Aerodynamics

How do airplanes fly?

1 Big Idea

Angle of Attack (AoA)
*The angle between a wing's **chord line** and the **flight path***

*As the AoA increases, **lift** increases.*

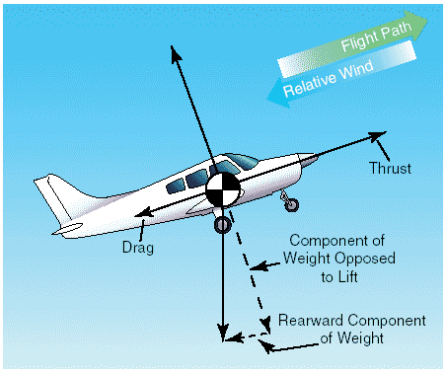
*If the AoA exceeds the **Critical AoA,** the airplane will **stall.***

To exit a stall, the pilot must lower the nose to decrease the AoA.

2 Sets of Opposing Forces

Lift vs. Gravity
If gravity wins, you will sink!

Thrust vs. Drag
If drag wins, you won't move forward!



Types of Drag

Induced Drag
A byproduct of lift

Parasite Drag
Caused by any part that doesn't produce lift.
3 Types:
- ***Form Drag***
  Front profile of airplane
- ***Skin Friction***
  Surface of airplane. Increases if skin is dirty.
- ***Interference Drag***
  Occurs at corners and intersections where parts meet. Decreased by use of fairings.

3 Axes (plural of "Axis") around which an airplane pivots, and their associated movements

Lateral:
Wingtip to wingtip
Pitch

Longitudinal:
Nose to tail
Roll

Vertical:
Skewer through the Center of Gravity
Yaw

4 Control Surfaces

Flaps:
Increase lift and drag. On the wings (inboard).

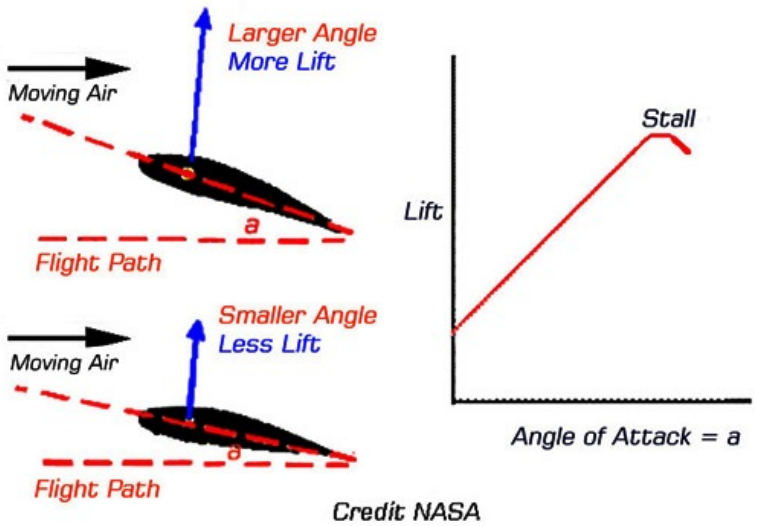
Elevator:
On the horizontal stabilizer (tail)

Ailerons:
On the wings (outboard)

Rudder:
On the vertical stabilizer (tail)

Homework

Explain to your parents where the three axes of an airplane are located. Using your model aircraft, show them how an airplane pitches, yaws and rolls around these axes.



Credit NASA