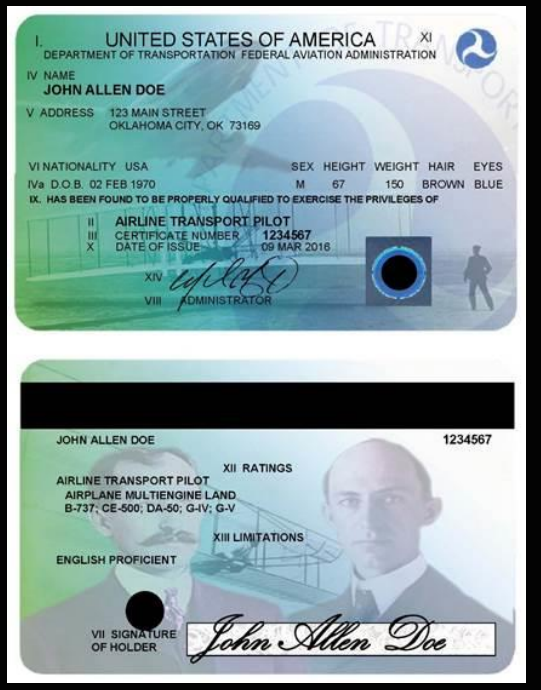


Role of the FAA

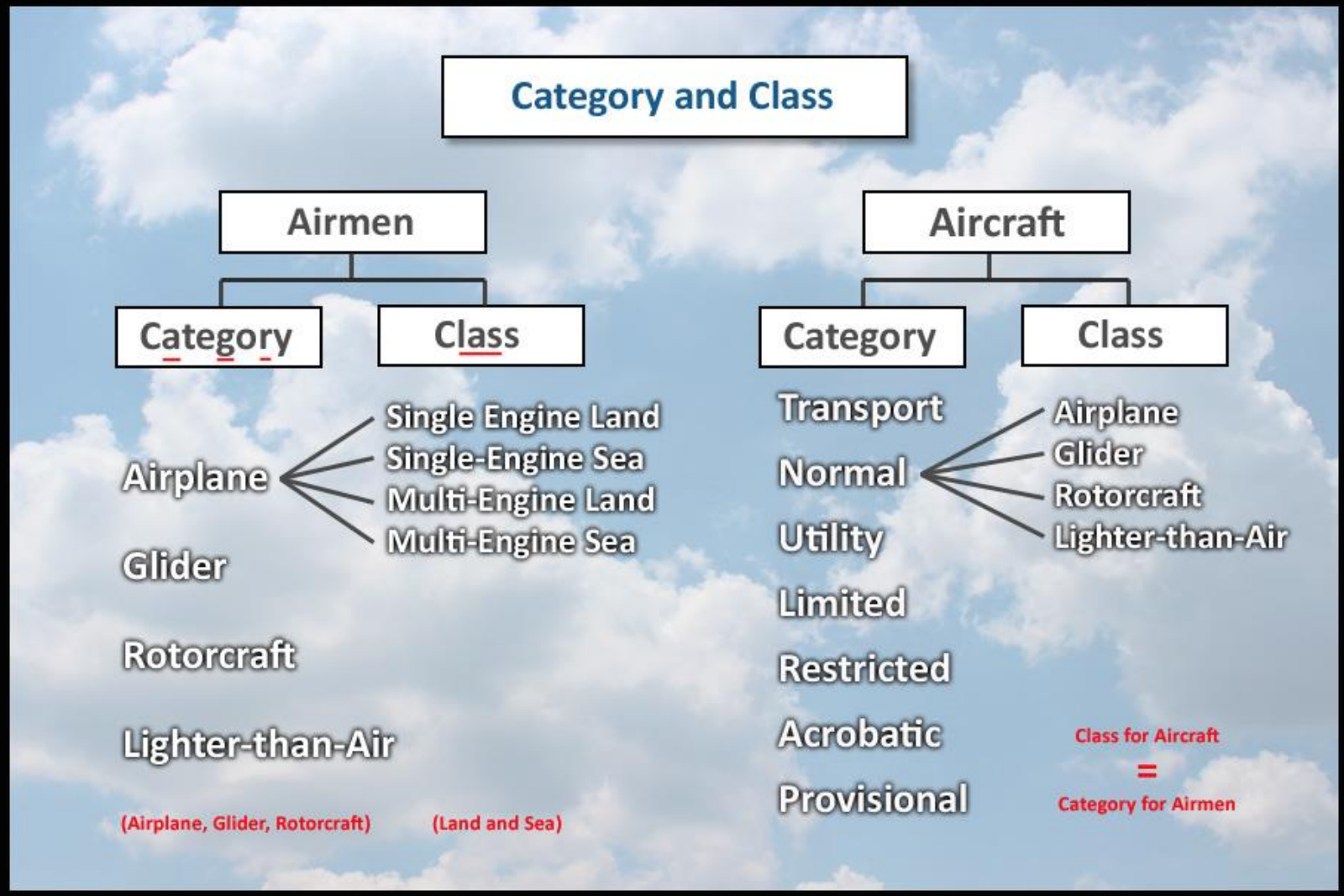
- The FAA is also responsible for publishing NOTAM’s. Notices to Air Missions, or NOTAMs, are time-critical aeronautical information either temporary in nature or not sufficiently known in advance to permit publication on aeronautical charts or in other operational publications.

Pilot Certification

- Each type of pilot's certificate has privileges and limitations that are inherent within the certificate itself. However, other privileges and limitations may be applicable based on the aircraft type, operation being conducted, and the type of certificate.
- Student Pilot
- Sport Pilot
- Recreational Pilot
- Private Pilot
- Commercial Pilot
- Airline Transport Pilot



Pilot Certification



Pilot Certification

- Pilot Training
  - Ground Instruction
  - Flight Instruction
- Aeronautical Knowledge Exam
- Practical Test (FAA Inspectors or Pilot Examiner)
  - Oral Test
  - Flight Test
- Difference between 14 CFR 61 and 141
- Advanced Qualification Programs

Pilot Recurrency and Proficiency

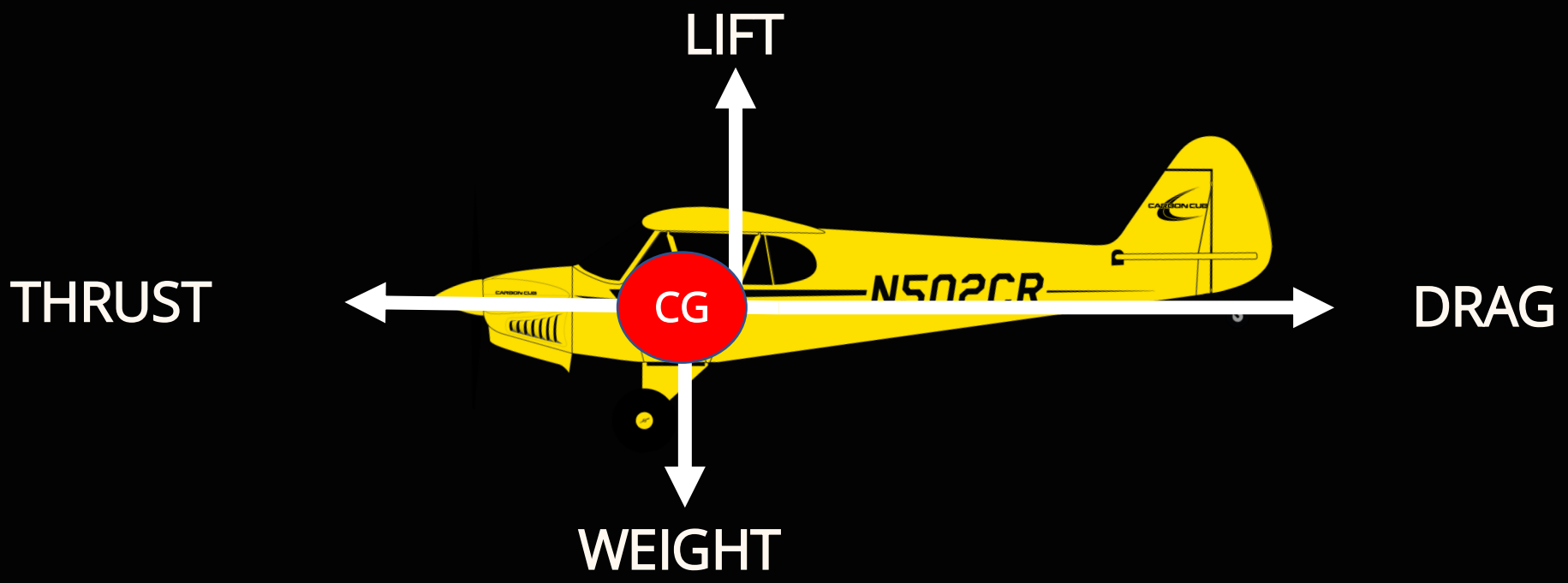
- FAA WINGS Pilot Proficiency Program is a collection of online course offered by the FAA to maintain a pilot's knowledge and skill.

Introduction Into Aviation

Airframe Construction

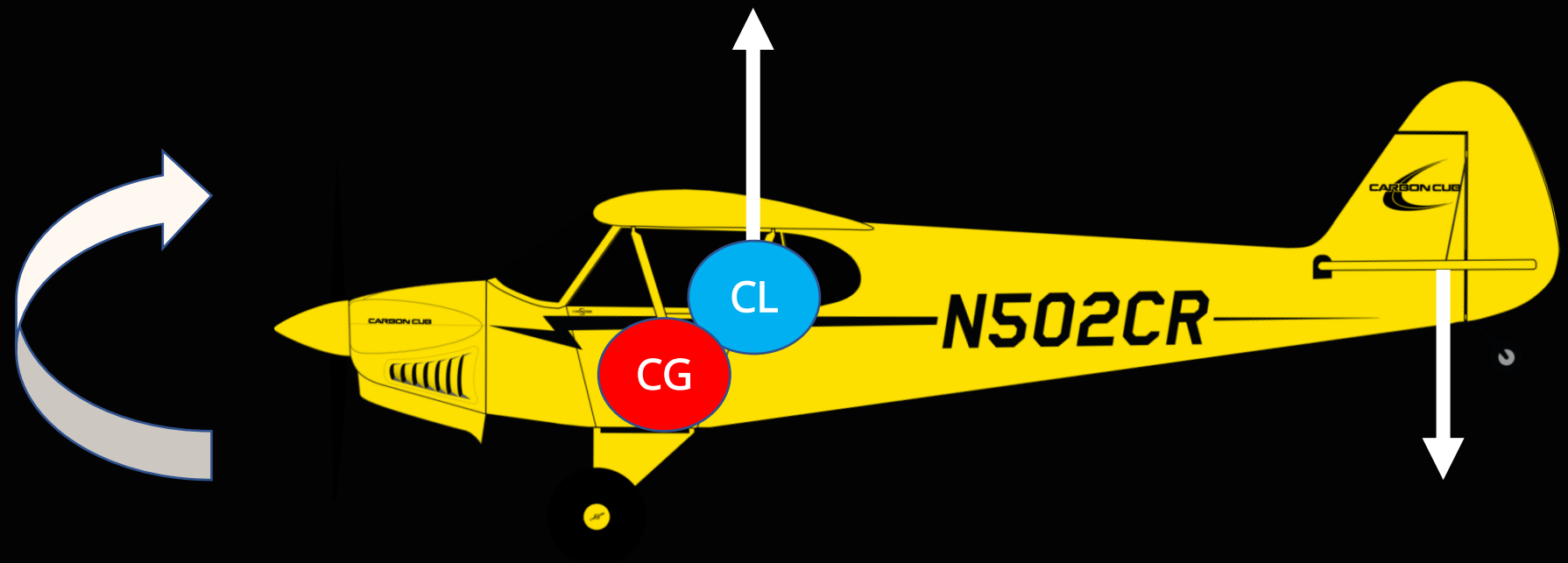
Introduction into Lift

- In order to understand the operation of the major components and subcomponents of an aircraft, it is important to understand basic aerodynamic concepts. Aircraft motion is connected to Center of Gravity.



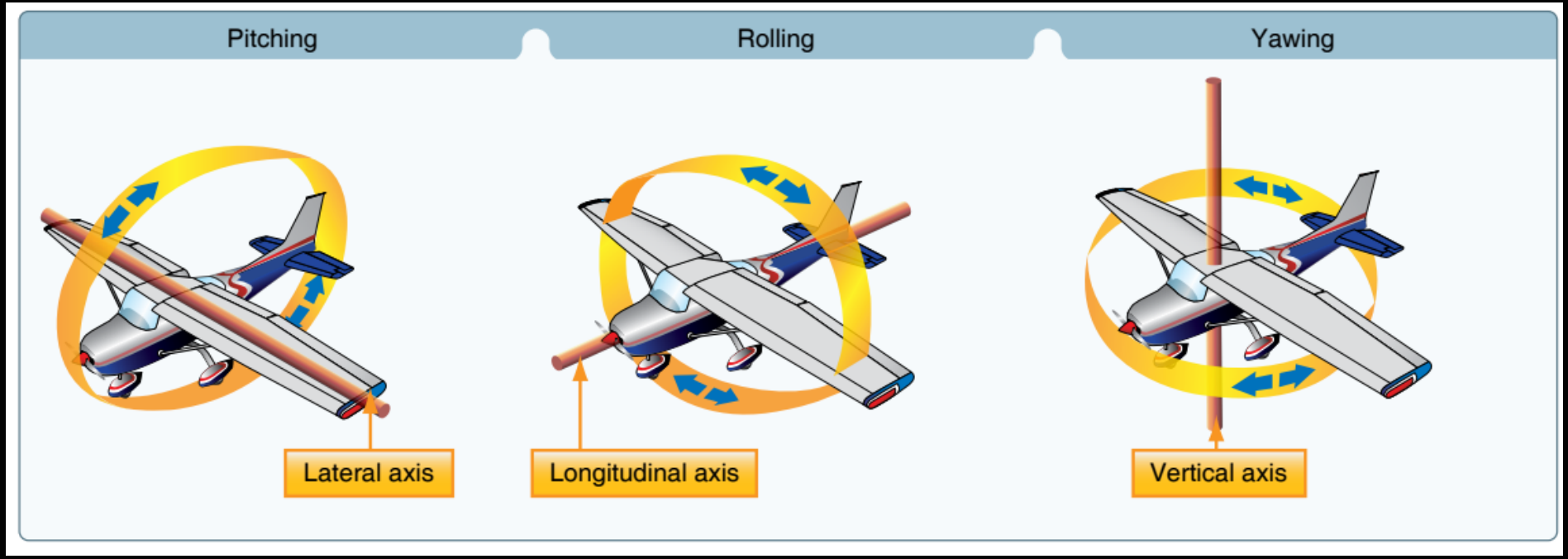
Introduction into Lift

- One of the most significant components of aircraft design is CG. It is the specific point where the mass or weight of an aircraft may be said to center; that is, a point around which, if the aircraft could be suspended or balanced, the aircraft would remain relatively level.



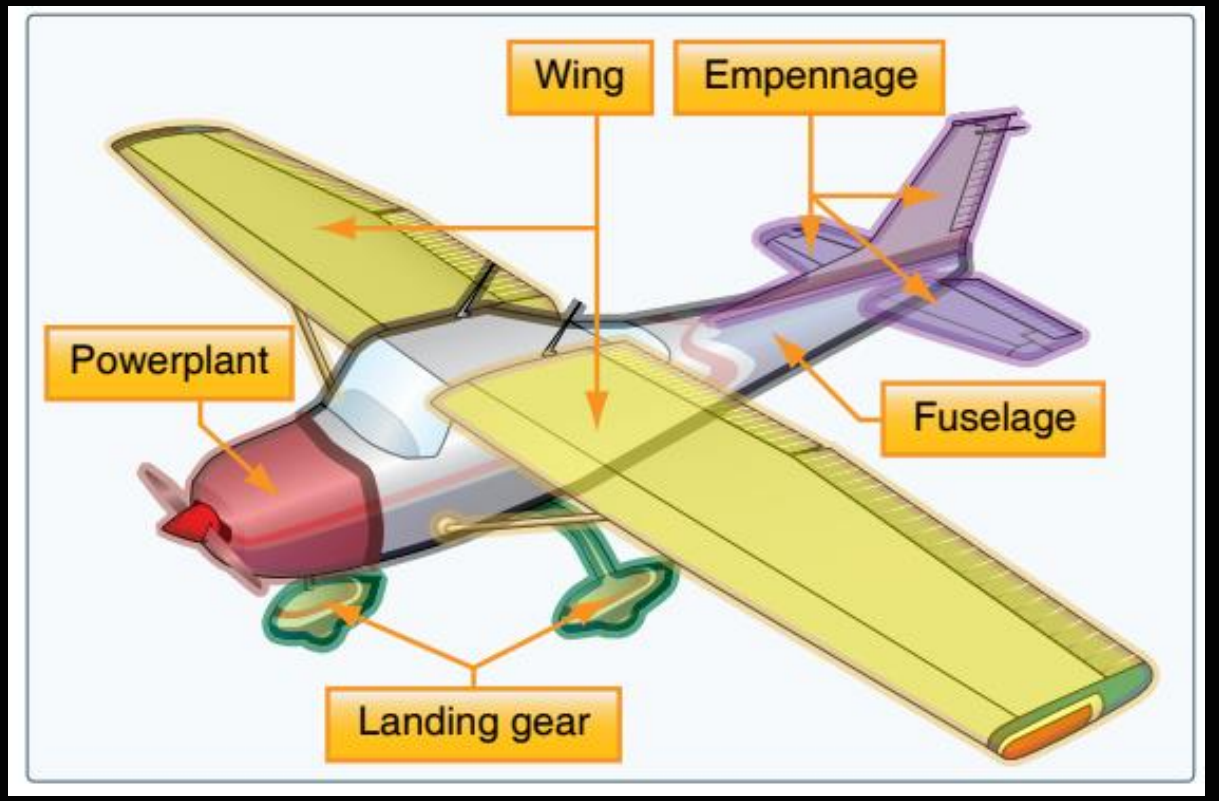
3 Axes of Flight

- An aircraft moves in three dimensions and is controlled by moving it about one or more of its axes. All control movements cause the aircraft to move around one or more of these axes and allows for the control of the aircraft in flight



Aircraft Construction

- Airplanes are designed for different purposes, but most airplane structures include a fuselage, wings, an empennage, landing gear, and a powerplant.



Fuselage

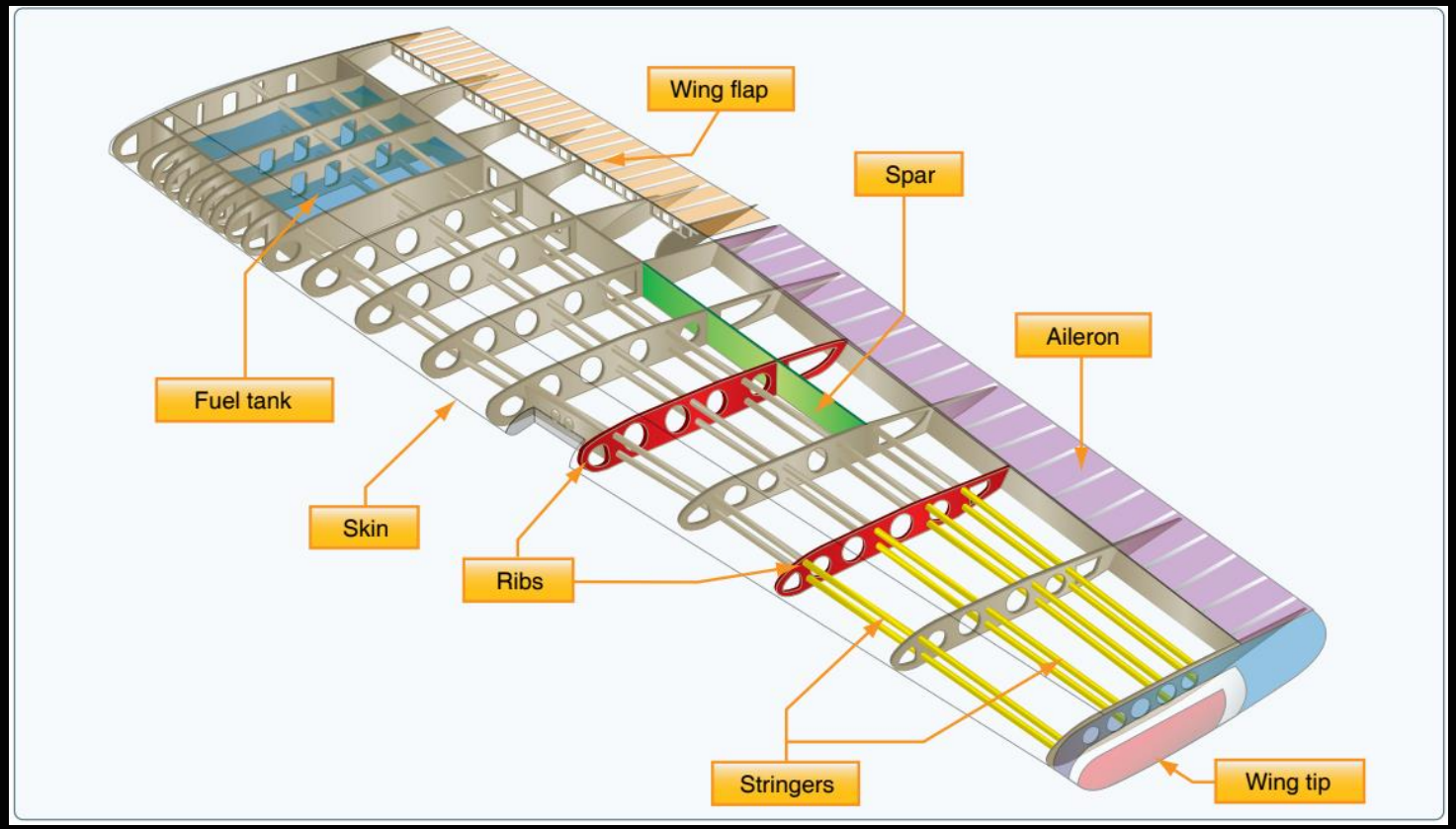
- The fuselage is the central body of an airplane and is designed to accommodate the crew, passengers, and cargo.
- It also provides the structural connection for the wings and tail assembly
- Older types of aircraft design utilized an open truss structure constructed of wood, steel, or aluminum tubing.
- The most popular types of fuselage structures used in today’s aircraft are the monocoque (French for “single shell”) and semimonocoque.

Wings

- The wings are airfoils attached to each side of the fuselage and are the main lifting surfaces that support the airplane in flight.
- There are numerous wing designs, sizes, and shapes used by the various manufacturers. Each fulfills a certain need with respect to the expected performance for the particular airplane.

Wings

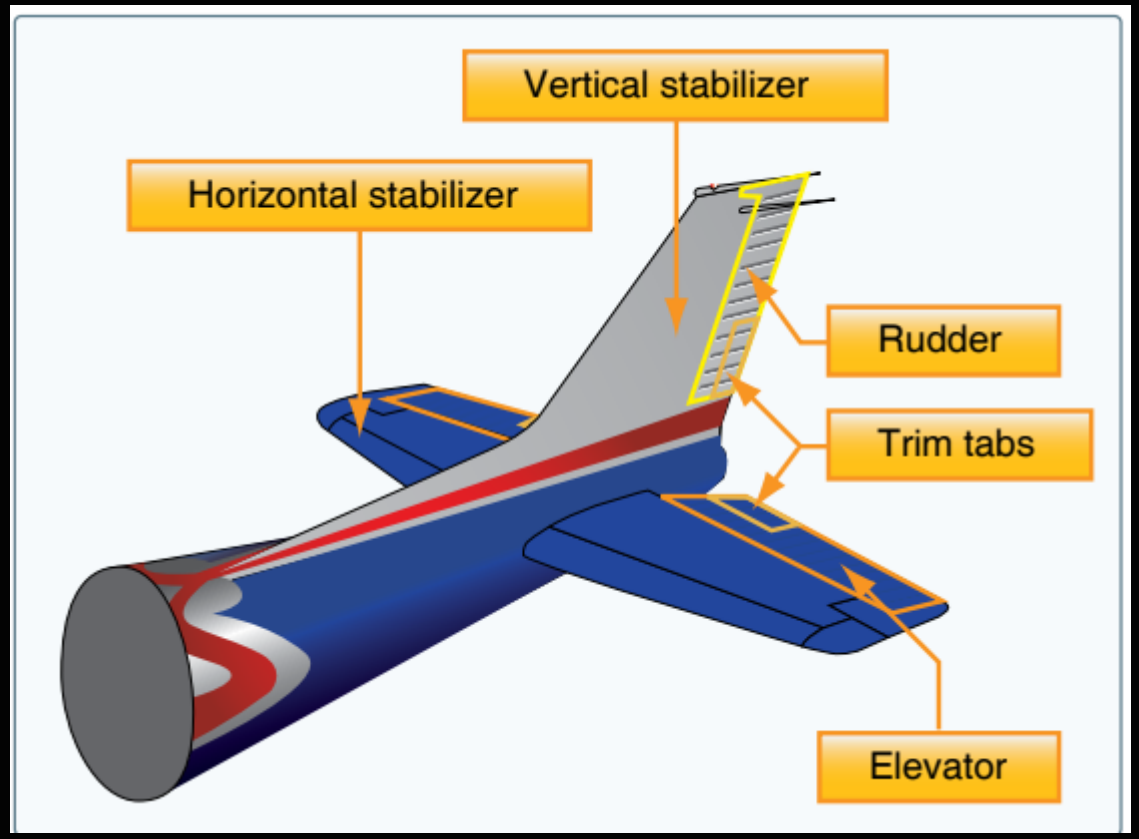
- Most light training airplane have wings similar internal structure.

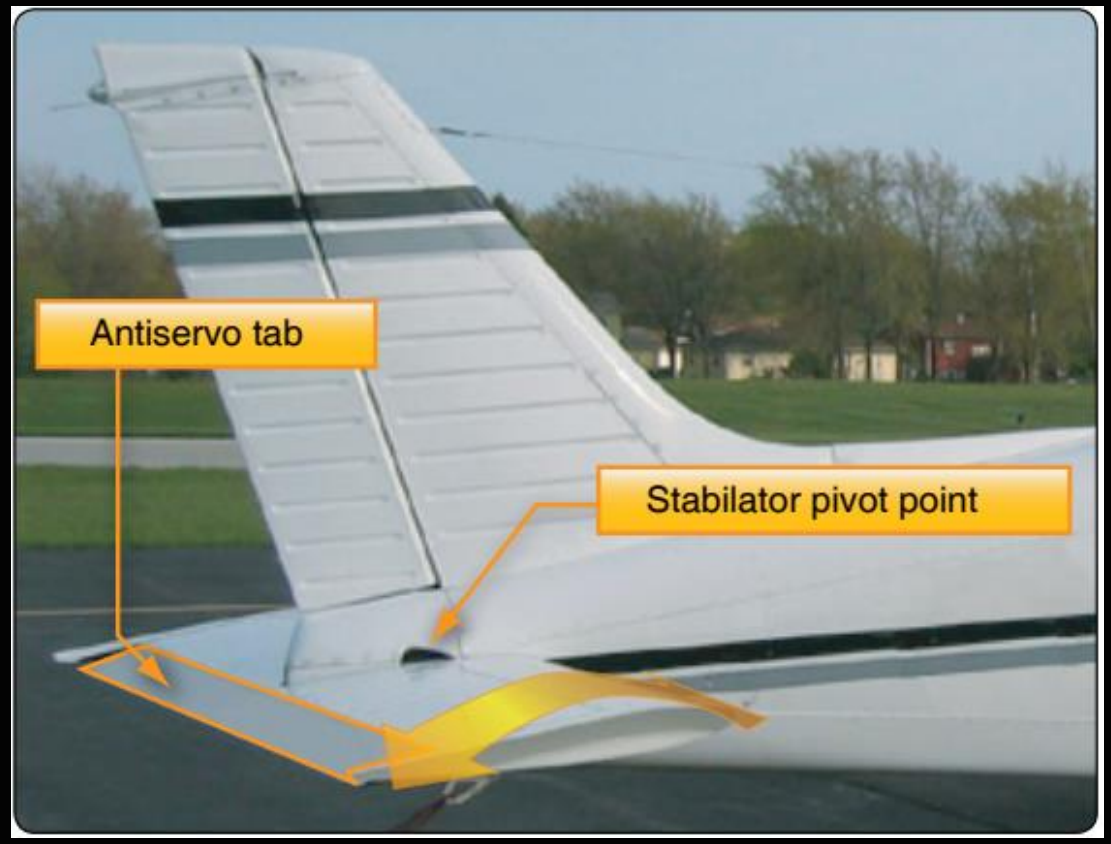


Empennage

- The empennage includes the entire tail group and consists of fixed surfaces, such as the vertical stabilizer and the horizontal stabilizer. The movable surfaces include the rudder, the elevator, and one or more trim tabs
- A second type of empennage design does not require an elevator. Instead, it incorporates a one-piece horizontal stabilizer that pivots from a central hinge point. This type of design is called a stabilator and is moved using the control wheel, just as the elevator is moved

Empennage


Vertical stabilizer
Horizontal stabilizer
Rudder
Trim tabs
Elevator


Antiservo tab
Stabilator pivot point

Landing Gear

- The landing gear is the principal support of the airplane when parked, taxiing, taking off, or landing. The most common type of landing gear consists of wheels, but airplanes can also be equipped with floats for water operations or skis for landing on snow.
- Two major types on landing gear configuration exist: Conventional (Tailwheel) and Tricycle

Landing Gear

Conventional

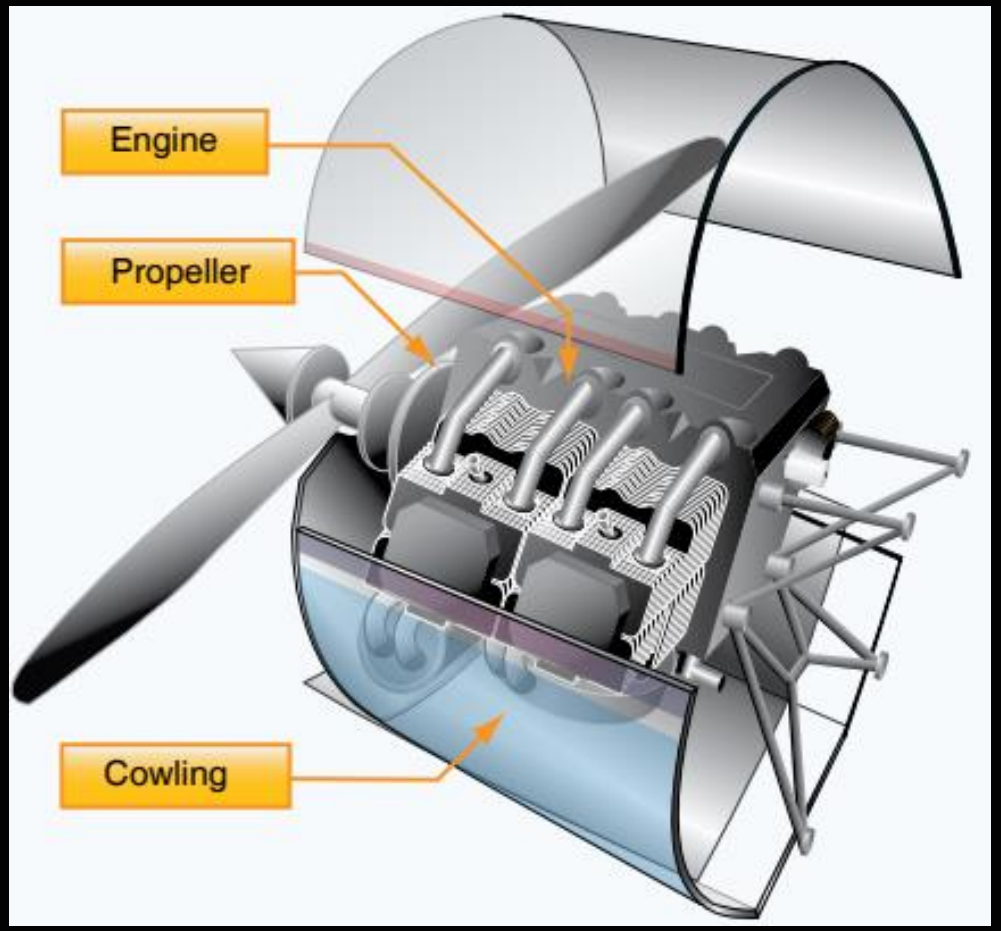
Float type

Tricycle

Powerplant

- The primary function of the engine is to provide the **power to turn the propeller**. It also generates electrical power, provides a vacuum source for some flight instruments, and in most single-engine airplanes, provides a source of heat for the pilot and passengers.
- Engines are also often cover by a cowling. A cowling help provide streamlined airflow around the engine and cooling to the engine itself.

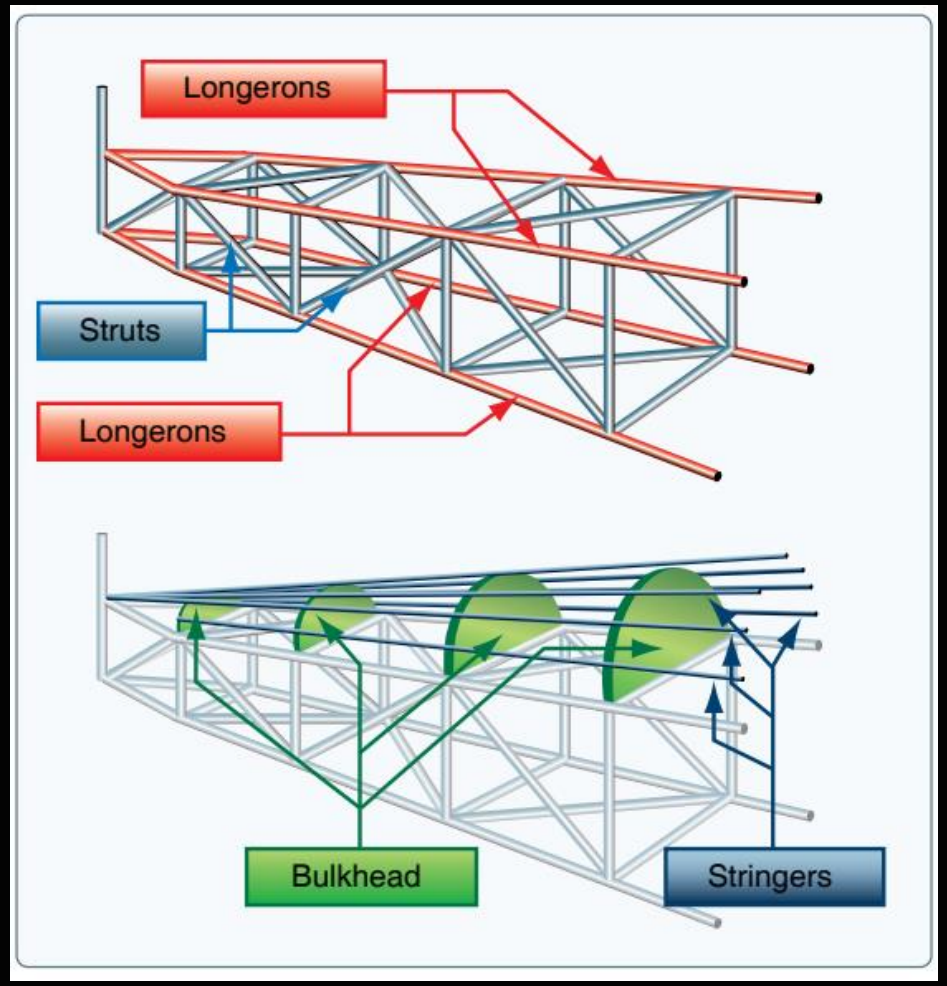
Powerplant



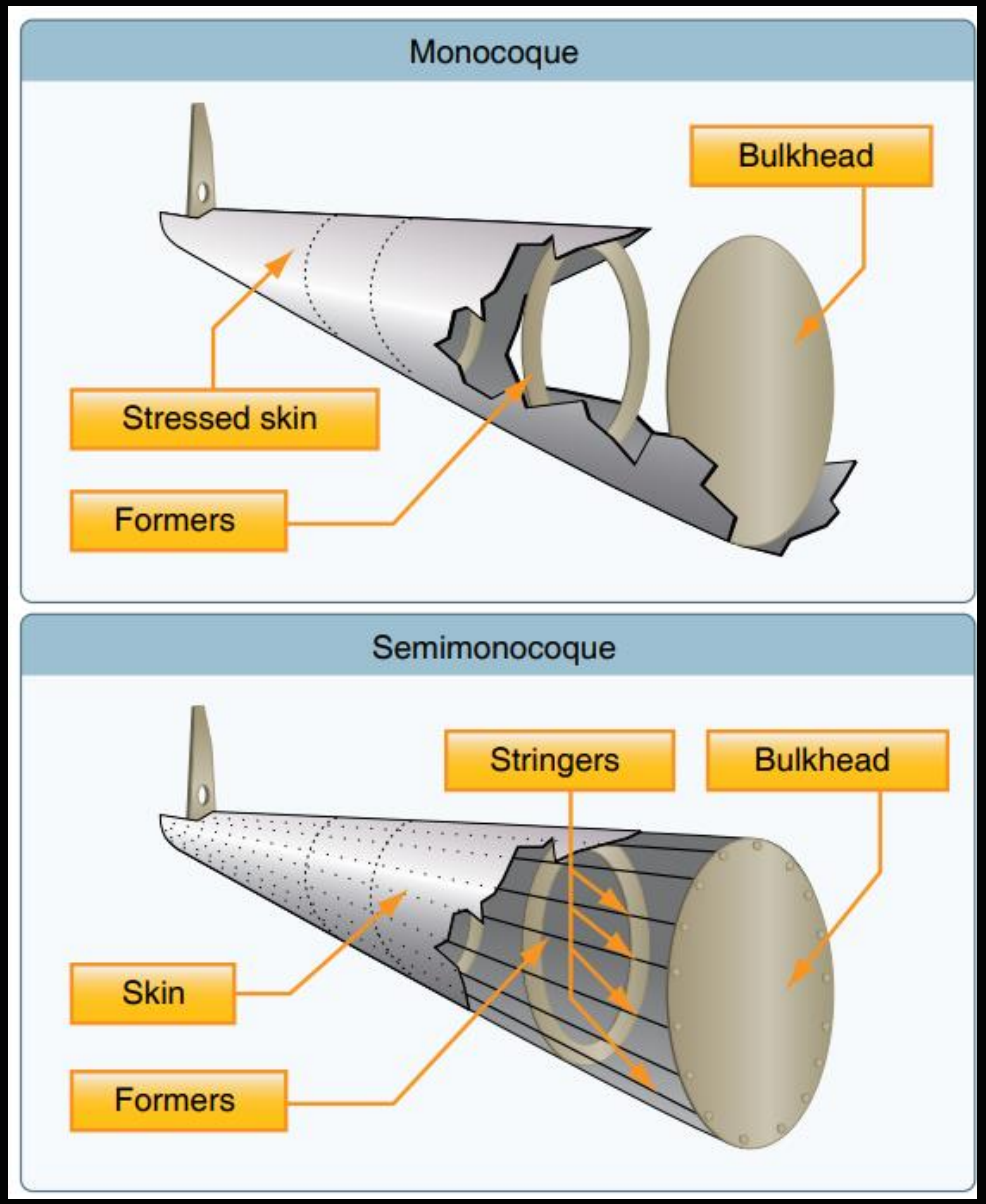
Powerplant

- The propeller, mounted on the front of the engine, translates the rotating force of the engine into thrust, a forward acting force that helps move the airplane through the air.
- Propeller produce lift just like the wing but in a different direction.
- A couple of major factors are considered in propeller design and will be covered later in the course. (Hint Pitch and AoA)

Construction



Truss-Type



Semimonocoque and Monocoque

Construction – Truss-Type

Classic design no longer commonly used

Piper Super Cub

The main drawback of truss structure is its lack of a streamlined shape. In this construction method, lengths of tubing, called longerons, are welded in place to form a well braced framework. As technology progressed, aircraft designers began to enclose the truss members to streamline the airplane and improve performance.

Construction – Monocoque

Classic design no longer commonly used

1918 Lockheed S-1 Racer

Monocoque construction uses stressed skin to support almost all loads much like an aluminum beverage can. Although strong, this design does not stand well to heavy loads. For example, an aluminum beverage can supports considerable forces at the ends of the can, but if the side of the can is deformed slightly while supporting a load, it collapses easily

Construction - Semimonocoque

Popular design with many different aircraft designs.

1976 Cessna C-182 “Skylane”

The internal construction of a semi-monocoque airplane showing damage from a wildlife strike.

Semimonocoque construction, partial or one-half, uses a substructure to which the airplane’s skin is attached. The substructure, which consists of bulkheads and/or formers of various sizes and stringers, reinforces the stressed skin by taking some of the bending stress from the fuselage.

Construction - Composite

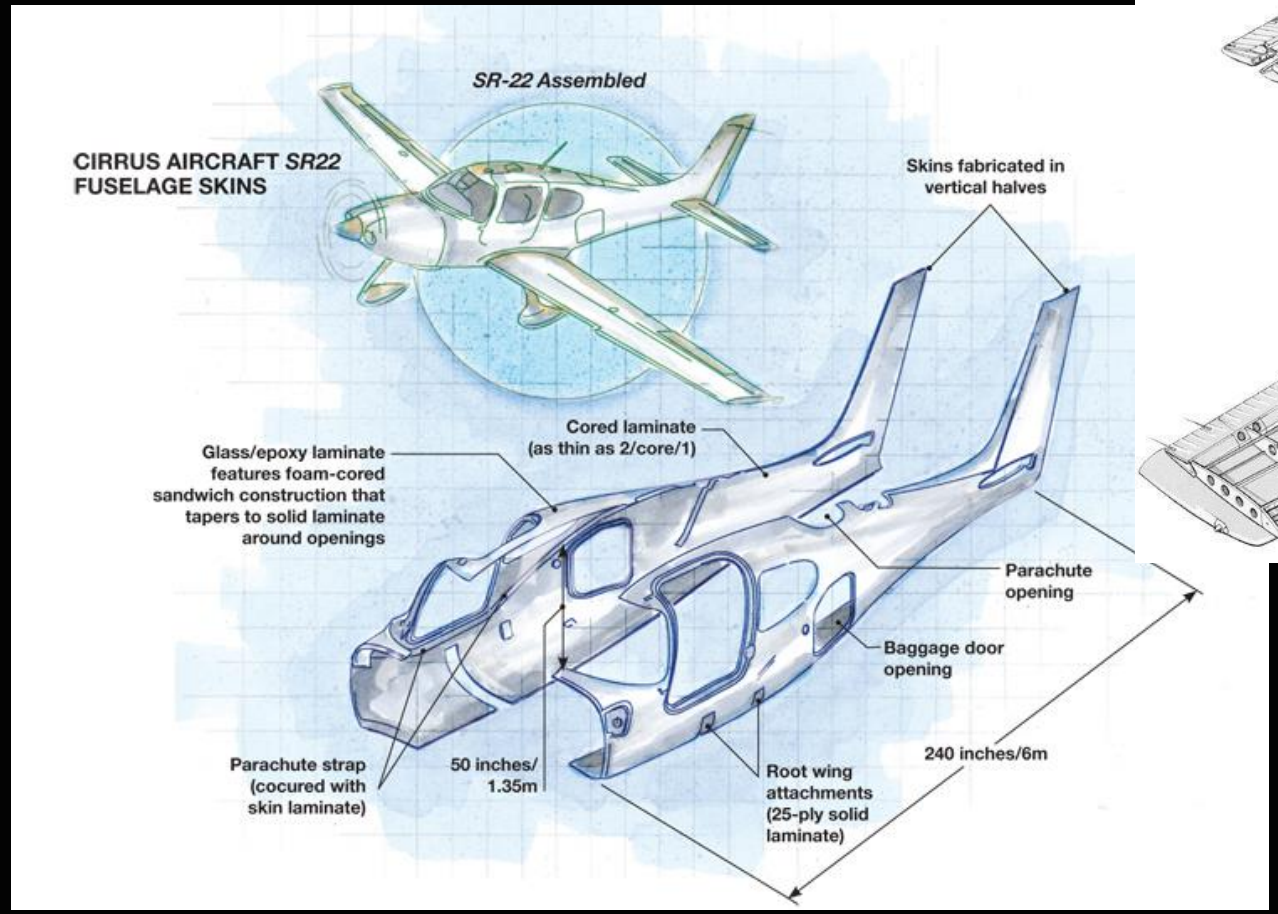
Modern aircraft use Semimonocoque and single-piece composite materials

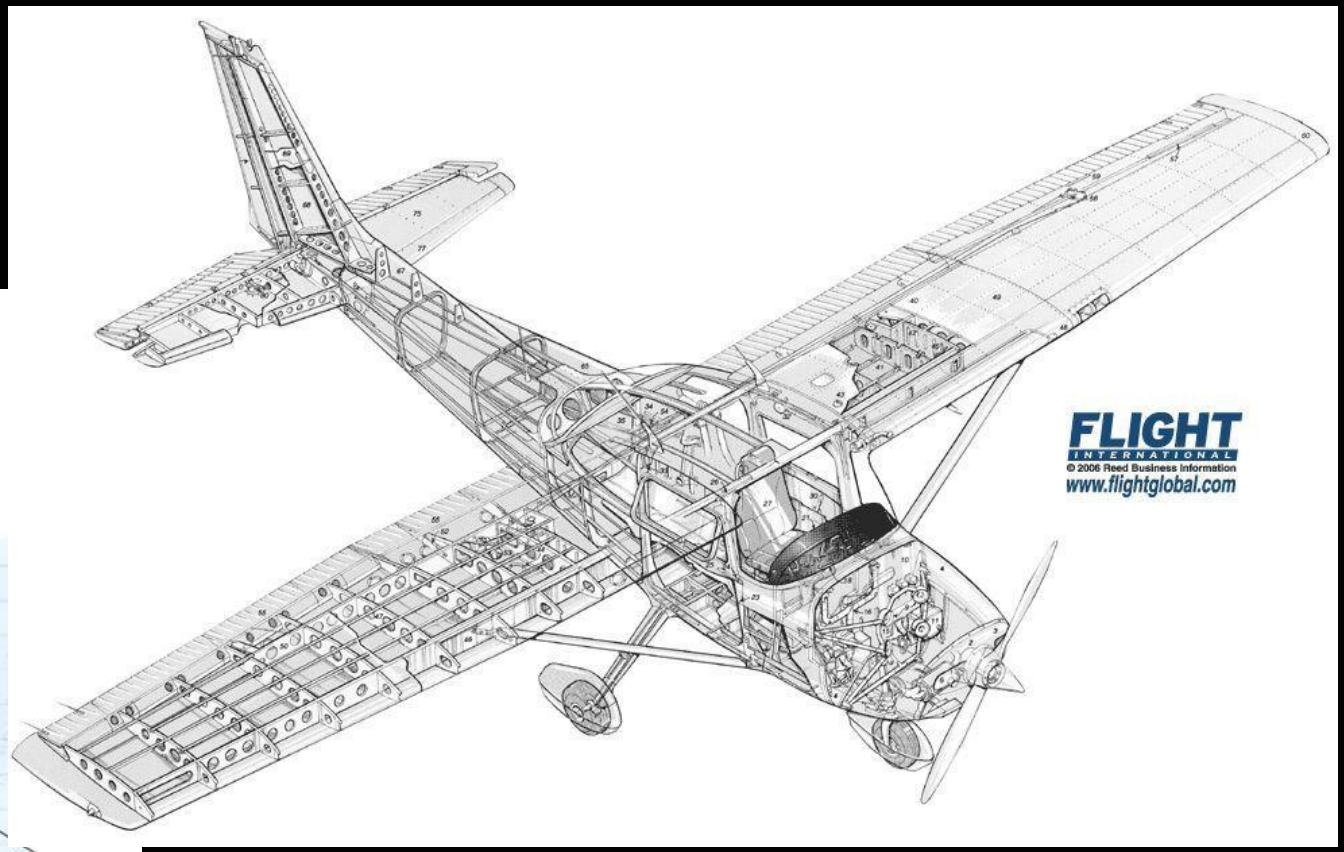
Cirrus SR 22

Composite is a broad term and can mean materials such as fiberglass, carbon fiber cloth, Kevlar™ cloth, and mixtures of all of the above. Composite construction offers two advantages: extremely smooth skins and the ability to easily form complex curved or streamlined structures.

Most common are fiberglass and carbon fiber cloth.

Construction





Introduction Into Aviation

Principles of Flight

Atmosphere

- Before we can understand basic principles of flight, we must understand what we are flying through.
- Air is a FLUID! Air is a gas… that's a fluid!
- Fluids take on the shape of their containers (Atmosphere).
  - Fluids generally do not resist deformation when even the smallest stress is applied, or they resist it only slightly. We call this slight resistance **viscosity**.
  - Fluids also have the ability to flow. Just as a liquid will flow to fill its container, air will do the same.
- Both liquids and gasses display these unique fluid properties, even though they differ greatly in density.

Atmosphere – Viscosity

- Viscosity is resistant to flow
- AKA… High-viscosity fluids are “thick” and resist flow; low-viscosity fluids are “thin” and flow easily. Air has a low viscosity and flows easily. Water V. Molasses.
- Different Viscosity fluid will appear to flow at different rates.

Atmosphere – Friction

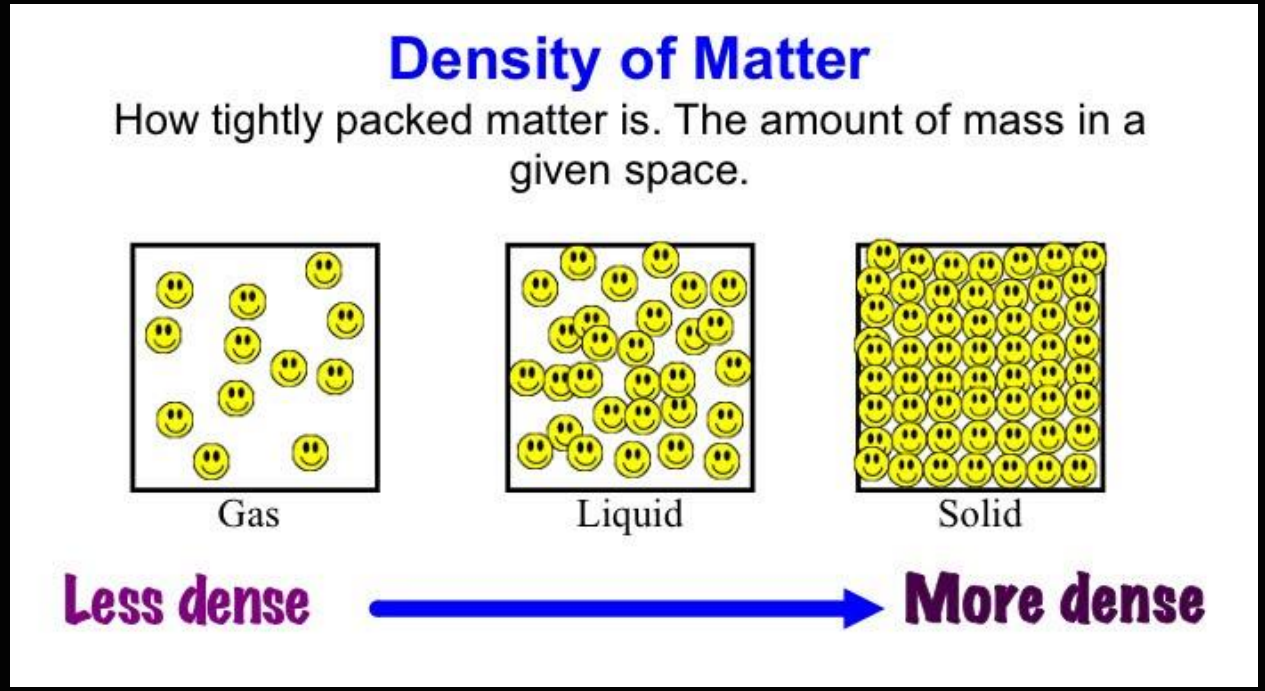
- Friction is the resistance that one surface or object encounters when moving over another. Friction exists between any two materials that contact each other.
- The surface of a wing, like any other surface, has a certain roughness at the microscopic level. The surface roughness causes resistance and slows the velocity of the air flowing over the wing

Atmosphere – Pressure

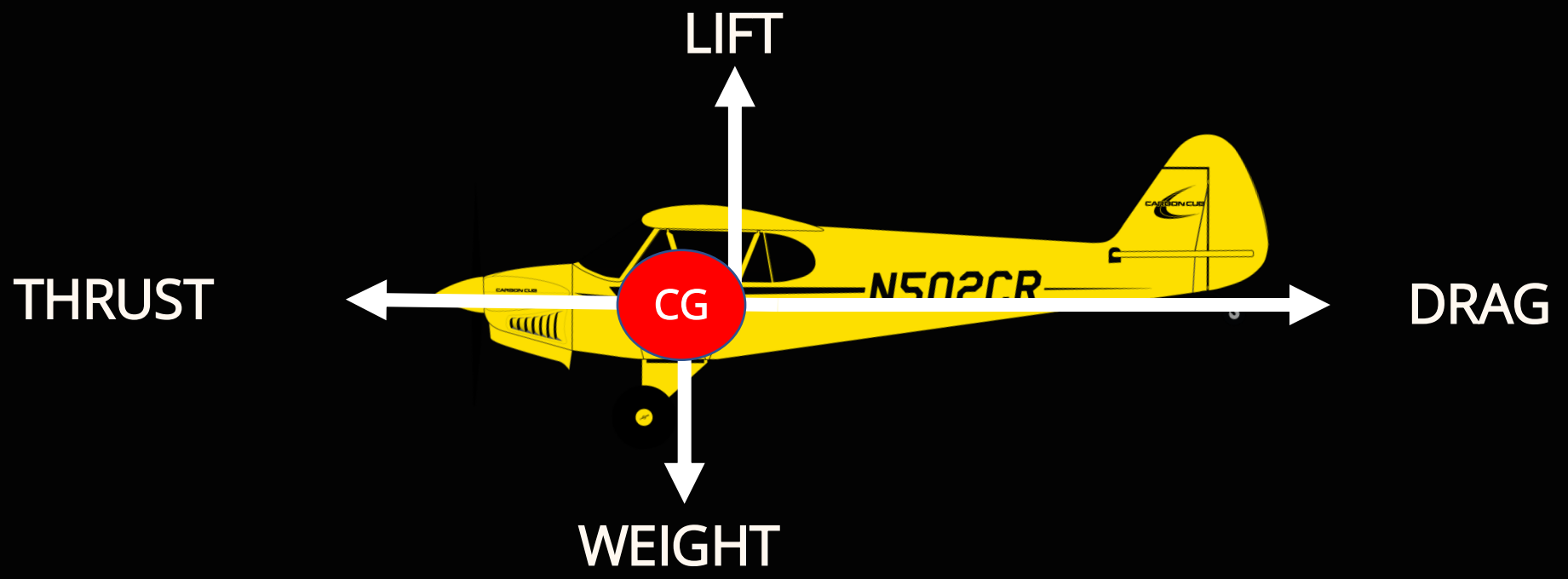
- Pressure is the force applied in a perpendicular direction to the surface of an object.
- Pressure is often measured in PSI or inches of Hg.
- If the pressure on one surface of the object becomes less than the pressure exerted on the other surfaces, the object will move in the direction of the lower pressure.
  - Hint! Hint! Airplane Wing

Atmosphere – Density

- Density is a substances mass per unit volume. How much space for how much stuff



Four Forces of Flight



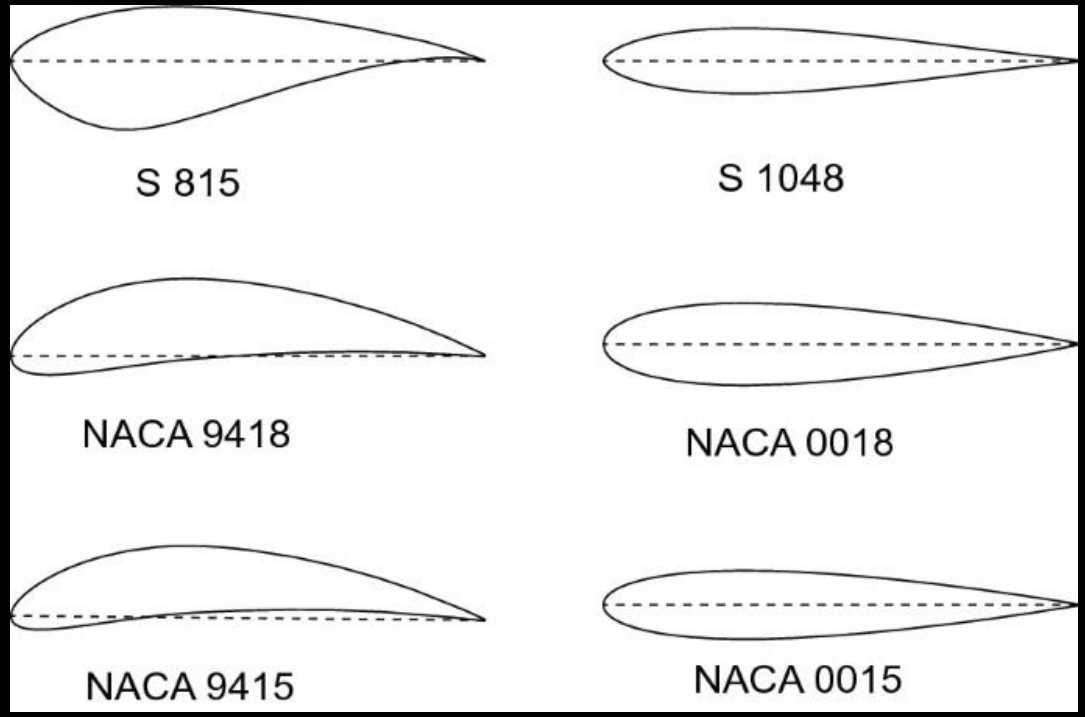
Change in any of these force will cause the airplane to climb, turn, or descend

Four Forces of Flight - Weight

- What is weight? Total weight of the airplane
- Weight = Mass x Acceleration (Gravity) [W=Mg]

Four Forces of Flight - Lift

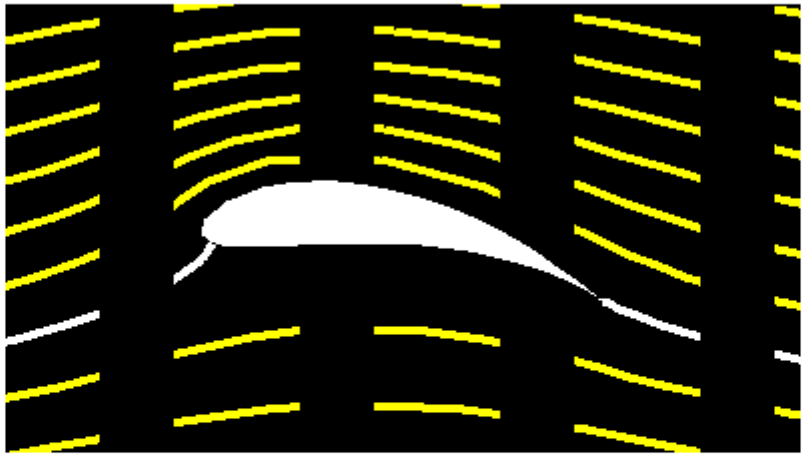
- What causes lift? What is Lift? Hint... it is not magic
- Wing (Airfoil) Shape
- Lift is a force



Four Forces of Flight - Lift

Lift from Flow Turning

Glenn Research Center



Lift is a force.

Force = mass X acceleration

$$F = m\,a$$

Force = mass X change in velocity with time

$$F = \frac{m\,(V_1 - V_0)}{(t_1 - t_0)}$$

Velocity has both magnitude (speed) and direction.

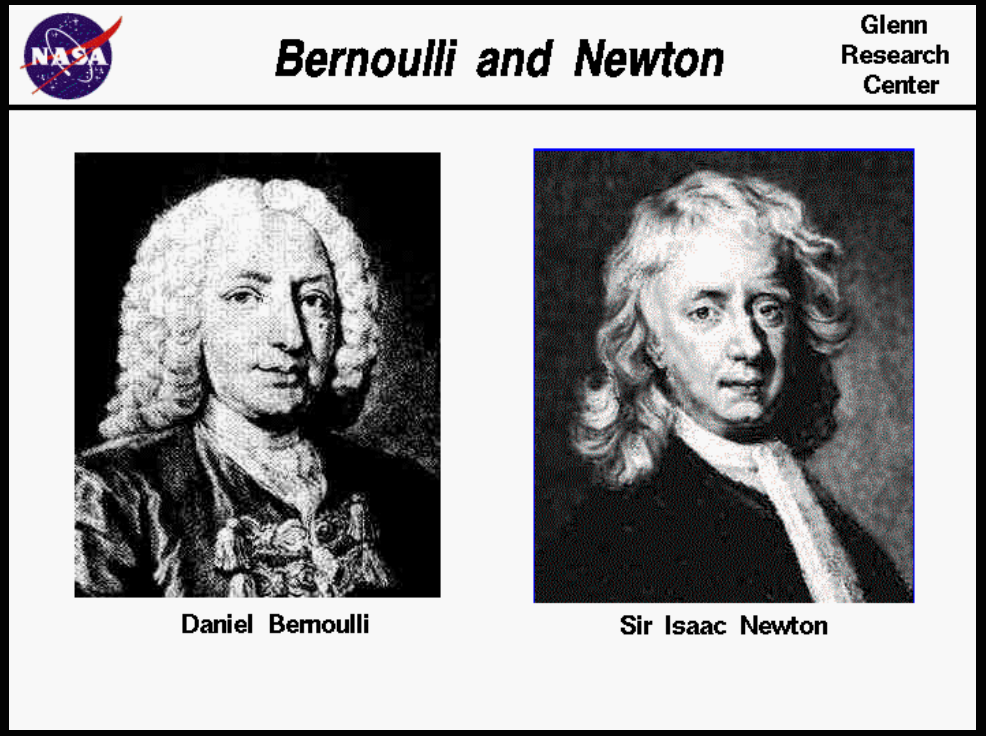
Changing either the speed or direction of a flow generates a force.

Lift is a force generated by turning a moving fluid.

Four Forces of Flight - Lift

- Two major theories exist today. Newton's Laws of Motion and Bernoulli's Principle

https://www.grc.nasa.gov/www/k-12/airplane/bernnew.html

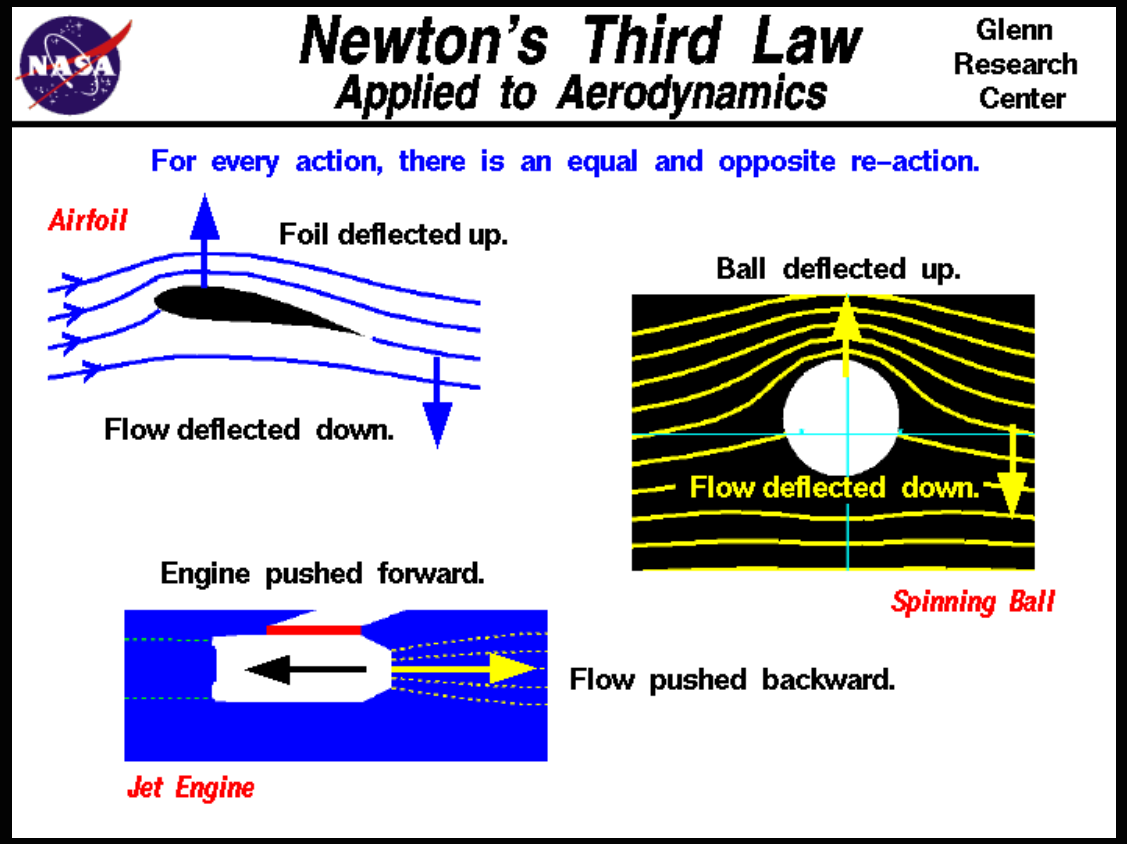


Four Forces of Flight – Newton's 3rd Law

- Newton's First Law: "Every object persists in its state of rest or uniform motion in a straight line unless it is compelled to change that state by forces impressed on it."
- Newton's Second Law: "Force is equal to the change in momentum per change in time. For a constant mass, force equals mass times acceleration."
- **Newton's Third Law: "For every action, there is an equal and opposite reaction."**

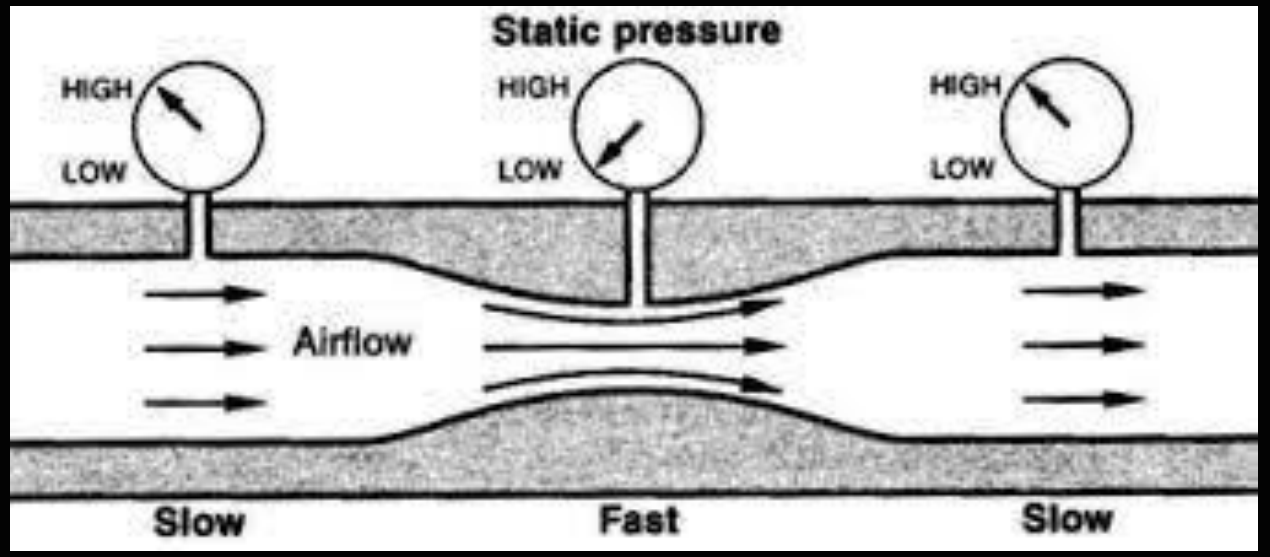
Four Forces of Flight – Newton's 3rd Law

- Air being deflected down due to wing shape cause a force vertically

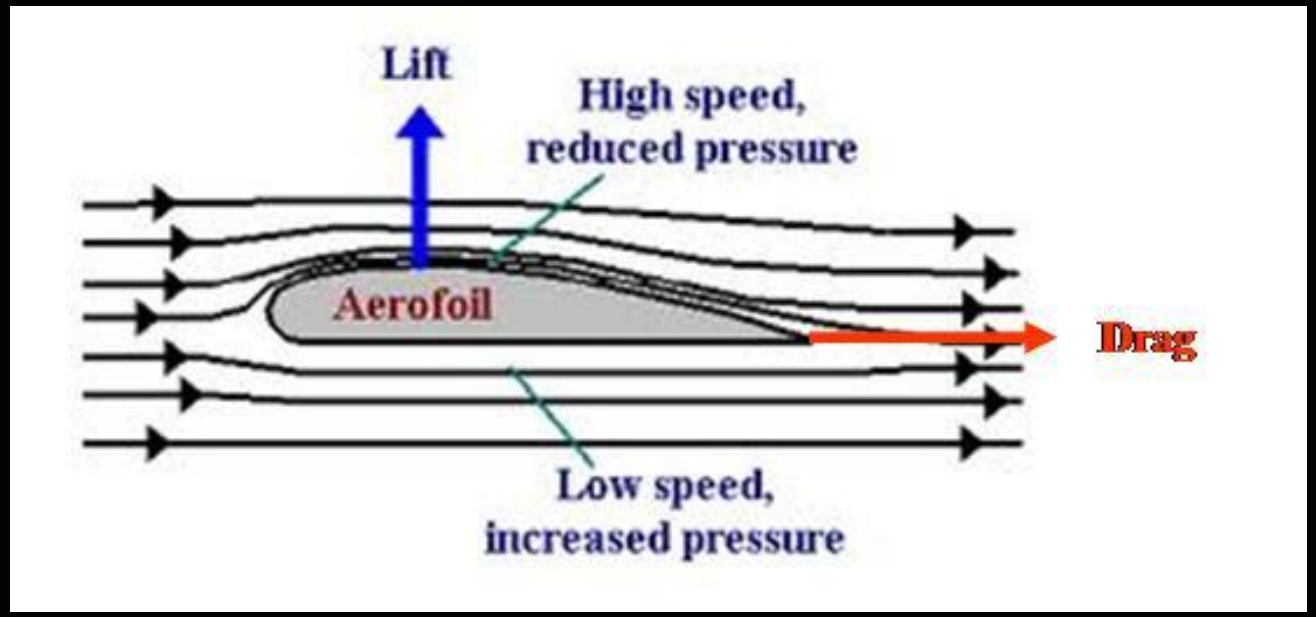


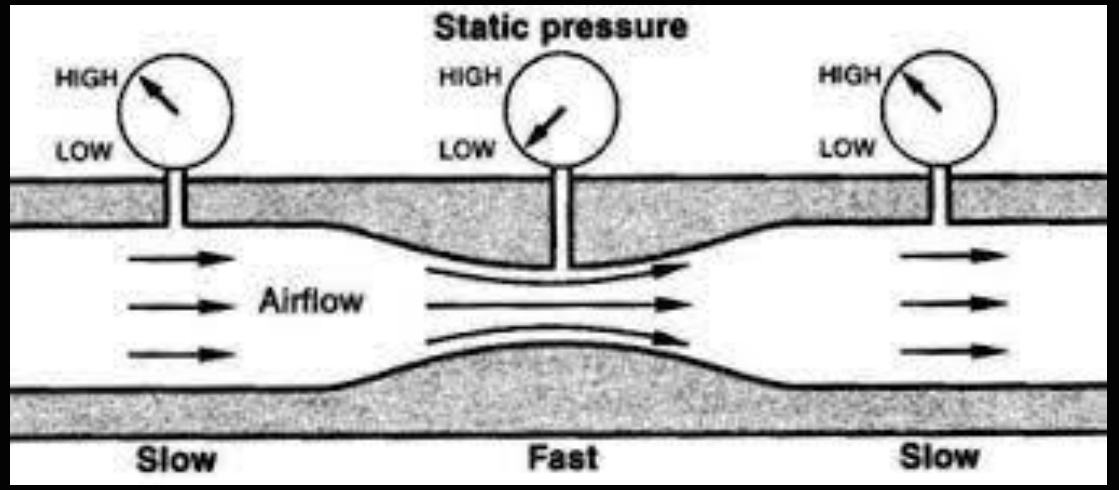
Four Forces of Flight – Bernoulli's Principle of Lift

- The pressure of a moving fluid (liquid or gas) varies with its speed of motion. Bernoulli's Principle states that as the velocity of a moving fluid (liquid or gas) increases, the pressure within the fluid decreases. This principle explains what happens to air passing over the curved top of the airplane wing.



Four Forces of Flight – Bernoulli's Principle of Lift





Four Forces of Flight – Bernoulli's Principle of Lift

Four Forces of Flight – Lift

Four Forces of Flight – Misconceptions

Incorrect Theory #1

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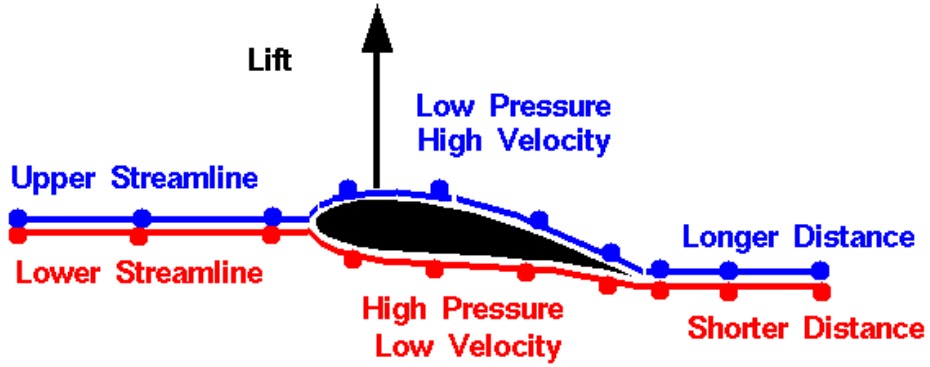

"Longer Path" or "Equal Transit" Theory

Top of airfoil is shaped to provide longer path than bottom. Air molecules have farther to go over the top.

Air molecules must move faster over the top to meet molecules at the trailing edge that have gone underneath.

From Bernoulli's equation, higher velocity produces lower pressure on the top.

Difference in pressure produces lift.

Incorrect Theory #2

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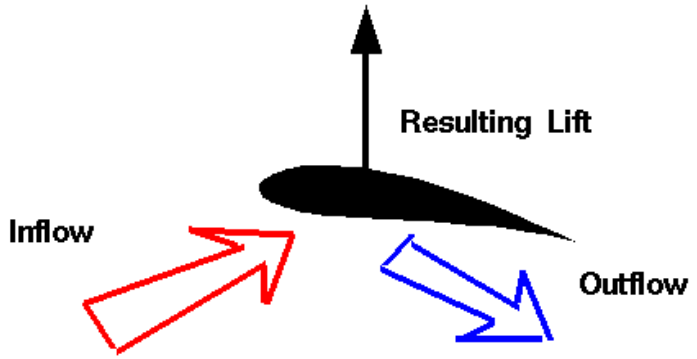
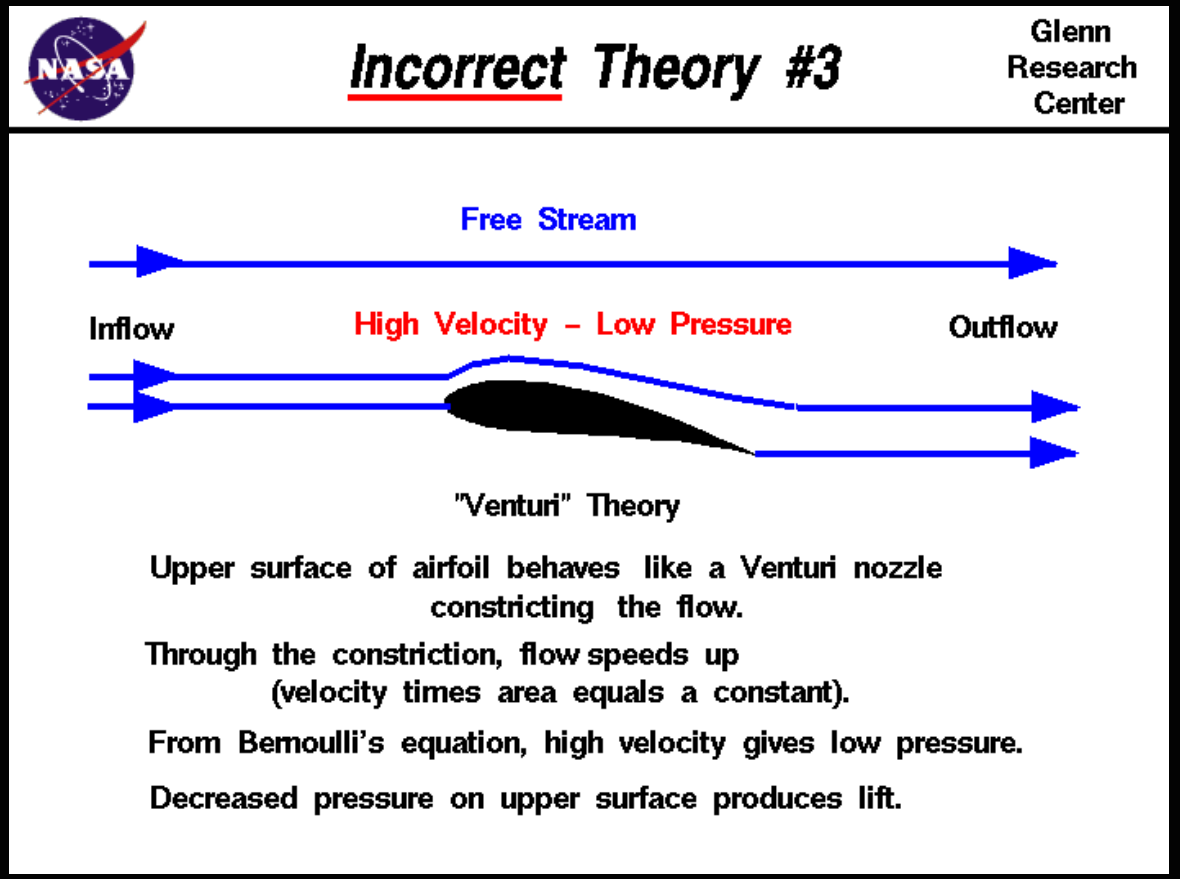


"Skipping Stone" Theory

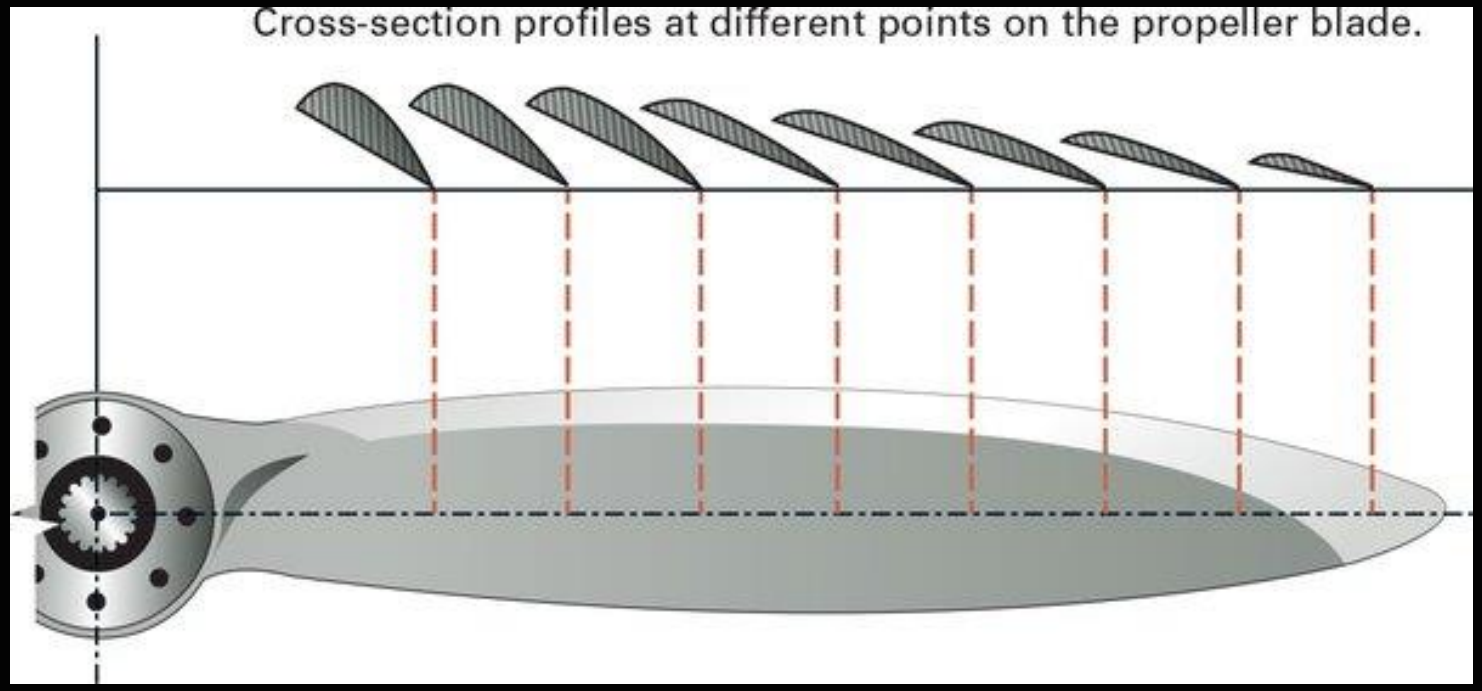
Lift is the result of simple action <--> reaction as air molecules strike bottom of the airfoil imparting momentum to the foil.

Four Forces of Flight – Misconceptions



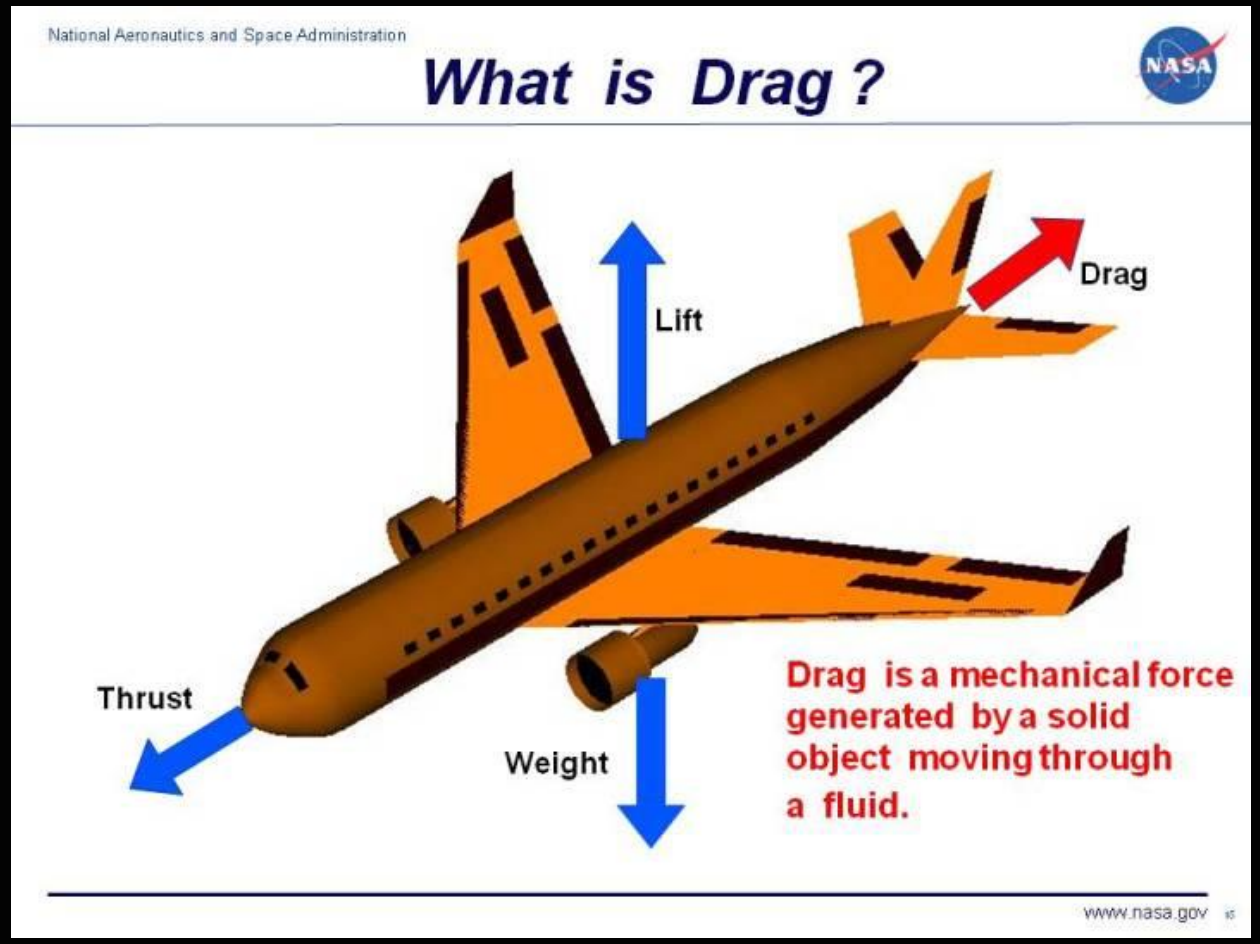
Four Forces of Flight – Thrust

- Thrust is the force that accelerates the airplane forward. In many airplanes this is accomplish by using a propeller (prop is powered by an engine).
- Produces a force forward



Four Forces of Flight – Drag

- Drag is any force that opposes thrust.
- Drag is natural with an object moving through a fluid
- Parasite and Induced



Knowledge Check

What Is the primary role of the Federal Aviation Administration (FAA)?

A. Promote aviation and safety
B. Regulate airline travel only
C. Enforce regulations by enacting legal action
D. Promote air transportation for private users only

Knowledge Check

What Is the primary role of the Federal Aviation Administration (FAA)?

A. Promote aviation and safety
B. ~~Regulate airline travel only~~
C. ~~Enforce regulations by enacting legal action~~
D. ~~Promote air transportation for private user only~~

Knowledge Check

Wing design changes for each airplane and it’s mission?

A. True
B. False

Knowledge Check

Wing design changes for each airplane and it's mission?

A. True

~~B. False~~

Knowledge Check

Aircraft pitch is controlled by rotating around which axis?

A. Longitudinal
B. Vertical
C. Lateral
D. Horizontal

Knowledge Check

Aircraft pitch is controlled by rotating around which axis?

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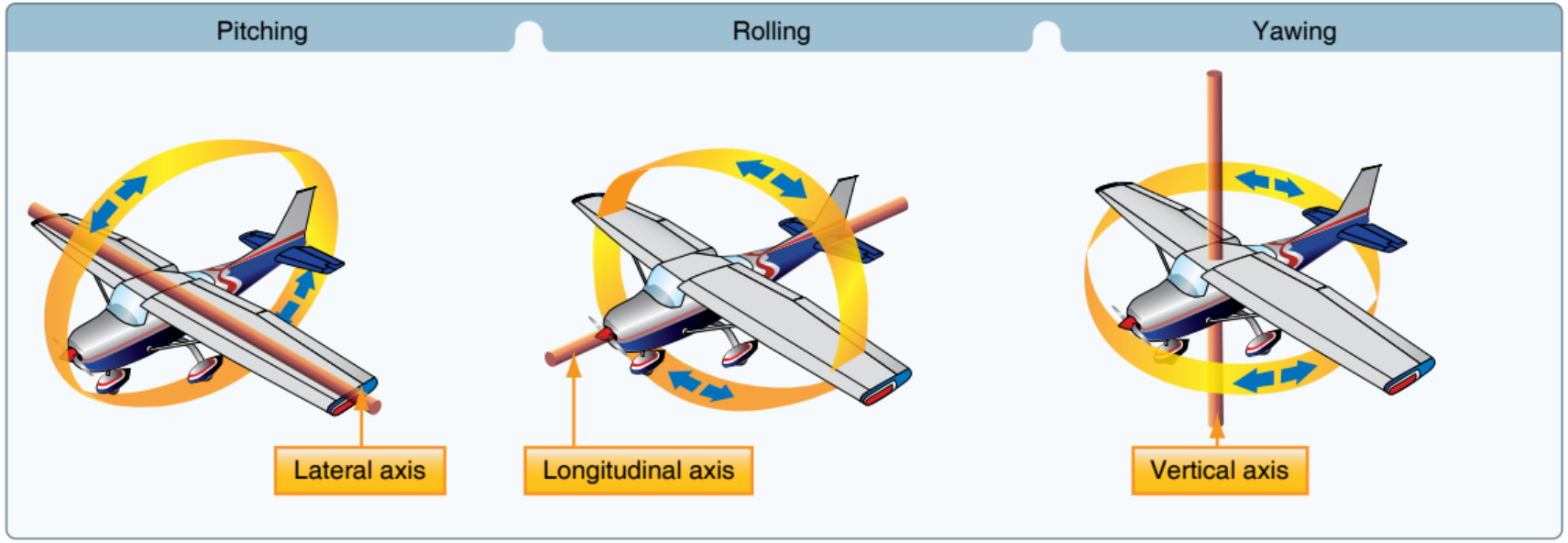
~~D. Horizontal~~



Knowledge Check

In level cruise flight, will lift equal weight?

A. True
B. False

Knowledge Check

In level cruise flight, will lift equal weight?

A. True

~~B. False~~

Knowledge Check

Newton’s theory of lift is based on which law?

A. First Law
B. Second Law
C. Third Law
D. None of the Above

Knowledge Check

Newton’s theory of lift is based on which law?

~~A. First Law~~

~~B. Second Law~~

C. Third Law

~~D. None of the Above~~

Knowledge Check

Bernoulli's principle is dependent upon which concept?

A. Newtons Third Law
B. Venturi
C. Viscosity
D. All of the Above

Knowledge Check

Bernoulli's principle is dependent upon which concept?

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