The Purpose and Function of Airplane Parts

Warm-Up Questions

CPS Questions 1-2

Lesson Overview

- How the fuselage and wing shape correspond to an aircraft's mission
- The types, purpose, and function of airfoil design
- The role of stabilizers and rudders
- The positions of flaps, spoilers, and slats on an aircraft
- How the airflow and airfoil affect flight movement
- The purpose and function of propellers, turbines, ramjets, and rocket propulsion systems

Quick Write

Write about another time in history when a major event spurred technological progress, and list three inventions that resulted.

(Note to teacher: Use "Pick a Student" button in CPS)

Courtesy of NASA Langley Research Center (NASA-LaRC)

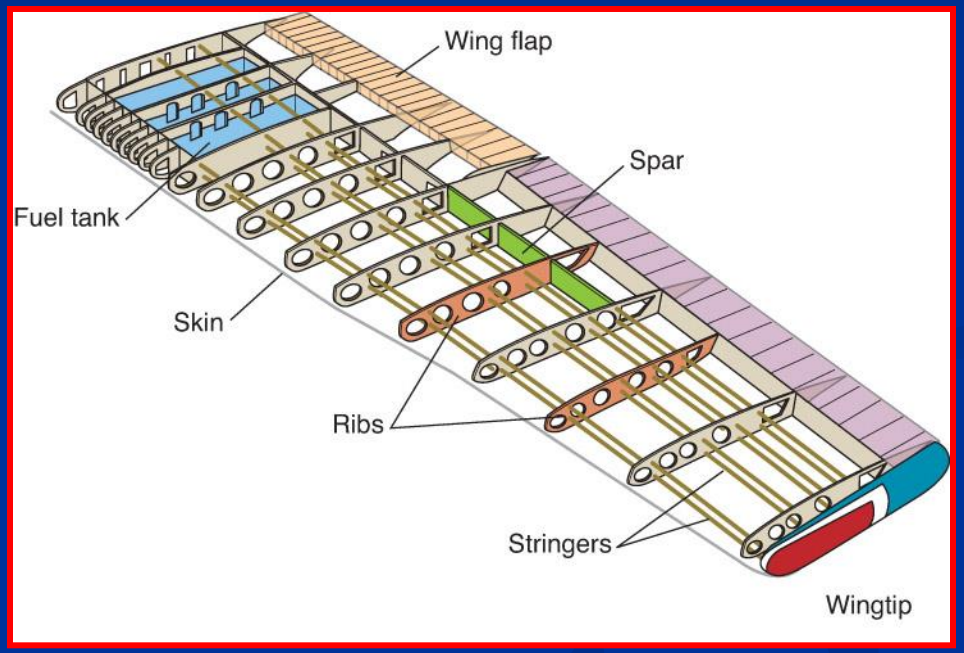
The Fuselage

- The fuselage is the aircraft body
- Fuselage vary in shape to fit the mission
- Aircraft rotates around center of gravity inside the fuselage
- Fuselage must be strong enough to withstand torque

Courtesy of USAF/CMSgt Gary Emery

Wing Position and Parts

- Wing position depends on aircraft's mission
- Main internal parts are spars, ribs and stringers
- Fuel tanks usually part of wing

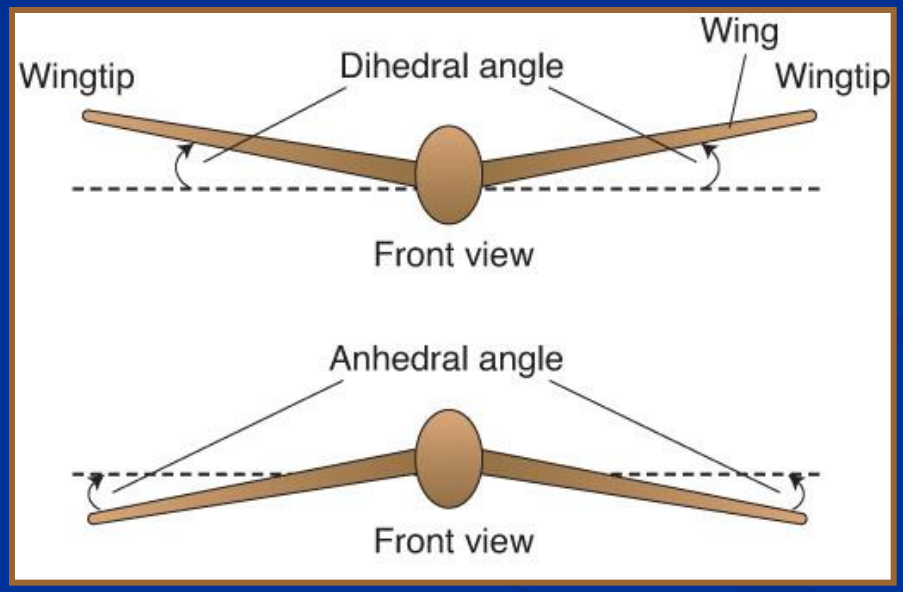


Wing Size

- Glider travels slow and has high-aspect wing ratio and long wingspans
- Glider wings elliptical shaped to reduce drag and result in long, slow flight
- Greater the aspect area the lower the induced drag and greater the lift
- F-16 and space shuttle have low-aspect ratio wings

Wing Angles

- Dihedral angles give aircraft roll stability and level flight
- Large commercial airliner wings have dihedral angles
- Fighter aircraft have anhedral angles



Modified from NASA/Glenn Research Center

Learning Check Questions

CPS Questions 3-4

Activity 1: All About Wings

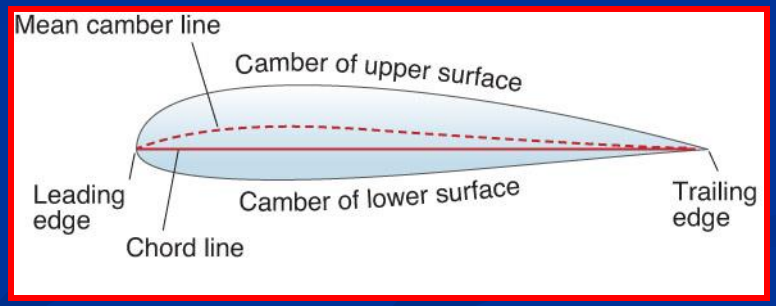
- Complete the matching and short answer activities about wing types, sizes, positions, and angles

Activity 2: Wing Area

- Review the shapes of wing forms
- Use geometry to calculate the area of each wing form presented

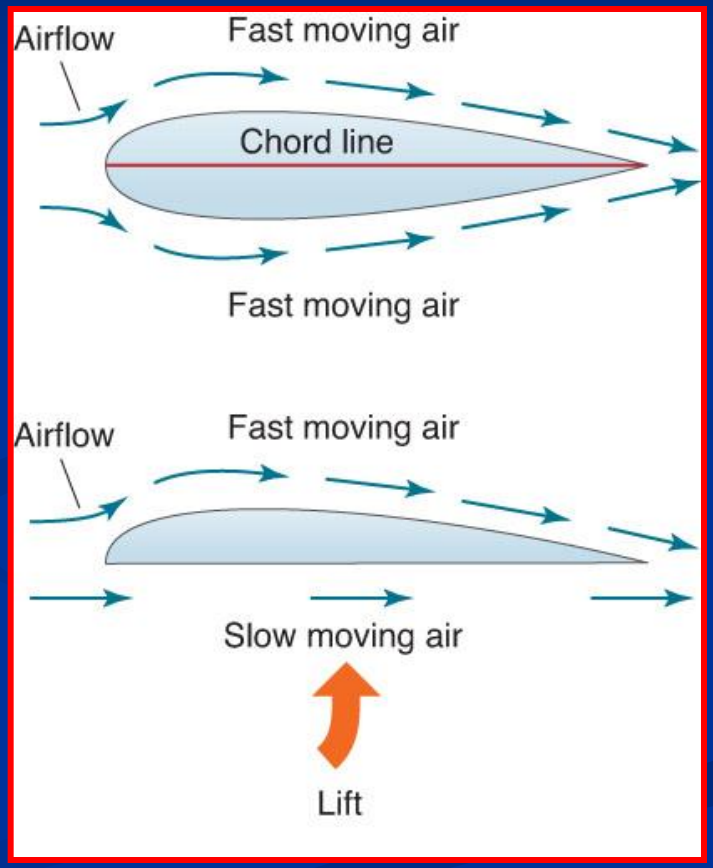
Airfoil Camber

- The curve in an airfoil is the camber
- In most airfoils the upper surface curves more than the lower surface
- Airfoil's thickness is the maximum distance between the upper and lower wing surfaces



Types, Purpose, and Function

- Aircraft weight, speed, and purpose determine wing's shape
- Concave lower surfaces produce greatest lift at low speeds
- Streamlined airfoils don't create enough lift
- Teardrop shaped airfoils have no lift at zero angle of attack



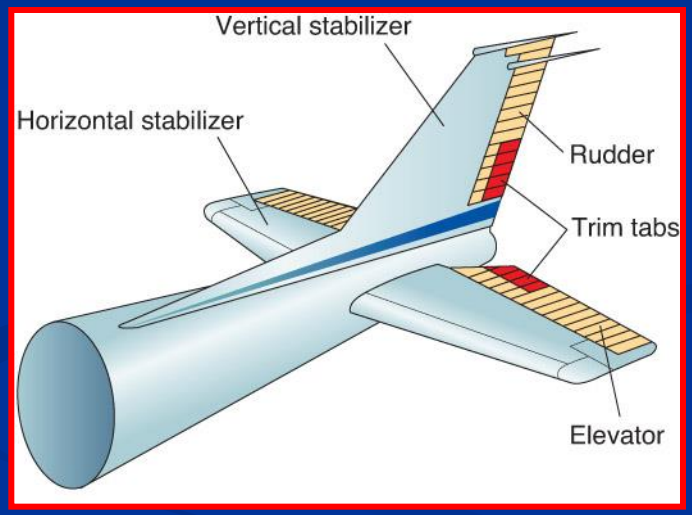
Activity 3:
Airfoils and Airflow

- Review the vocabulary on airfoil design and function

- Draw and label an airfoil shape to include a leading edge, trailing edge, camber, and an airfoil showing airflow

The Role of Stabilizers and Rudders

- Stabilizers keep aircraft stable so it can maintain straight flight path
- Vertical stabilizer prevents the nose of plane from roving side to size
- Horizontal stabilizer keeps plane from bobbing up and down

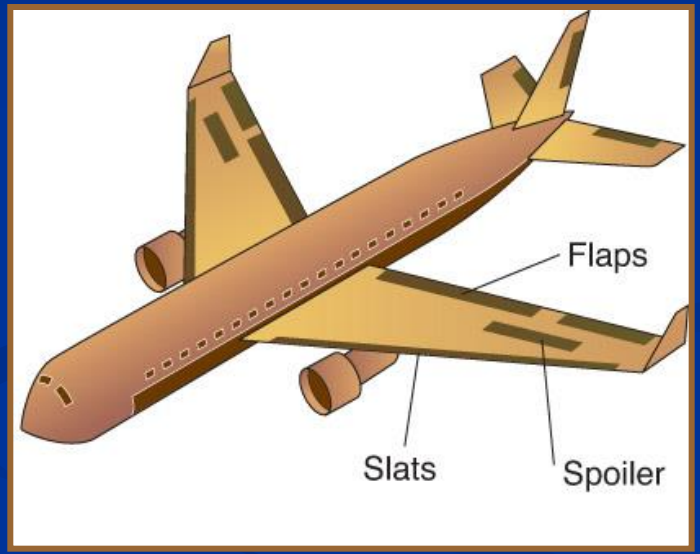


The Role of Stabilizers and Rudders, cont.

- Rudder is fastened with hinges to back of vertical stabilizer
- Lets pilot steer the aircraft by moving the tail left and right
- Elevators are attached with hinges and direct the tail up or down
- Trim tabs are also attached by hinges—fine tune left-right and up-down movements

The Positions of Flaps, Spoilers, and Slats on Aircraft

- Flap is hinged device at wing's trailing edge that produces lift
- Spoiler is small, flat plate that attaches the tops of wings; it increases drag
- Slat is moveable, hinged parts that pivot down to generate more force



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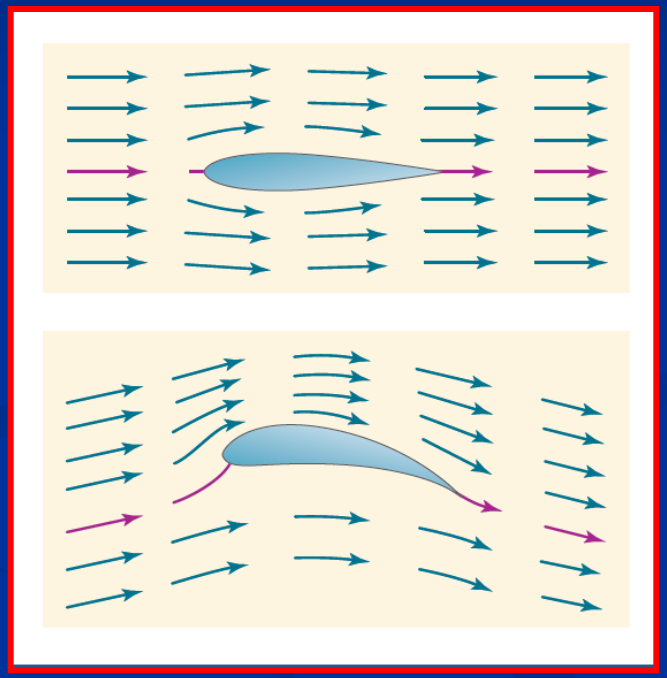
How the Airflow and Airfoil Affect Flight Movement

- Air flowing evenly along both sides of wing produces no lift at zero angle of attack
- Airfoils that curve dramatically toward trailing edge produce a large amount of lift
- Trailing edges determine whether airfoil can turn flow and cause lift
- Flaps, spoilers, and slats let pilots manipulate flow turning



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Learning Check Questions

CPS Questions 5-7

Activity 4:
Airplane Parts and Functions

- Label the airplane parts
- Define their function in flight

The Purpose and Function of Propulsion Systems

- Propulsion Systems provide aircraft's thrust to maintain forward movement
- When aircraft is in straight and level flight, thrust must balance drag
- When accelerating plane, thrust produced must exceed drag

Propellers

- Attached to hub and act like wings
- Subject to the same forces that an airfoil is
- Blades experience low- and high-pressure areas when producing lift

Courtesy of USAF/SrA Laura Turne

Turbines

- Turbines or jet engines can fly at higher speeds than propellers
- Turboprop is a turbine engine that turns a propeller
- Gas turbines depend on oxygen from surrounding air for combustion

Courtesy of USAF/SSgt Benjamin Wilson

Ramjets

- Lighter and simpler than turbojets
- Combust fuel and derive thrust from hot exhaust accelerated through nozzle
- Rely more on gas exit velocity than on mass flow of gas through engine
- More efficient than other jet engines at supersonic speeds

Rocket Engines

- Working fluid is hot rocket exhaust
- Carry their own oxygen to mix with fuel
- Solid propellant is mixed but doesn't burn until ignited; can sit in storage for a long time

Courtesy of NASA/USAF

Learning Check Questions

CPS Questions 8-9

Activity 5:
Propulsion System Poster

- Create an informational poster of a propeller, turbine, ramjet, or rocket propulsion system
- Conduct research on the NASA website and include at least one photograph or picture and 3-4 distinguishing characteristics or functions of the system

Activity 6:
Flaps and Leading Edge Slats

- Identify different positions of aircraft flaps and leading edge slats using Microsoft Flight Simulator

Summary

- How the fuselage and wing shape correspond to an aircraft's mission
- The types, purpose, and function of airfoil design
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Review Questions

CPS Questions 10-11

Next….

- Done – the purpose and function of airplane parts
- Next – aircraft motion and control

Courtesy of USAF