



# AVIATION MERIT BADGE

J. H. Welsch  
Private Pilot



## Requirements

### 1. Do the following:

- a) Define 'aircraft'. Describe some kinds and uses of aircraft today. Explain the operation of piston, turboprop, and jet engines.
- b) Point out on a model airplane the forces that act on an airplane in flight.
- c) Explain how an airfoil generates lift, how the primary control surfaces (ailerons, elevators, and rudder) affect the airplane's attitude, and how a propeller produces thrust.
- d) Demonstrate how the control surfaces of an airplane are used for takeoff, straight climb, level turn, climbing turn, descending turn, straight descent, and landing.
- e) Explain the following: the recreational pilot and the private pilot certificates; the instrument rating.



## Requirements

### 2. Do TWO of the following:

- a) Take a flight in an aircraft, with your parent's permission. Record the date, place, type of aircraft, and duration of flight, and report on your impressions of the flight.
- b) Under supervision, perform a preflight inspection of a light aircraft.
- c) Obtain and learn how to read an aeronautical chart. Measure a true course on the chart. Correct for magnetic variation, compass deviation, and wind drift. Arrive at a compass heading.
- d) Using one of many flight simulator software packages available for computers, 'fly' the course and heading you established in requirement 2c or another course you have plotted.
- e) On a map, mark a route for an imaginary airline trip to at least three different locations. Start from the commercial airport nearest your home. From timetables (obtained from agents or online from a computer, with your parent's permission), decide when you will get to and leave from all connecting points. Create an aviation flight plan and itinerary for each destination.
- f) Explain the purposes and functions of the various instruments found in a typical single-engine aircraft: attitude indicator, heading indicator, altimeter, airspeed indicator, turn and bank indicator, vertical speed indicator, compass, navigation (GPS and VOR) and communication radios, tachometer, oil pressure gauge, and oil temperature gauge.
- g) Create an original poster of an aircraft instrument panel. Include and identify the instruments and radios discussed in requirement 2f.



## Requirements

### 3. Do ONE of the following:

- a) Build and fly a fuel-driven or battery-powered electric model airplane. Describe safety rules for building and flying model airplanes. Tell safety rules for use of glue, paint, dope, plastics, fuel, and battery packs.
- b) Build a model FPG-9. Get others in your troop or patrol to make their own model, then organize a competition to test the precision of flight and landing of the models.



## Requirements

**4. Do ONE of the following:**

- a) Visit an airport. After the visit, report on how the facilities are used, how runways are numbered, and how runways are determined to be 'active.'
- b) Visit a Federal Aviation Administration facility — a control tower, terminal radar control facility, air route traffic control center, flight service station, or Flight Standards District Office. (Phone directory listings are under U.S. Government Offices, Transportation Department, Federal Aviation Administration. Call in advance.) Report on the operation and your impressions of the facility.
- c) Visit an aviation museum or attend an air show. Report on your impressions of the museum or show.



## Requirements

- 5. Find out about three career opportunities in aviation. Pick one and find out the education, training, and experience required for this profession. Discuss this with your counselor, and explain why this Profession might interest you.**

**1a. Define 'aircraft'. Describe some kinds and uses of aircraft today. Explain the operation of piston, turboprop, and jet engines.**



## **Define “Aircraft”**

- “a weight-carrying structure for navigation of the air that is supported either by its own buoyancy or by the dynamic action of the air against its surfaces.” – **Websters**
- “a device that is used or intended to be used for flight in the air.” - **FAA**



**1a. Define 'aircraft'. Describe some kinds and uses of aircraft today. Explain the operation of piston, turboprop, and jet engines.**



## **Types of Aircraft** (The FAA calls these “Categories”)

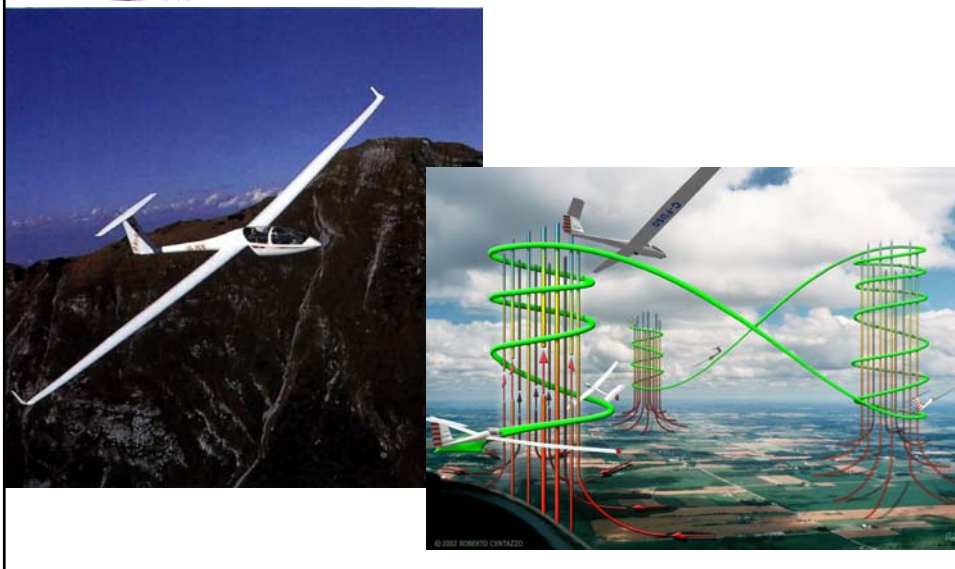
- Lighter-than-air
- Glider
- Airplane
- Rotorcraft
- Powered Lift



## Lighter-than-Air “Balloons and Airships”



## Glider “Sailplanes”





# Airplanes



# Rotorcraft “Helicopters and Gyroplanes”





## Powered-Lift “V-22 Osprey”



**1a.** Define 'aircraft'. Describe some kinds and uses of aircraft today. Explain the operation of piston, turboprop, and jet engines.

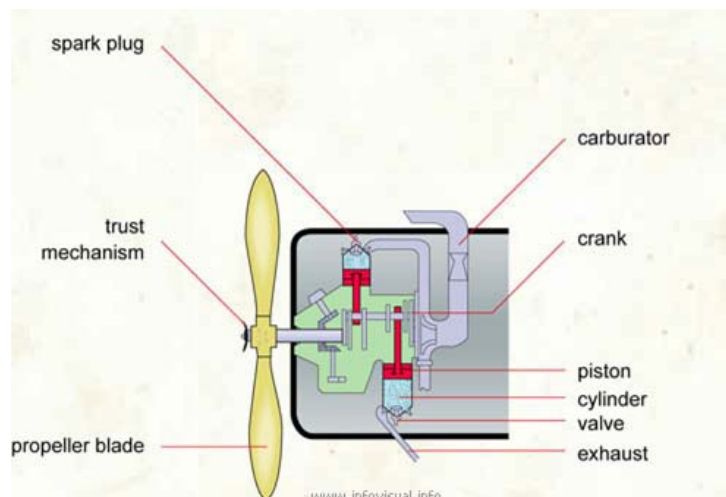


# Engines

- Piston
- Turboprop
- Jet



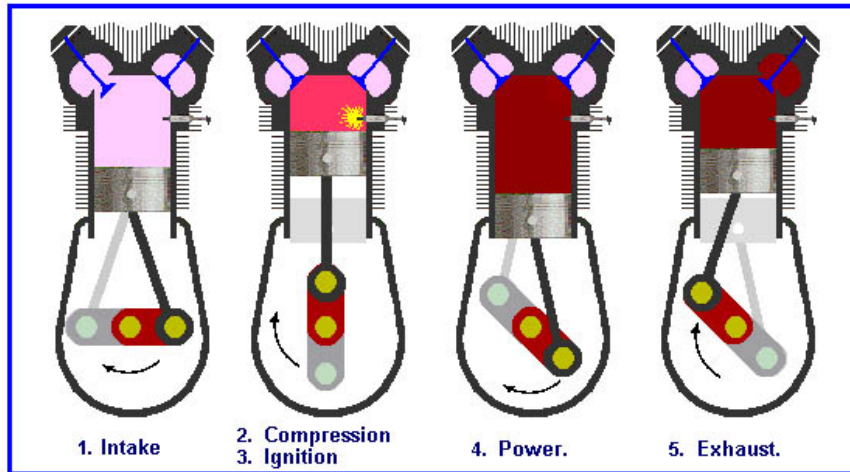
## Piston Engine



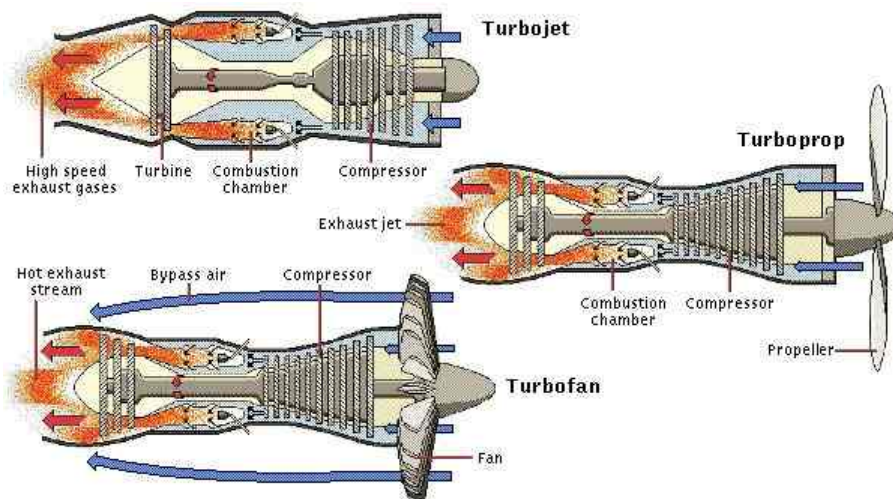




## Piston Engine



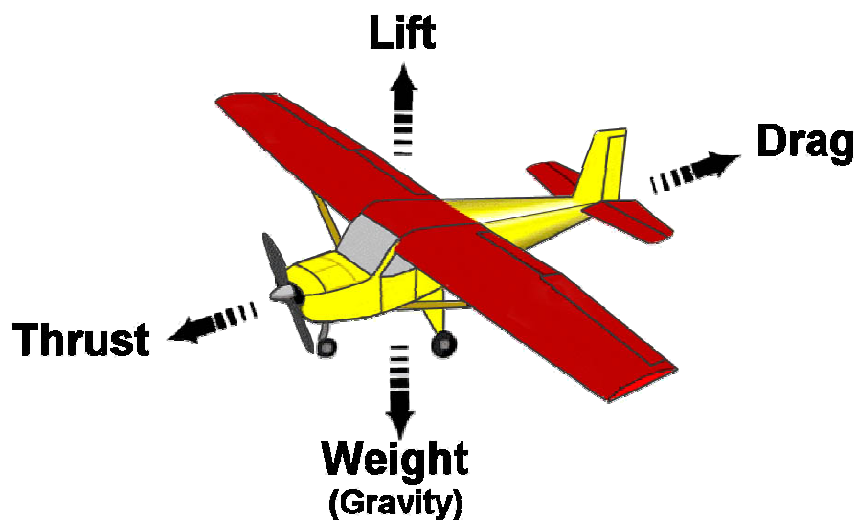
## Jet Engines



**1b. Point out on a model airplane the forces that act on an airplane in flight.**



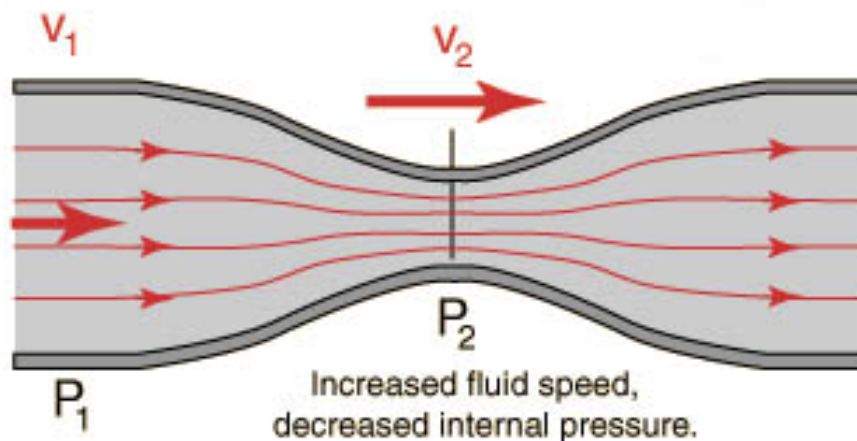
## **Forces Acting on Aircraft**



**1c. Explain how an airfoil generates lift, how the primary control surfaces (ailerons, elevators, and rudder) affect the airplane's attitude, and how a propeller produces thrust.**



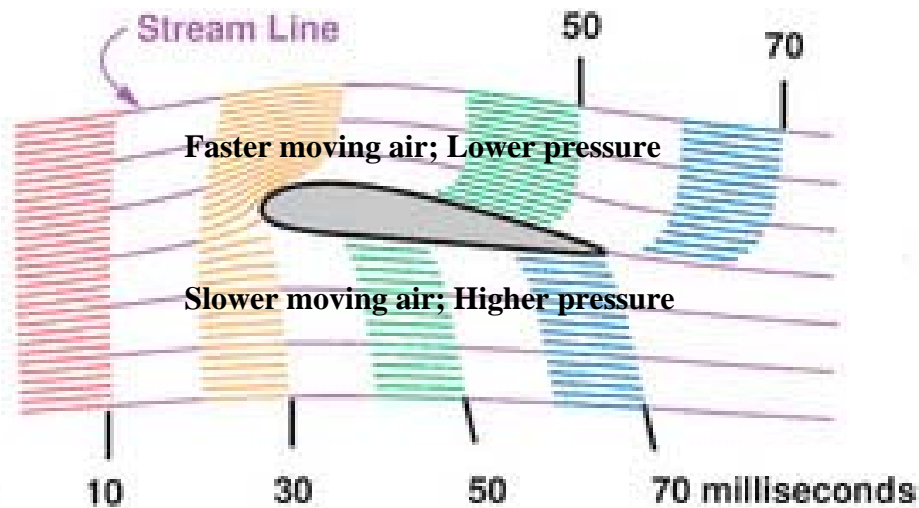
## How an Airfoil Works Bernoulli's Principle







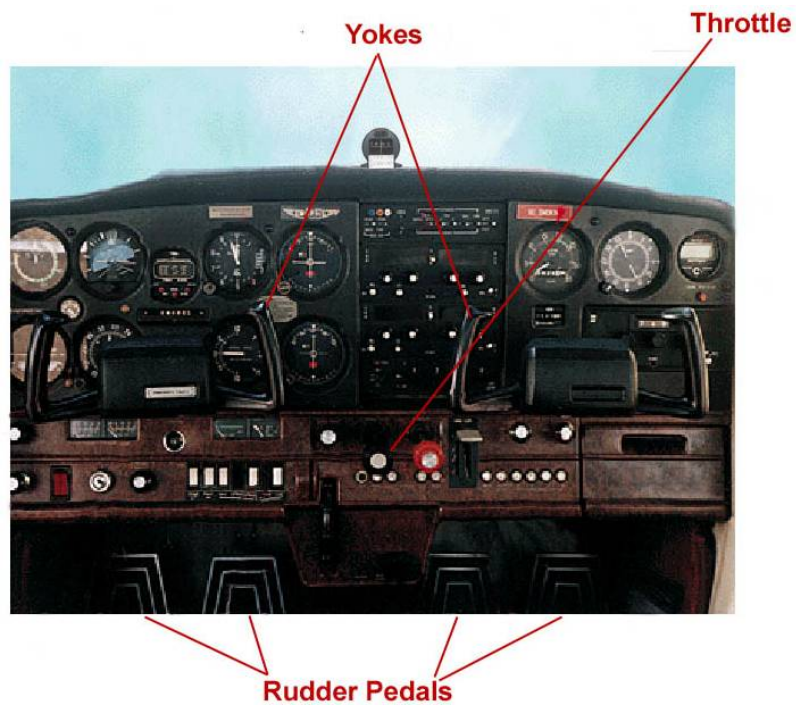
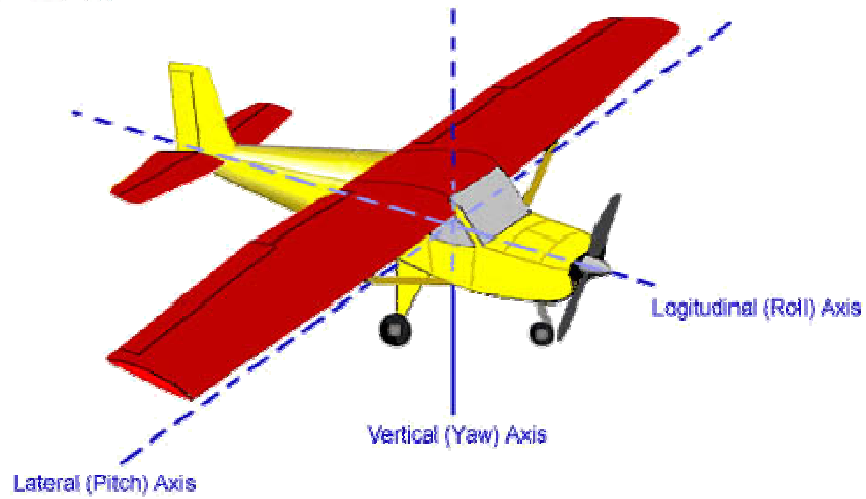
## How an Airfoil Works



**1c.** Explain how an airfoil generates lift, how the primary control surfaces (ailerons, elevators, and rudder) affect the airplane's attitude, and how a propeller produces thrust.

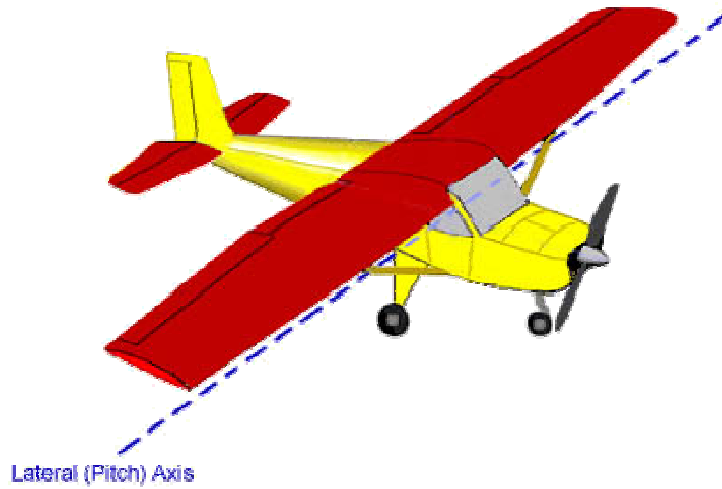


# Aircraft Control

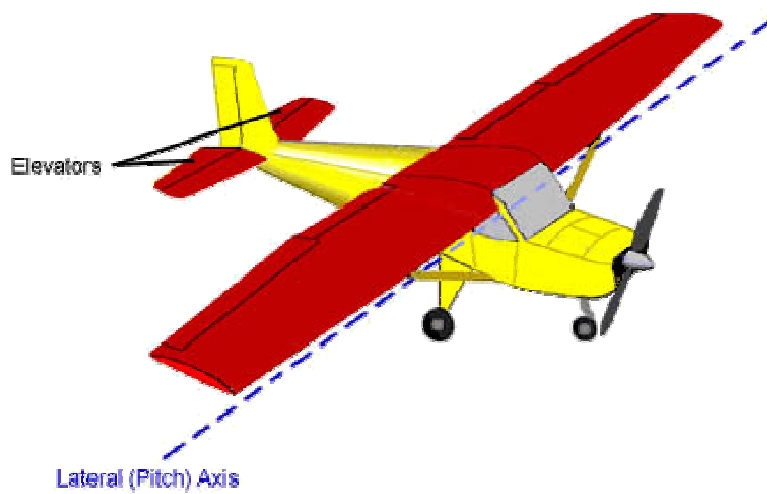




## Aircraft Control Pitch



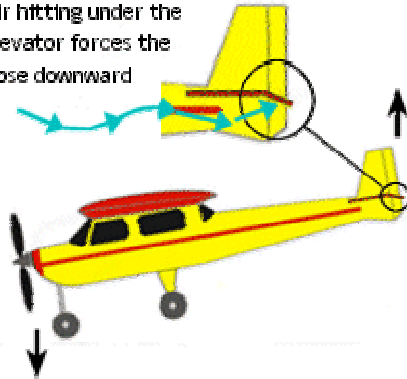
## Aircraft Control Pitch





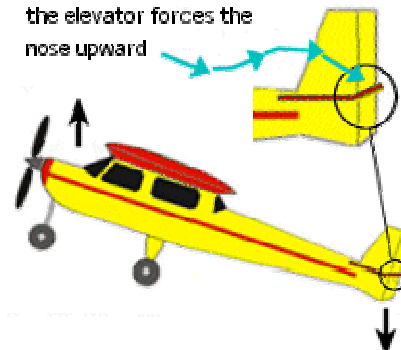
## Control Surfaces The Elevator

Air hitting under the elevator forces the nose downward



(Push stick or yoke forward)

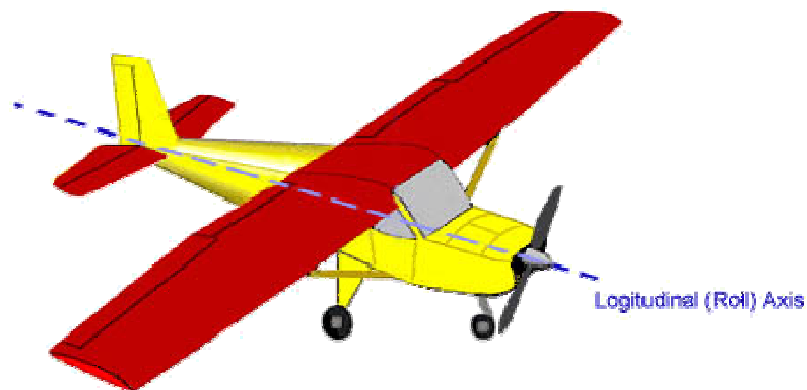
Air hitting the top of the elevator forces the nose upward



(Pull stick or yoke back)

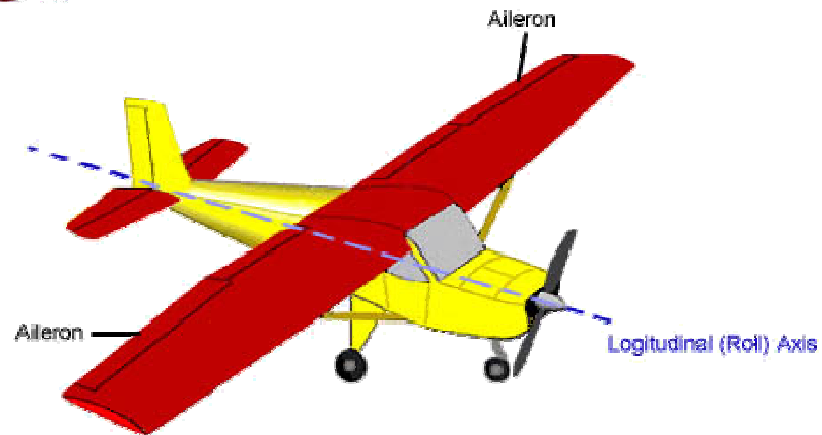


## Aircraft Control Roll





## Aircraft Control Roll



## Control Surfaces Ailerons

Left aileron down, right one up  
causes a roll to the right



(Push stick or turn yoke to right)

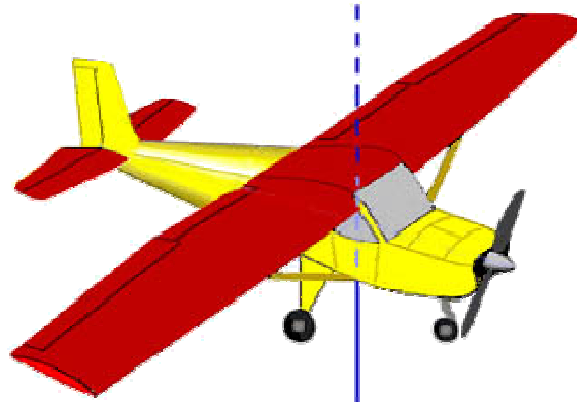
Left aileron up, right one down  
causes a roll to the left



(Push or turn yoke to left)



## Aircraft Control Yaw

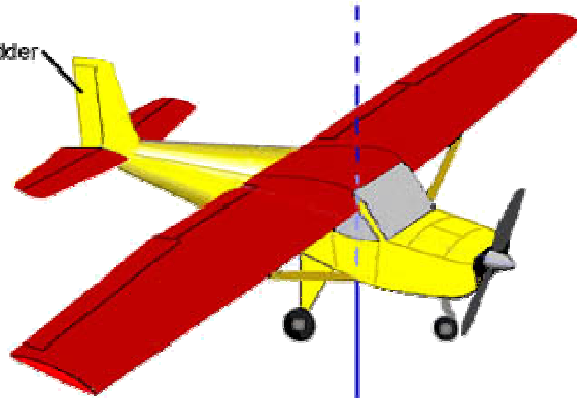


Vertical (Yaw) Axis

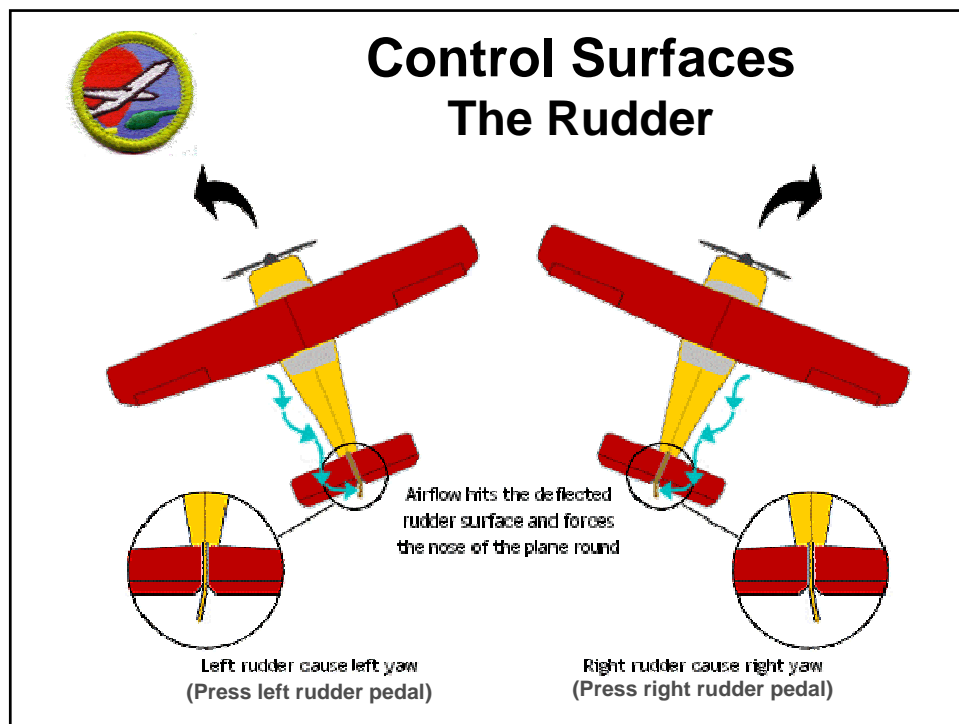


## Aircraft Control Yaw

Rudder



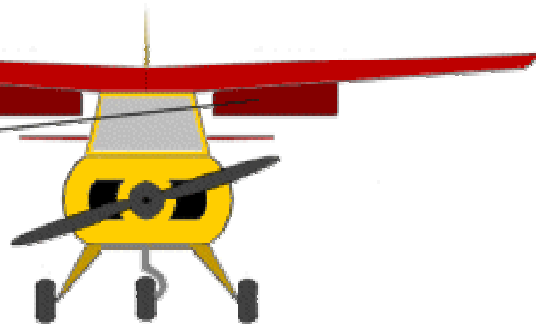
Vertical (Yaw) Axis



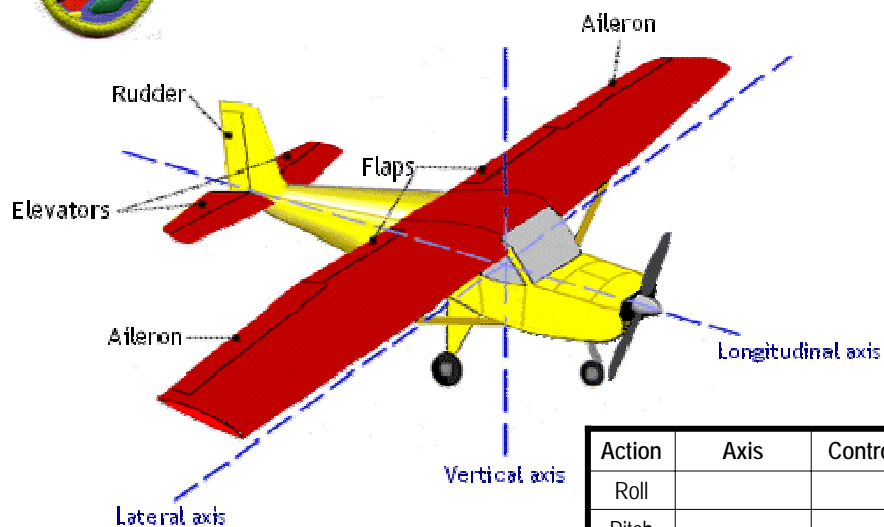


## Aircraft Control Flaps

Lowered flaps slow the airplane by causing more drag, but also generate extra lift at the slower speeds

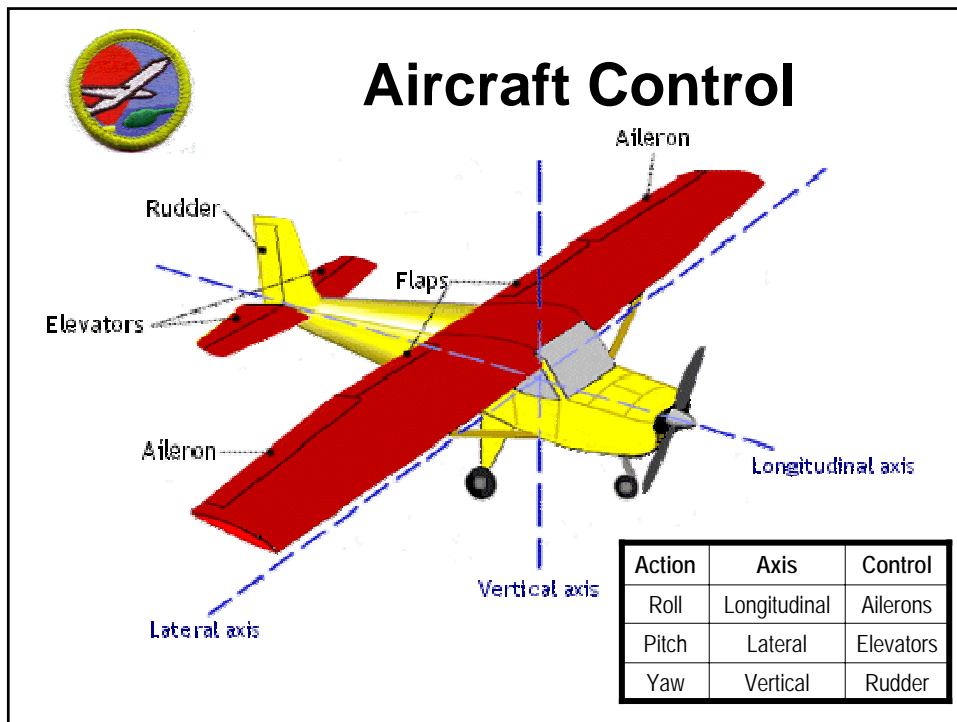


## Aircraft Control



Action	Axis	Control
Roll		
Pitch		
Yaw		





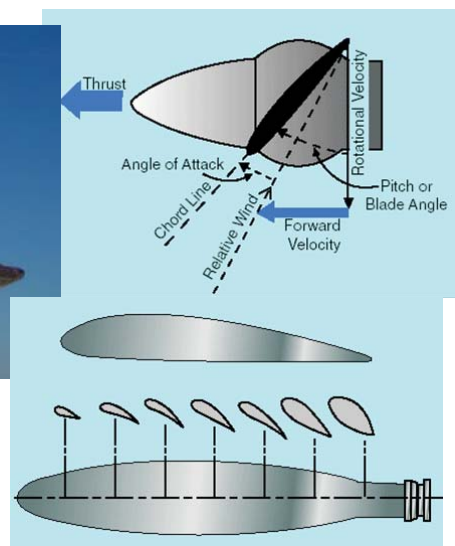
**1c. Explain how an airfoil generates lift, how the primary control surfaces (ailerons, elevators, and rudder) affect the airplane's attitude, and how a propeller produces thrust.**



# Propeller



# Propeller



**1d. Demonstrate how the control surfaces of an airplane are used for takeoff, straight climb, level turn, climbing turn, descending turn, straight descent, and landing.**



## Takeoff & Climb

1. NOSEWHEEL OFF

2. LIFT-OFF (MAIN GEAR OFF)

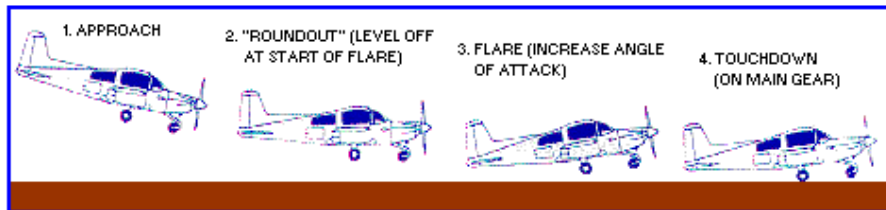
3. GAIN AIRSPEED

4. CLIMB





# Landing



# Aircraft Control

	Ailerons	Elevators	Rudder	Flaps
Takeoff	?	?	?	?
Straight Climb	?	?	?	?
Level Turn	?	?	?	?
Climbing Turn	?	?	?	?
Straight Descent	?	?	?	?
Turning Descent	?	?	?	?
Landing	?	?	?	?

**1e. Explain the following: the recreational pilot and the private pilot certificates; the instrument rating.**



## **Certificates/Ratings**

### **Recreational pilot certificate**

- Requires minimum of 30 hours flight time before getting license.
- Pilot must be at least 17 and have 3<sup>rd</sup> class medical.
- Pilot must read, speak and understand English
- Candidate must pass a “written”, oral and flight test.
- Pilot is qualified to act as pilot-in-command of a single-engine aircraft carrying 1 passenger.
- Flights must be “Day VFR” – (Daytime with visibility good enough to fly without need for instruments.)
- Flights limited to 50 mile range.
- Pilot cannot be paid for flying.



## Certificates/Ratings

### Private pilot certificate

- Requires minimum of 40 hours flight time before getting license.
- Pilot must be at least 17 and have 3<sup>rd</sup> class medical.
- Pilot must read, speak and understand English
- Candidate must pass a “written”, oral and flight test.
- Pilot can act as pilot-in-command of an aircraft carrying passengers and baggage.
- Can fly day or night.
- Can fly in bad weather only with an instrument rating.
- Pilot cannot be paid for flying.



## Certificates/Ratings

### Instrument Rating

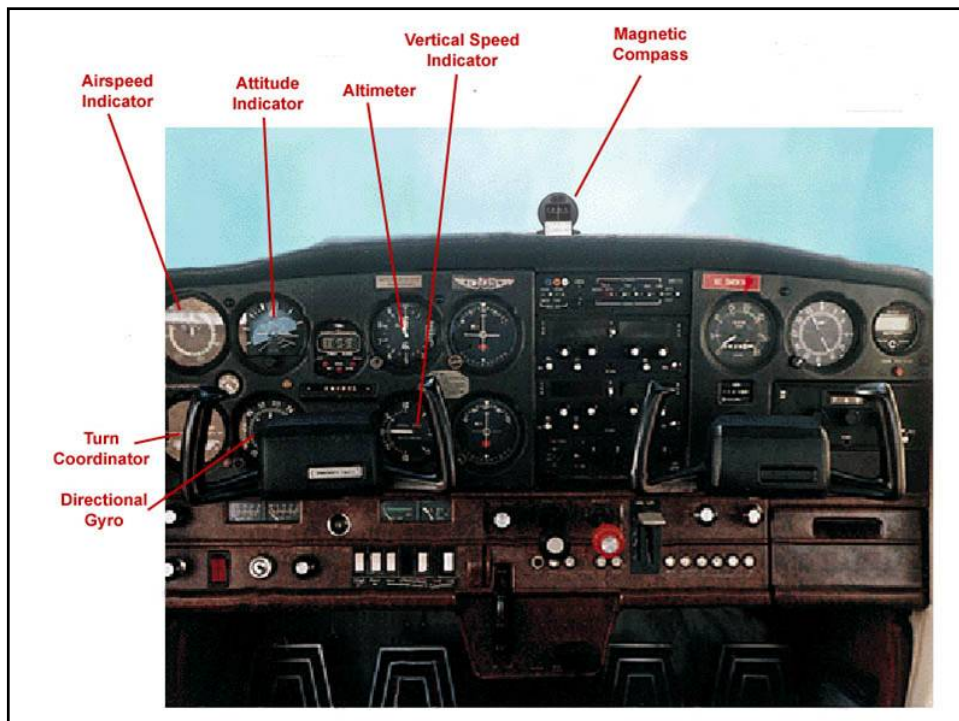
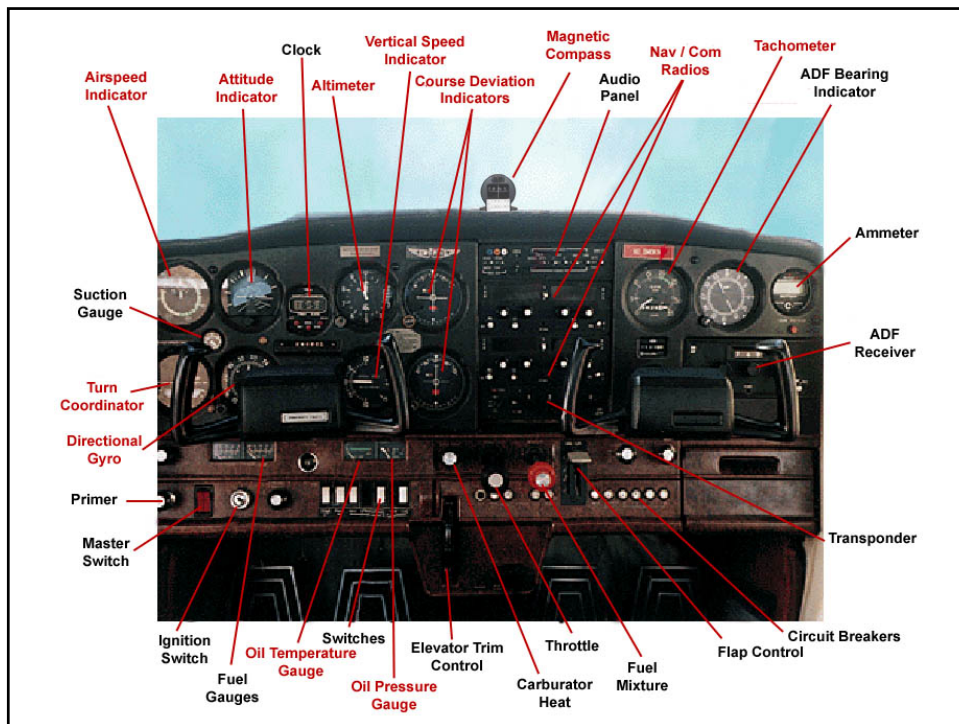
- Requires minimum of 125 hours flight time, of which at least 50 are “cross country”.
- Pilot must hold at least a private pilot’s license and have 3<sup>rd</sup> class medical.
- Pilot must read, speak and understand English
- Candidate must pass a “written”, oral and flight test.
- Pilot can fly the aircraft by solely using the flight instruments within the aircraft.

**2f. Explain the purposes and functions of the various instruments found in a typical single-engine aircraft: attitude indicator, heading indicator, altimeter, airspeed indicator, turn and bank indicator, vertical speed indicator, compass, navigation (GPS and VOR) and communication radios, tachometer, oil pressure gauge, and oil temperature gauge.**



## Control Panels

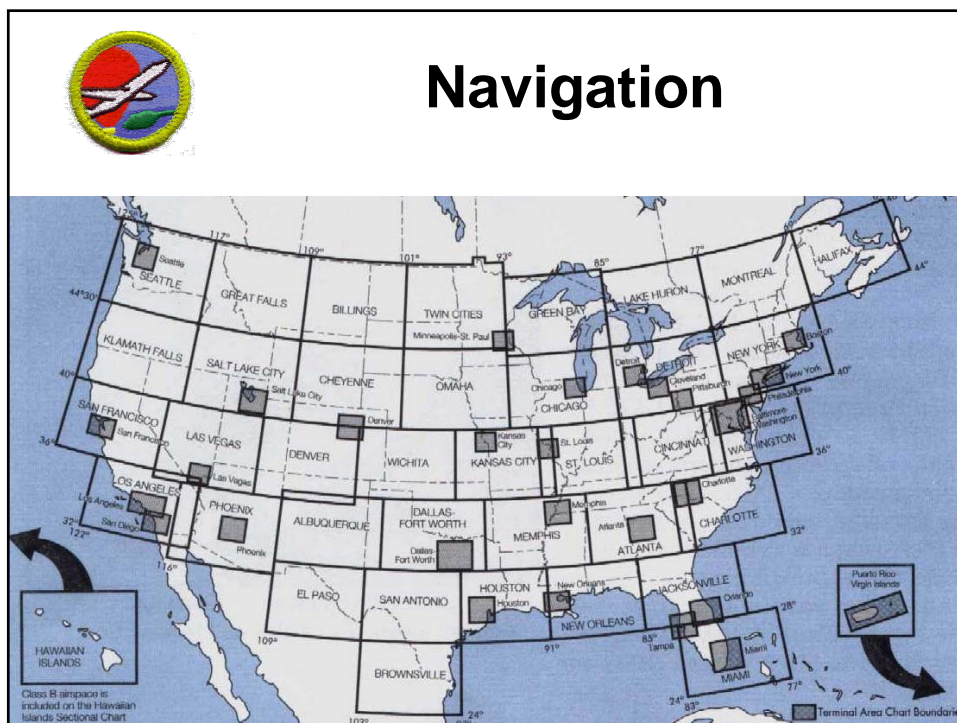
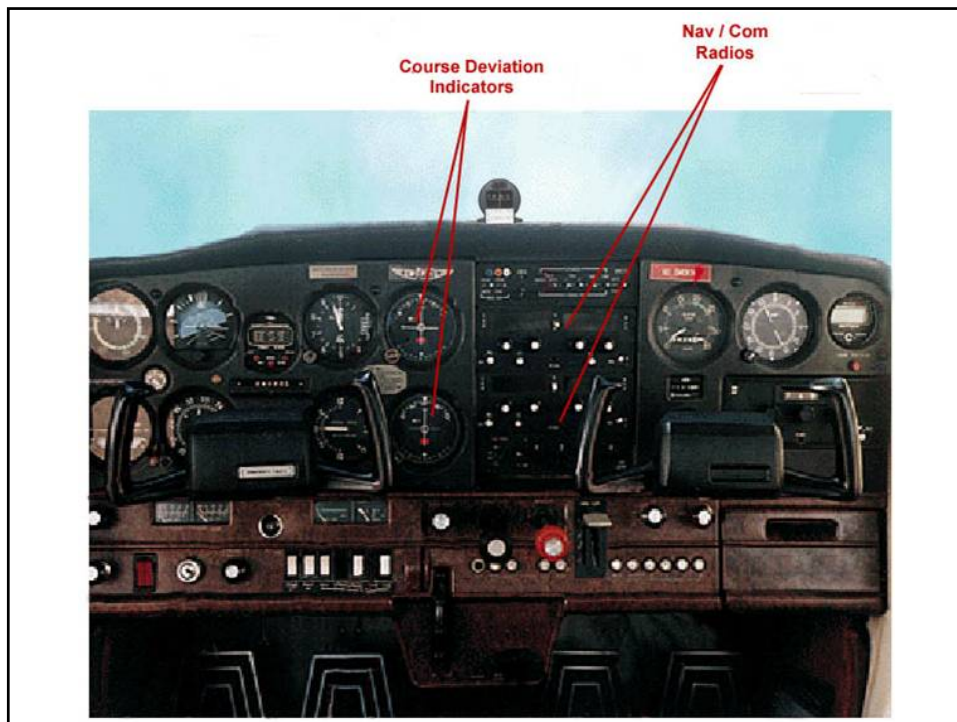


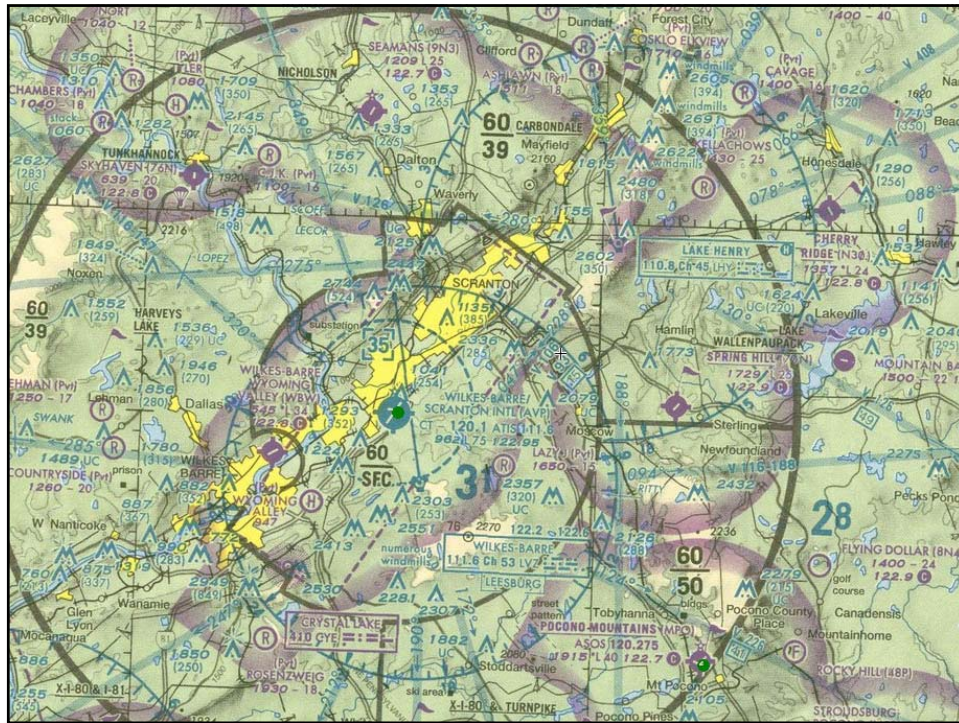






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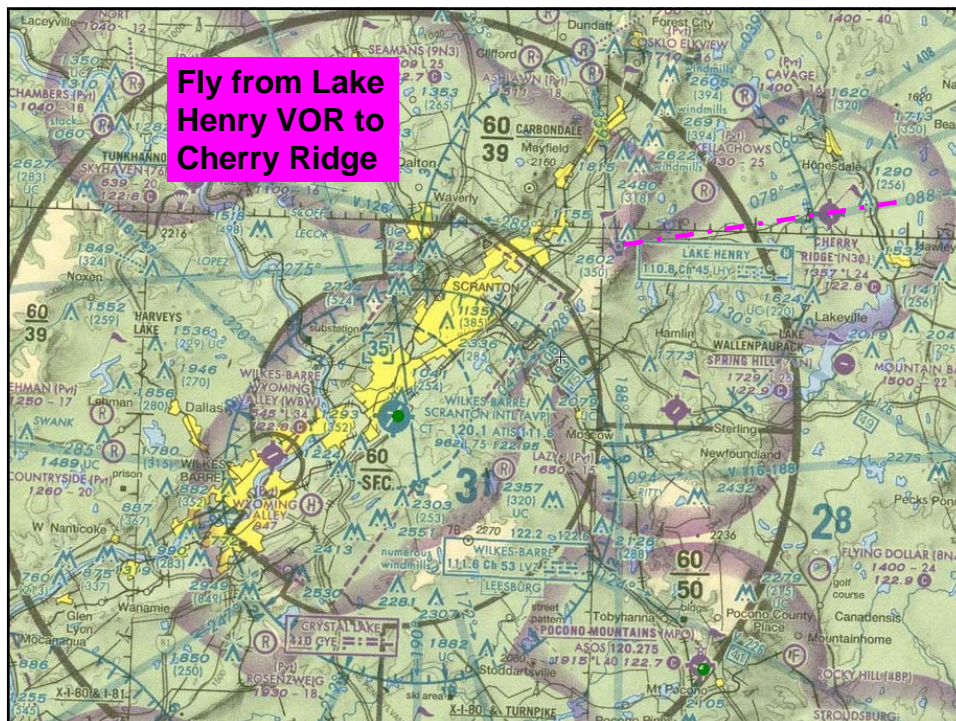




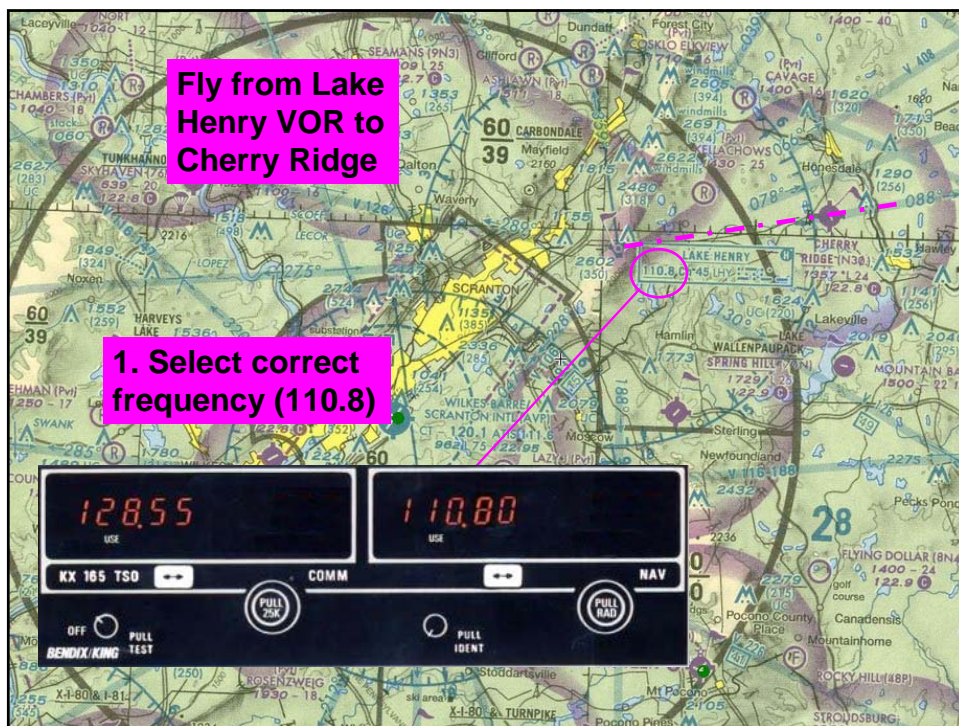




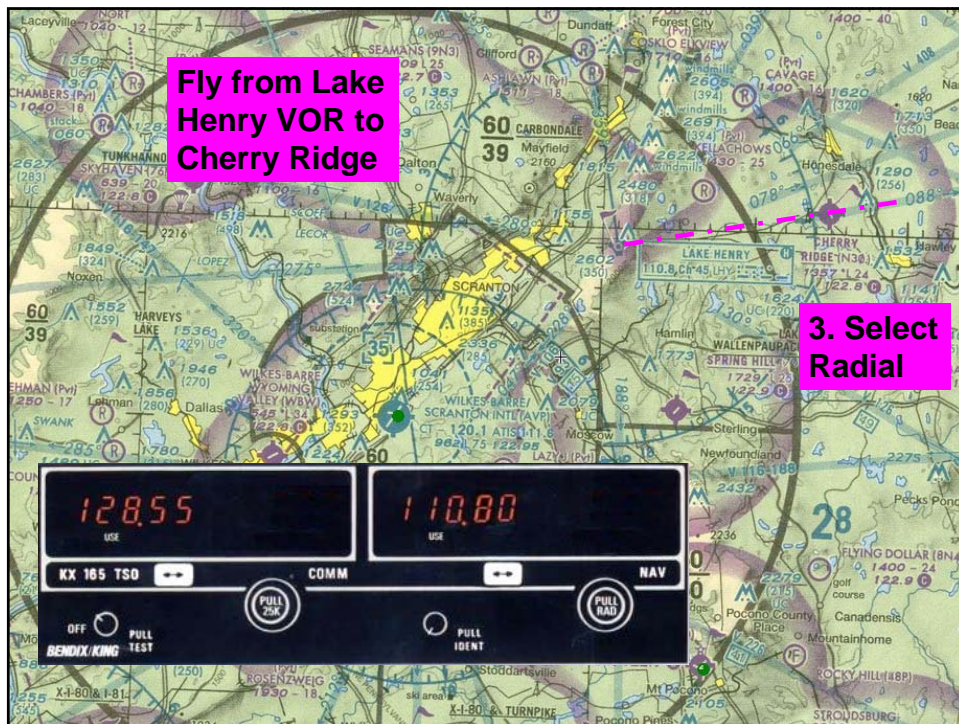
# Radios and Navigation



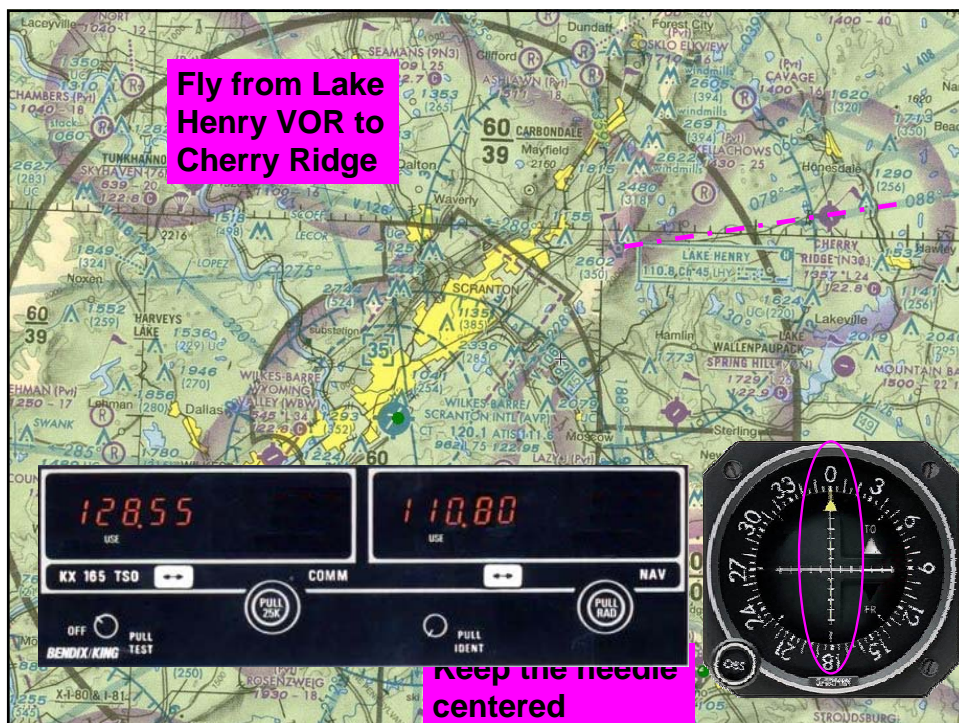
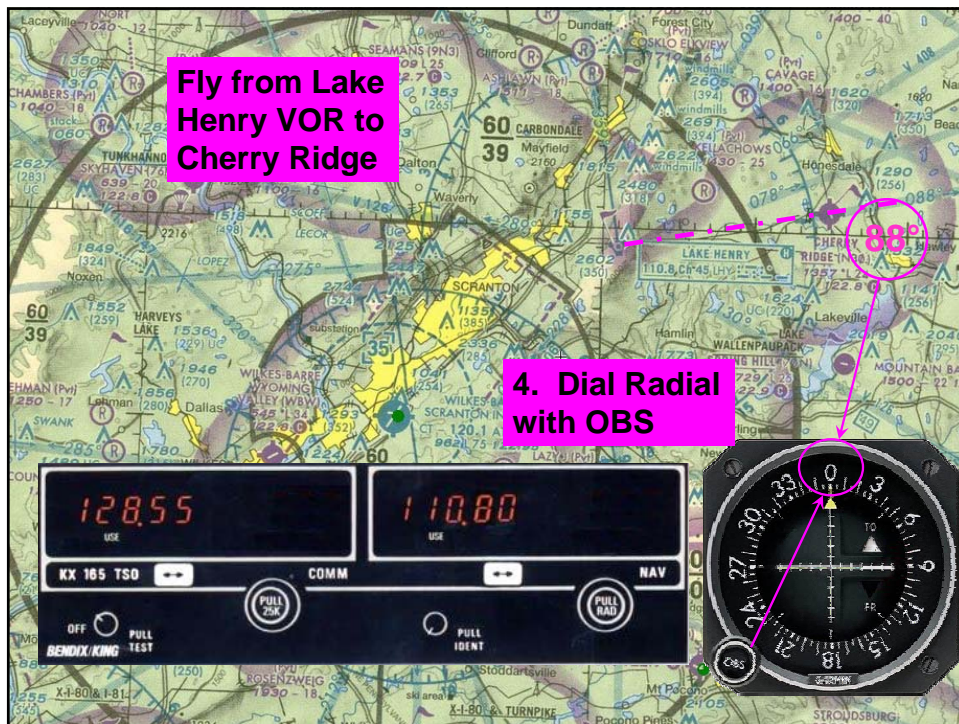




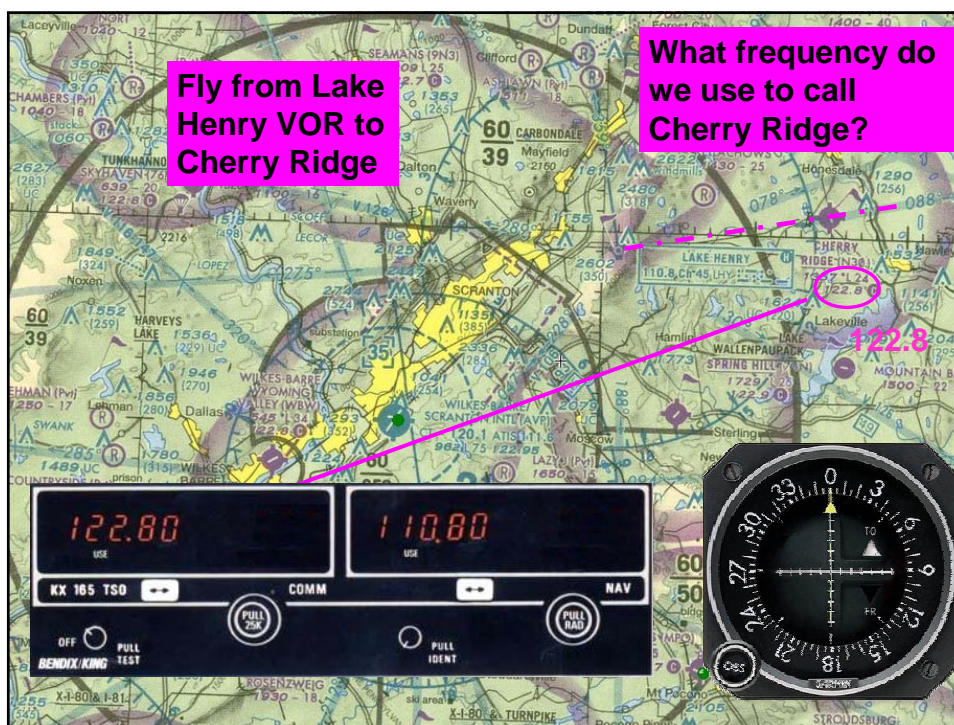
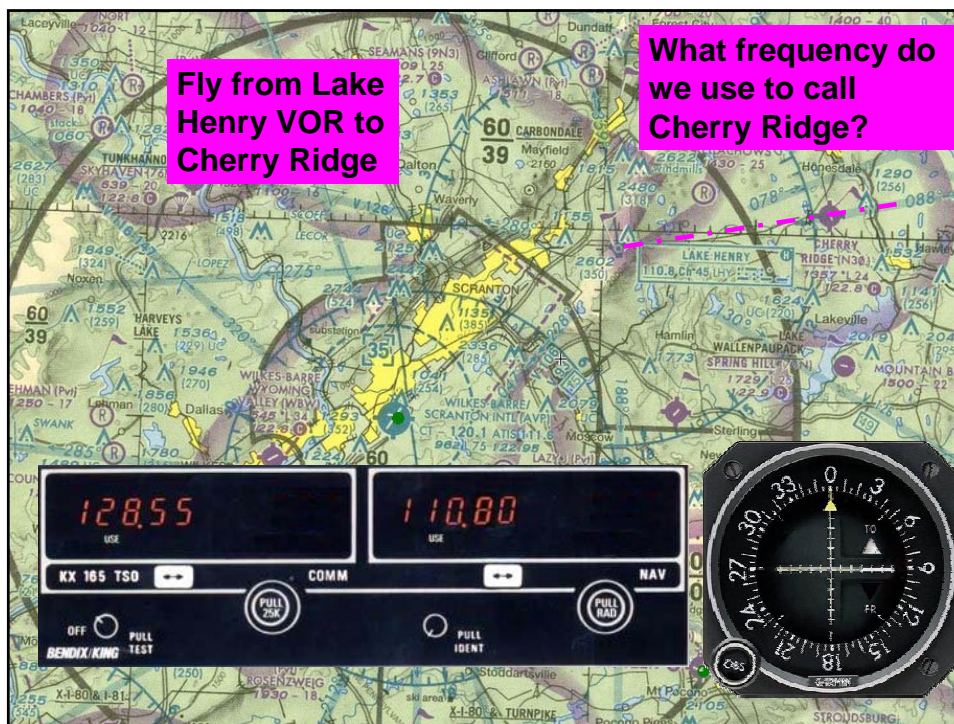












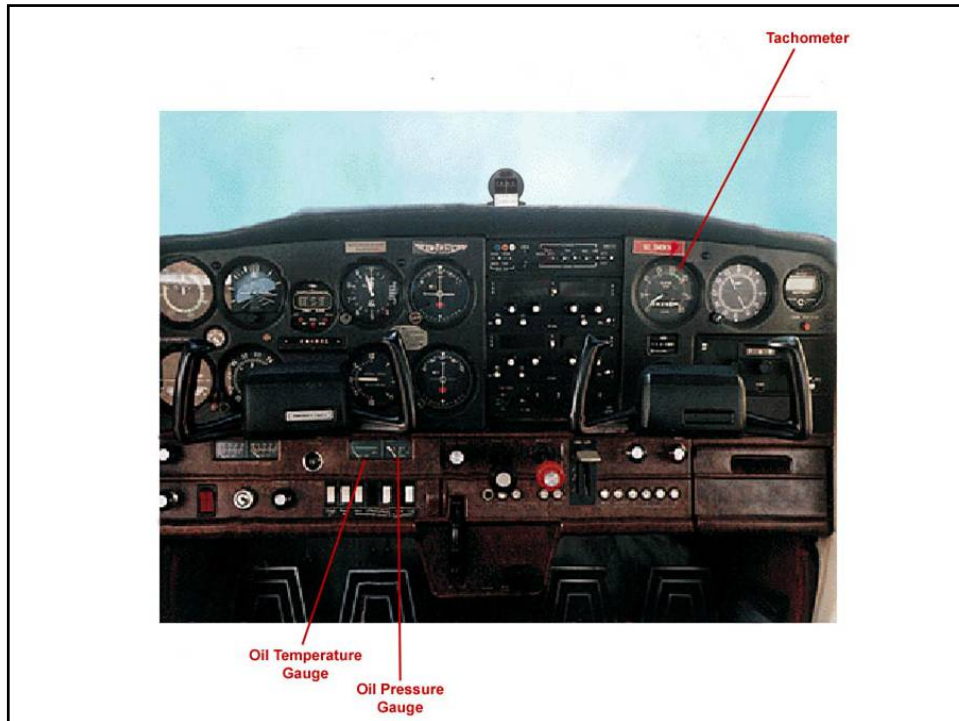




## GPS Navigation



**2f. Explain the purposes and functions of the various instruments found in a typical single-engine aircraft: attitude indicator, heading indicator, altimeter, airspeed indicator, turn and bank indicator, vertical speed indicator, compass, navigation (GPS and VOR) and communication radios, tachometer, oil pressure gauge, and oil temperature gauge.**



## Engine gauges

A close-up of a tachometer gauge. It has a black face with a green outer ring and white markings. The scale ranges from 0 to 35, with major numbers every 5 units. The needle is pointing to approximately 10.

Tachometer

A close-up of an oil temperature gauge. It has a black face with white markings. The scale ranges from 50 to 250, with major numbers every 50 units. The needle is pointing to approximately 100.

Oil Temperature

A close-up of an oil pressure gauge. It has a black face with white markings. The scale ranges from 0 to 100, with major numbers every 20 units. The needle is pointing to approximately 20.

Oil Pressure

**2g. Create an original poster of an aircraft instrument panel. Include and identify the instruments and radios discussed in requirement 2f.**



## Requirements

**3. Do ONE of the following:**

- a) Build and fly a fuel-driven or battery-powered electric model airplane. Describe safety rules for building and flying model airplanes. Tell safety rules for use of glue, paint, dope, plastics, fuel, and battery packs.
- b) Build a model FPG-9. Get others in your troop or patrol to make their own model, then organize a competition to test the precision of flight and landing of the models.



## Requirements

### 4. Do ONE of the following:



- a) Visit an airport. After the visit, report on how the facilities are used, how runways are numbered, and how runways are determined to be 'active.'
- b) Visit a Federal Aviation Administration facility — a **control tower, terminal radar control facility**, air route traffic control center, flight service station, or Flight Standards District Office.
- c) Visit an aviation museum or attend an air show. Report on your impressions of the museum or show.

- ### 5. Find out about three career opportunities in aviation. Pick one and find out the education, training, and experience required for this profession. Discuss this with your counselor, and explain why this Profession might interest you.



## Job Opportunities

- Airlines
- Landing Facilities
- General Aviation
- Aerospace Industries
- FAA (Preflight Specialist, Traffic Controller, etc.)
- Military Aerospace (**USAF, USN, USMC, USA**)
- National Aeronautics & Space Administration (**NASA**)



## Credits & Reference

- Troop 509 of Hurlburt Field, FL has some excellent information at <http://troop509.org/aviationmb.htm>, some of which was incorporated here. Scroll down past the requirements; there's LOTS of info there!
- See also:
  - <http://meritbadge.com/files/mb-pdfs/Aviation.pdf>
  - <http://www.rc-airplane-world.com/rc-airplane-controls.html>