Badger Aviators Ground School
Principals of Flight/Aerodynamics
Name Tags

John Smith
The Atmosphere

What are some properties of the atmosphere?
The Atmosphere

1. Has Mass/Pressure
2. Temperature
3. Humidity
4. Chemical Makeup
Atmospheric Pressure

1. Directly related to how much air is above you
2. Decreases with consistently with altitude
3. Pressure can be measured in many ways but in aviation we use in Hg
4. Standard pressure is 29.92 inHg
Thought Experiment

If I take a balloon for a flight, what would I expect to happen and why?

How about a bag of chips?
Pressure Altitude

1. Altitude affects the performance of piston aircraft
2. “Altitude adjusted for non-standard pressure”
3. Obtained by setting altimeter to 29.92 in Hg
1. Standard temperature is 15°C/59°F
2. Standard lapse rate
   a. 2°C/1000ft
   b. Will become more important during weather discussion
3. Stability is directly related to lapse rate and is the tendency of the atmosphere to resist lifting action

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<th>Standard Atmosphere</th>
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Density Altitude

1. “Altitude adjusted for non-standard pressure and non-standard temperature”
2. Requires OAT (outside air temperature) and pressure altitude to calculated
Forces of Flight

1. Thrust - Produced from engine, pulls airplane forward
2. Drag - Counteracts Thrust
3. Lift - Produced by the wings
4. Weight - Exists due to gravity
Balance of Forces

1. When an aircraft is in straight, level, unaccelerated flight:
   a. Thrust = Drag
   b. Weight = Lift
Airfoils

Watch ERAU Video @ 1:05

http://bit.ly/2dOg5Ig
Bernoulli’s Principle

1. As air travels through a venturi, the air pressure decreases.
2. This is due the air moving faster through the smaller portion of the venturi.
Bernoulli’s Principle: Application

Discuss in groups on how Bernoulli’s Principle helps an airplane fly.
Newton’s 3rd Law

1. For every action there is an equal and opposite reaction
2. Wing deflects air downwards
3. A propeller pushes air backwards which pulls the airplane forwards
Stalls

What comes to mind when you hear the word stall?
Angle of Attack (AOA)

1. The angle between the chord line and the relative wind
2. Very important angle when discussing stalls
Stalls

1. Have nothing to do with the engine
2. Occurs when the wings stop producing sufficient lift
3. Occurs when airplane reaches critical AOA
4. Airflow separates from top of the wing
Drag: Parasite Drag

1. Form Drag - Due to aircraft shape
2. Interference Drag - Occurs where two structures meet
3. Skin Friction Drag - Caused by surface of airfoil
Drag: Induced Drag

1. Lift cannot be created for free
2. Induced drag is the cost of producing lift
The Power Curve

1. Parasite drag increases with speed
2. Induced drag decreases with speed
Control Surfaces: Ailerons

1. Ailerons work opposite of each other to affect the airplane’s bank
2. The aileron that goes down causes the airfoil to generate more lift
3. The aileron that goes up causes the airfoil to generate less lift

Figure 4-3 Forces Exerted by Ailerons
Control Surfaces: Elevator

1. Works similarly to the ailerons
2. Controls pitch of the airplane
Control Surfaces: Rudder

1. Similar aerodynamics to previous control surfaces
2. Deflects air which yaws the airplane in accordance with Newton’s 3rd Law of Motion
Control Surfaces: Flaps

Discuss in groups, what you think the flaps do on an airplane.

(Note that the flaps go down and up in unison)
Wingtip Vortices

1. Air on bottom of wings wants to move to low pressure
2. Air moves from fuselage to wing tips and as it falls off the tip, it creates a spiraling motion
3. Wingtip vortices sing at hundreds of ft/min
4. They are strongest when produced by a heavy, clean, and slow aircraft
5. Wake turbulence avoidance
Ground Effect

1. Cushion of air between wing and ground
2. Reduces the amount of lift required to fly
Left Turning Tendency: Torque

1. Newton’s Third Law
2. Airplane wants to turn opposite of the engine
Left Turning Tendency: P-Factor
Questions?
Next Time

1. Tuesday, October 18th @ 6:00 p.m.
2. Topic: Instruments