

Wings: Airfoils

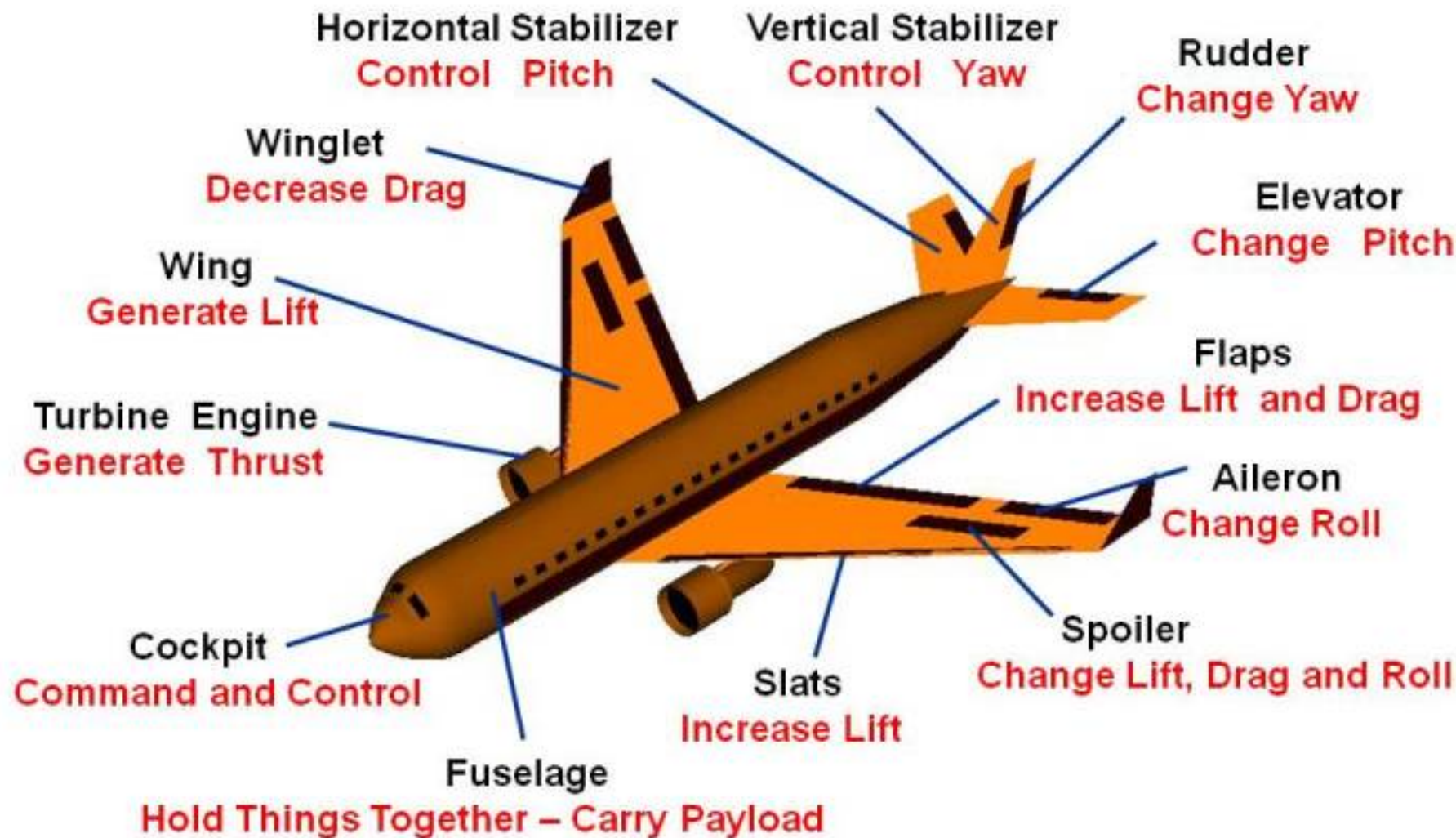


Except where otherwise noted, this work is licensed under
<http://creativecommons.org/licenses/by-sa/3.0/>

Created by [The North Carolina School of Science and Math](#).
Copyright 2012. [North Carolina Department of Public Instruction](#).

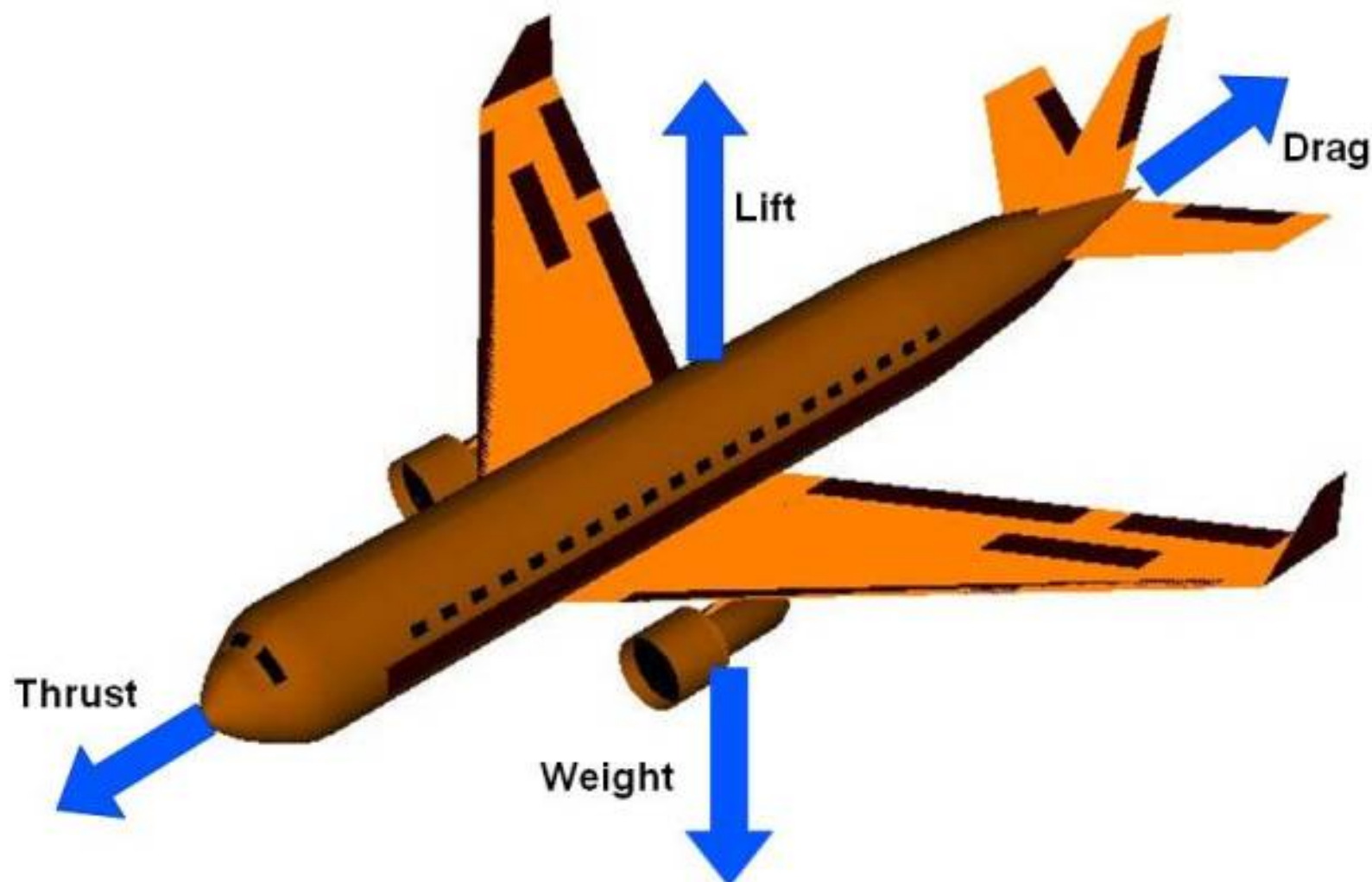


Airplane Parts *and Function*





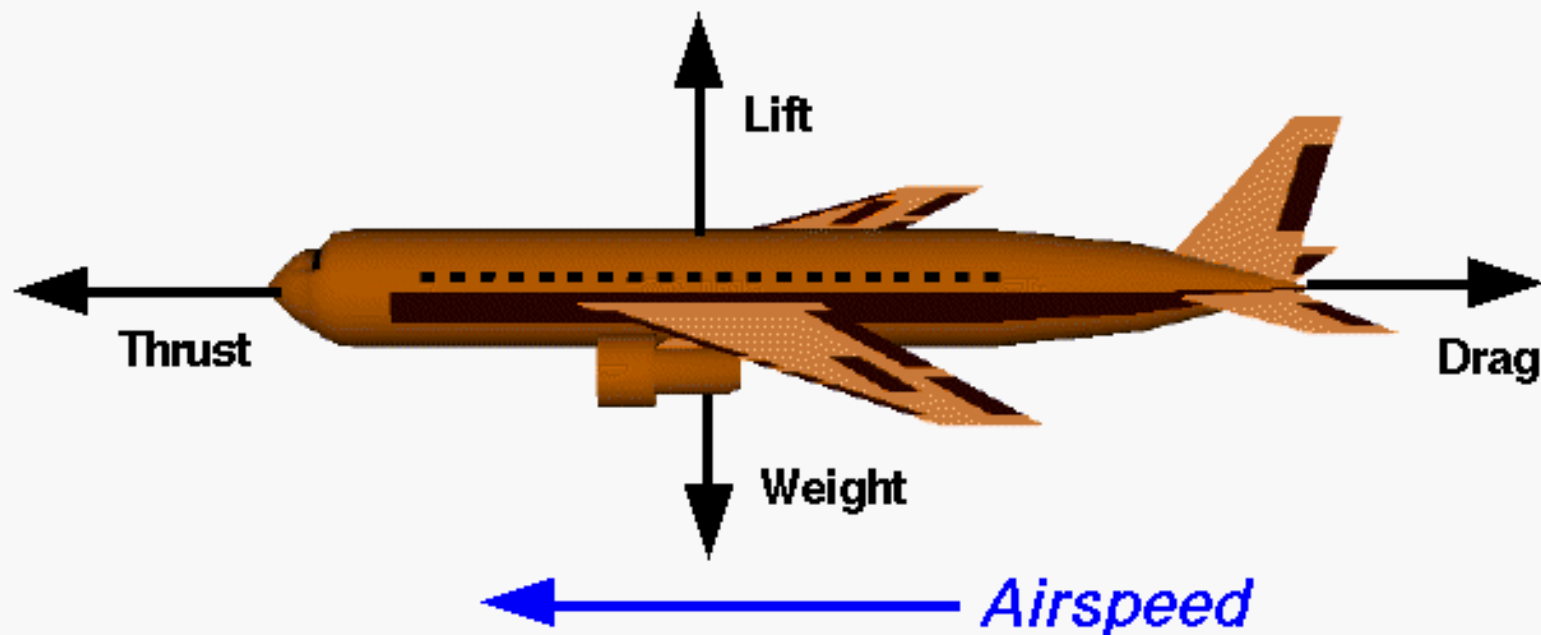
Four Forces on an Airplane





Cruise - Balanced Forces

Glenn
Research
Center



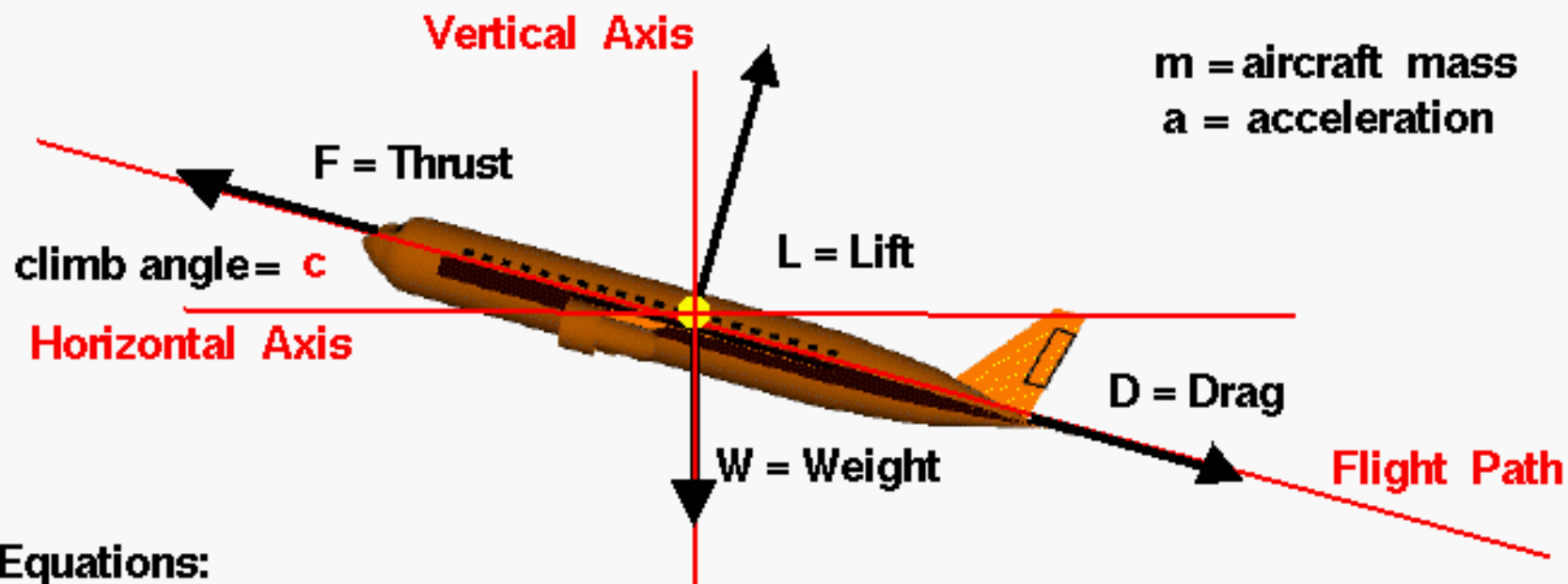
$$\begin{aligned}\text{Lift} &= \text{Weight} \\ \text{Thrust} &= \text{Drag}\end{aligned}$$

**Airplane moves in a straight line at
constant airspeed.**



Forces in a Climb

Glenn
Research
Center



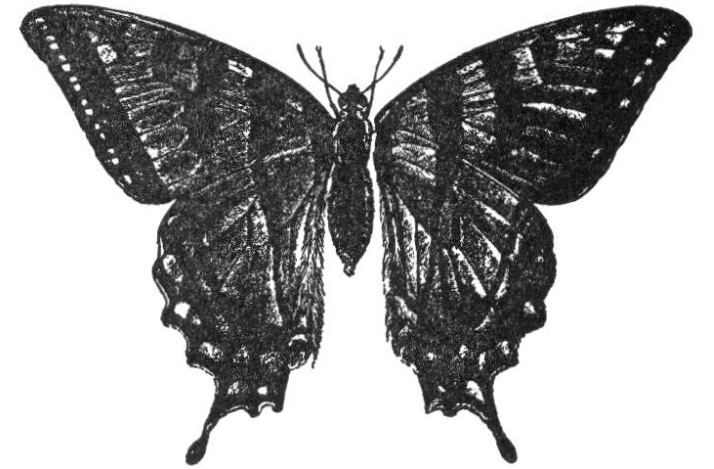
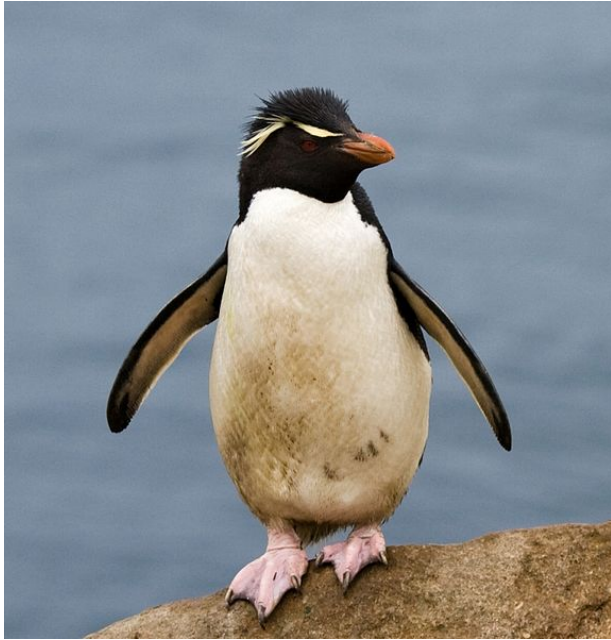
Equations:

Vertical	$F \sin(c) - D \sin(c) + L \cos(c) - W = m a_v$
Horizontal	$F \cos(c) - D \cos(c) - L \sin(c) = m a_h$

Definition of Excess Thrust: $F - D = F_{ex}$

Vertical	$F_{ex} \sin(c) + L \cos(c) - W = m a_v$
Horizontal	$F_{ex} \cos(c) - L \sin(c) = m a_h$

Wings



Wings





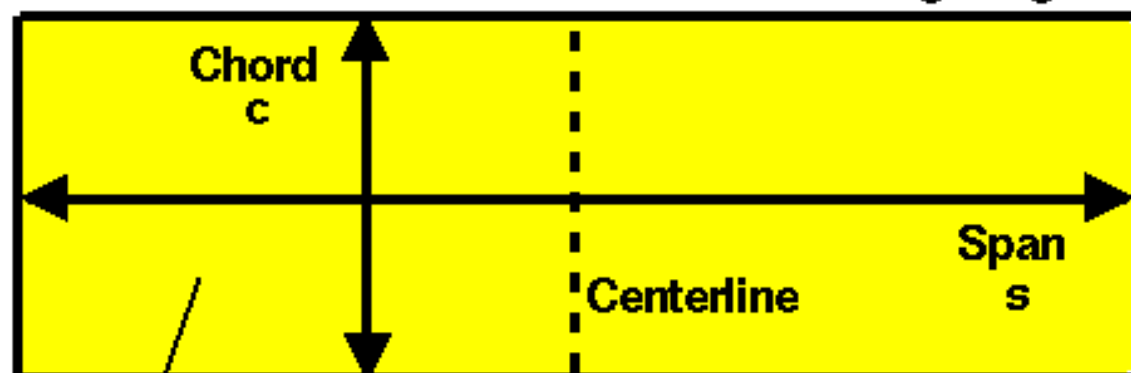
Wing Geometry Definitions

Glenn
Research
Center

Top View

Wing Planform

Trailing Edge



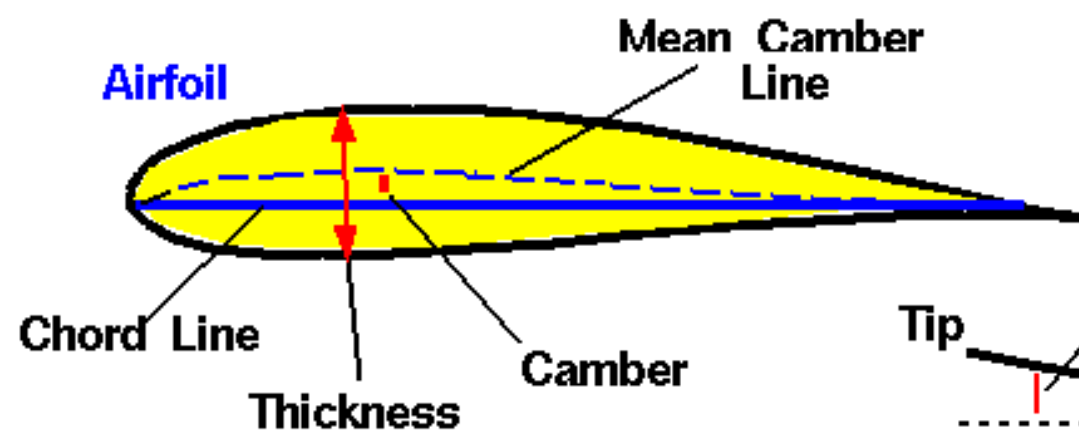
Wing Area A

Aspect Ratio = AR

$$AR = \frac{s^2}{A}$$

$$AR = \frac{s}{c} \text{ for rectangle}$$

Airfoil



Side View



Symmetric Airfoil



Front View

Wing Geometry NASA Activity

- 1) Go to: <http://www.grc.nasa.gov/WWW/k-12/airplane/geom.html>
- 2) Explore how the geometry of the wing affects performance