

# INTRODUCTION TO FLIGHT

## (REVIEW, AEROSPACE DIMENSIONS, MODULE 1)



**CAPTAIN. JERRY PAINTER**  
**AEROSPACE EDUCATION OFFICER**  
COMPOSITE SQUADRON 316,  
(CIVIL AIR PATROL)  
CASA GRANDE, ARIZONA

# IMPORTANT TERMS-THE LANGUAGE OF AVIATION

- **AERO**-PARTAINING TO “AIR”
- **AERODYNAMICS**-FORCES OF AIR IN MOTION
- **AERONAUTICS**-SCIENCE OF FLIGHT IN THE
- **AEROSPACE**-COMBO: AERONAUTICS AND SPACE ATMOSPHERE
- **AGL**-ABOVE GROUND LEVEL
- **AIRFOIL**-FORMED OBJECT TO PRODUCE “LIFT”
- **AIR**-ATMOS. MIX; 79% NITROGEN, 19% OXYGEN AND 2% OTHER GASES
- **AIRFOIL**-FORMED OBJECT TO PRODUCE “LIFT”
- **ALTITUDE**-HIEGHT ABOVE SEA/GROUND LEVEL
- **CAMBER**-CURVED PART OF AIRFOIL
- **DRAG**-FORCE SLOWING AN AIRCRAFT
- **LEADING EDGE**-FRONT PART OF AN AIRFOIL

# MORE AVIATION TERMS

- **LIFT**-UPWARD AND GRAVITY DEFEATING FORCE
- **STATIC**-WITHOUT MOTION, STANDING STILL
- **RELATIVE WIND**-AIR FLOW IN OPPOSITE DIRECTION OF FLIGHT
- **SUPERSONIC**-FASTER THAN THE SPEED OF SOUND
- **SUBSONIC**-LESS THAN SPEED OF SOUND **NOTE:** SPEED OF SOUND IS ABOUT 768 MPH OR 1125FT/SEC
- **THRUST**-FORCE MOVING AN AIRCRAFT AHEAD
- **WIND**-AIR IN MOTION
- **TRAILING EDGE**-BACK PART OF AN AIRFOIL
-

# EARLIEST KNOWN FLIGHTS

- **1299 A.D.**, MARCO POLO REPORTS CHINESE
- SAILORS ATTACHED TO KITES BEING USED
- AS MILITARY OBSERVERS
  
- **1783**, NOVEMBER 01: JOSEPH AND ETIENNE
- MONTGOLFIER PILOT THEMSELVES AND TWO
- OTHERS ON A 25 MINUTE FLIGHT OVER PARIS
- IN A HOT AIR BALLOON, COMPLETING MANS
- FIRST OFFICIAL FLIGHT ABOVE THE EARTH.

# Forces Acting on An Airplane

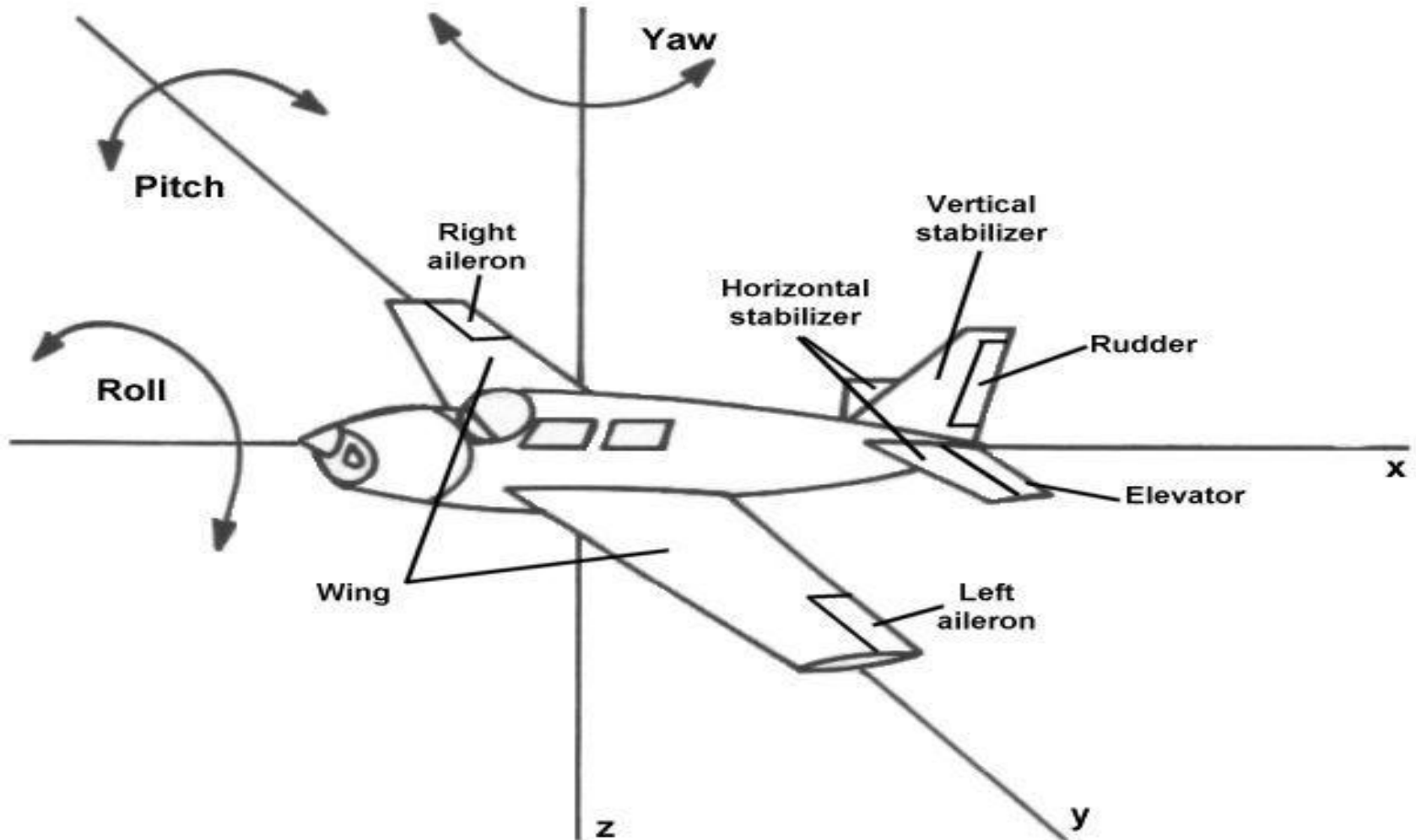
There are four forces acting on the airplane all the time during airplane is flying. The four forces are:

- (1) **Lift** (ARTIFICIAL FORCE, REQUIRES WING, TO CREATE BERNOULLI'S LAW)
- (2) **Thrust** (ARTIFICIAL FORCE, PROPELLER OR JET-THRUST CREATED)
- (3) **Gravity force** or Weight [PULLED DOWN] (NATURAL FORCE)
- (4) **Drag** [SWIMMING POOL RESISTANCE] (NATURAL FORCE)

Lift and Drag are considered aerodynamics forces because they exist due to the movement of the Airplane through the Air.



# AXIS OF ROTATION



# A LITTLE REVIEW!!!

- **1. BERNOULLI'S PRINCIPLE STATES THAT "THE CURVED WING SURFACE (TOP) WILL CAUSE AIRFLOW TO SLOW WHILE AIR UNDER BOTTOM SURFACE WILL SPEED UP: RESULT WILL BE THE WING WILL "LIFT"!!!!**
- **2. NEWTON'S THREE LAWS: (1.) FOR EVERY ACTION, AN EQUAL AND OPPOSITE REACTION, (2.) A BODY AT REST WILL REMAIN AT REST, AND FINALLY, (3) FORCE ON A BODY ACCELERATES THE BODY, ACCELERATION DIRECTLY PROPORTIONAL TO THE FORCE.**
- **3. THE PROPELLER: WHAT IS THE FASTEST MOVING SECTION (PART)?**
  - **A. THE TIP**
  - **B. THE HUB**
  - **C. HALF WAY BETWEEN HUB AND TIP**
  - **D. THE TURBINE**

# FLYING THE LIFTING POWER OF RISING AIR

## CHAPTER 2





# **SAILPLANE VS GLIDER**

- **SAIL PLANES RIDE THE “THERMALS” FOR HOURS, THEN EVENTUALLY GLIDE BACK TO EARTH.**
- **A GLIDER, ON THE OTHER HAND, IS TOWED ALOFT THEN RELEASED AT A PRE-SET ALTITUDE AND GLIDES BACK TO EARTH.**
- **MUCH HEAVIER THAN THE SAIL PLANE AND BASICALLY CANNOT GAIN ALTITUDE ON ITS OWN.**

# GLIDER TERMS

- **SPAN**=DISTANCE WING-TIP TO WING-TIP.
- **CONVECTION**=FLUID MOTIONS BETWEEN REGIONS OF UNEVEN HEATING.
- **GLIDE RATIO**=DISTANCE AN AIRCRAFT WILL GLIDE FROM A GIVEN HEIGHT. 20 TO 1 RATIO MEANS IF THE CRAFT IS ONE MILE UP, IT SHOULD BE ABLE TO GLIDE 20 MILES BEFORE HAVING TO LAND.
- **LAPSE RATE**= AVERAGE TEMPERATURE FALL AS ONE GOES HIGHER IN THE ATMOSPHERE. THE NORM IS 3.5 DEGREES F./2.0 C DEGREES PER 1000 FEET OF RISE.
- **SOARING**=STAYING ALOFT ONLY ON THE ATMOSPHERIC ENERGY (UNPOWERED).

# MORE GLIDER TERMS

- **THERMAL**=AN UPWARD MOVING COLUMN. GLIDERS “RIDE” THESE THERMALS.
- **WAVE**=AIR CROSSING MOUNTAINS CAN CAUSE WAVES ON THE DOWNWIND SIDE AND GLIDERS USE THESE WAVES TO GAIN ALTITUDE RESULTING IN A LONGER FLIGHT.
- **TOW PLANE**= NORMALLY A “S.E.L” AIRCRAFT (POWERED) USED TO TOW GLIDERS ALOFT.
- **STABILITY**=ATMOSPHERES RESISTANCE TO VERTICAL MOTIONS.
- **ALTITUDE**=HEIGHT ABOVE A REFERENCE POINT. IN AVIATION, THERE IS “**MSL**” OR “MEAN SEA LEVEL (HEIGHT ABOVE AVERAGE SEA LEVEL) AND “**AGL**”, “ABOVE GROUND LEVEL”.

# A LITTLE REVIEW!!

- **DISTANCE A GLIDER CAN TRAVEL FROM A GIVEN ALTITUDE IS KNOWN AS:**
  - 1. ASPECT RATIO    2. GLIDE RATIO    3. LAPSE RATE
- **AIR CROSSING A MOUNTAIN MAY FORM WHAT ON THE DOWN-WIND SIDE:**
  - 1. WAVE                      2. LAPSE RATE              3. CONVECTION RATIO
- **AIR IN MOTION IS CALLED:**    1. WAVE            2. THERMAL            3. WIND
- 4. TECHNICALLY, ALL ARE CORRECT WITH #3 MOST CORRECT!

# CHAPTER 3: BALLOONS-CREATE THEIR OWN THERMALS



# BALLOON TERMS

- **BALLOON**=USES LIGHTER-THAN-AIR GAS FOR LIFT, ONLY UP-DOWN CONTROL, NO HORIZONTAL CONTROL.
- **BURNER**=HEAT SOURCE TO FILL ENVELOPE WITH HOT AIR.
- **CROWN**=TOP OF THE BALLOON ENVELOPE.
- **MONTGOLFIER**=NAME OF FRENCH BROTHERS CREATING FIRST SUCCESSFUL MANNED HOT AIR BALLOON IN 1783 (ALSO THE FIRST EVER ACTUAL FLIGHT).
- **PROPANE**=LIGHTWEIGHT, LOW CARBON FUEL USED IN HOT AIR BALLOON BURNERS.

# MORE BALLOON TERMS

- **WICKER**=FORM OF CONSTRUCTION USED ON BASKETS (GONDOLA).
- **THERMISTER**=TEMPERATURE SENSOR WITHIN THE ENVELOPE.
- **PARACHUTE VALVE/PANEL**=TOP OF ENVELOPE, ALLOWS FOR DEFLATION.
- **BUOYANCY**=ABILITY TO RISE/FLOAT ON WATER OR WITHIN THE ATMOSPHERE.
- **GORE**=ONE OF THE SEVERAL VERTICAL PANELS THAT COMPRISE THE ENVELOPE.
-

# LIFTING CAPABILITY

- **HYDROGEN FILLED BALLOON:** 1,000 CUBIC FOOT BALLOON WILL
- LIFT ABOUT 60 POUNDS. EARLY ON HYDROGEN WAS USED IN
- DIRIGABLES BUT IT WAS FOUND TO BE TOO DANGEROUS. IN
- MOST CASES, HELIUM HAS REPLACED HYDROGEN AS HELIUM
- IS NON-FLAMMABLE.
  
- **HOT-AIR-BALLOON LIFT:** ONLY ABOUT 17-20 POUNDS PER 1,000
- CUBIC FEET (AT 100-120 DEGREES C.)
  
- **WEIGHT AT TAKE-OFF:** MINIMUM CRAFT OF AROUND 600 POUNDS
- TOTAL AT LIFT-OFF. THIS MEANS SOMETHING LIKE 77,000 CUBIC FEET
- NEEDED TO LIFT THE 600 POUND BALLOON/BASKET/EQUIPMENT
- AND THE PILOT ALONG WITH THREE OTHERS (ABOUT 1300
- POUNDS TOTAL). **EXPLAINS WHY SOME BALLOONS ARE HUGE!!!!**



# A LITTLE REVIEW!!

- 1. THERE IS **NO HORIZONTAL DIRECTION CONTROL**
- WITH “HOT-AIR-BALLOONS”, ONLY UP OR DOWN!
  
- 2. **HOT AIR WILL LIFT ABOUT 17-20 POUNDS PER 1,000**
- **CUBIC FEET OF GAS WHILE HYDROGEN WILL LIFT**
- **ABOUT 60 POUNDS WITH THE SAME 1,000 C.F.**
  
- 3. FOR RAPID DESCENT, A BALLOON PILOT WILL PULL
- DOWN ON THE “**PARACHUTE PULL CORD**” AND THIS
- **ALLOWS THE HOT AIR TO ESCAPE.**



# **CIVIL AIR PATROL SQUADRON 316, CASA GRANDE (ARIZONA WING)**



- **THIS CONCLUDES OUR REVIEW BASED ON  
MODULE 1, “INTRODUCTION TO FLIGHT”.**

- **THANK YOU FOR YOUR ATTENTION!**

- **CAPTAIN PAINTER**