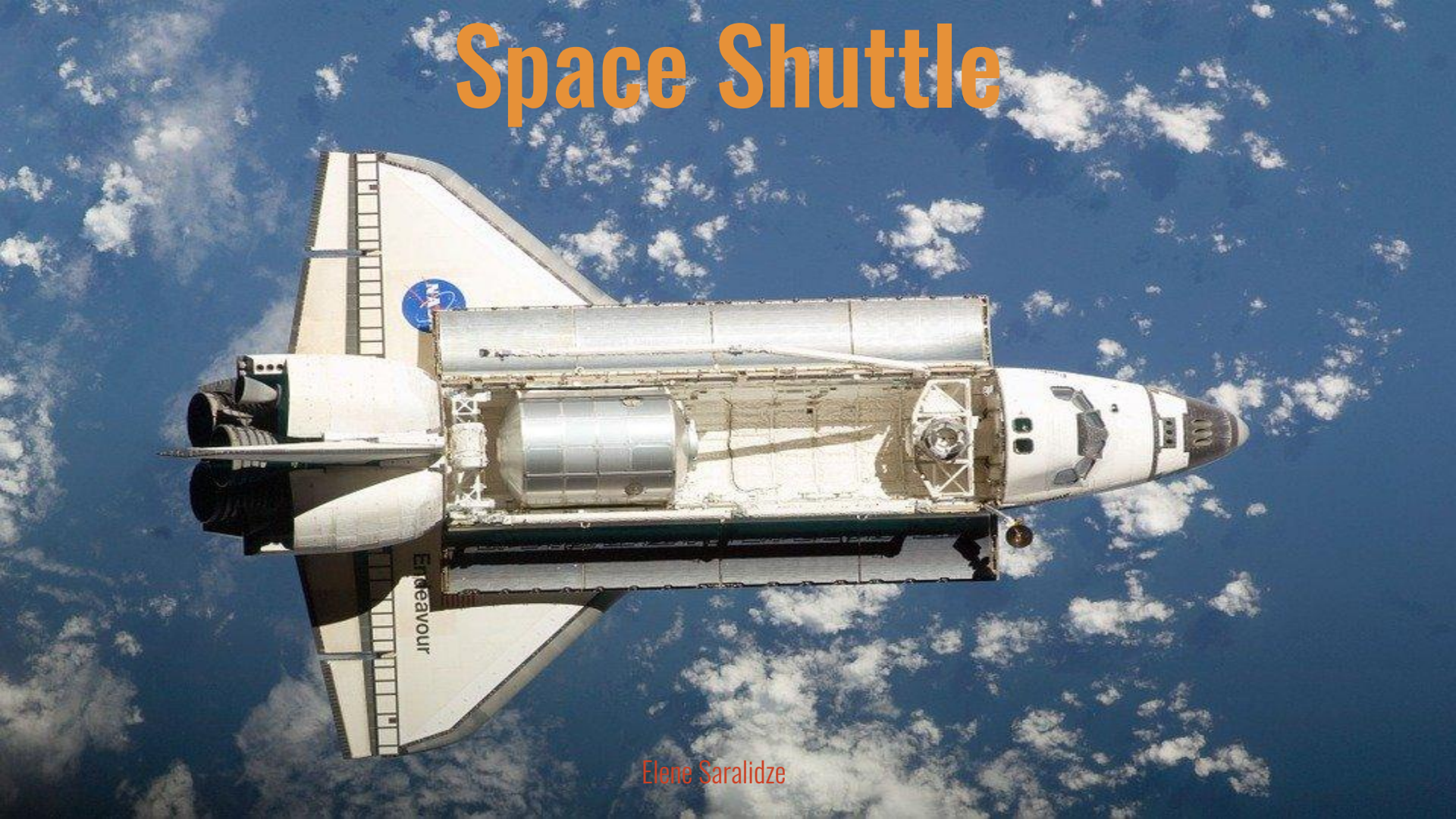
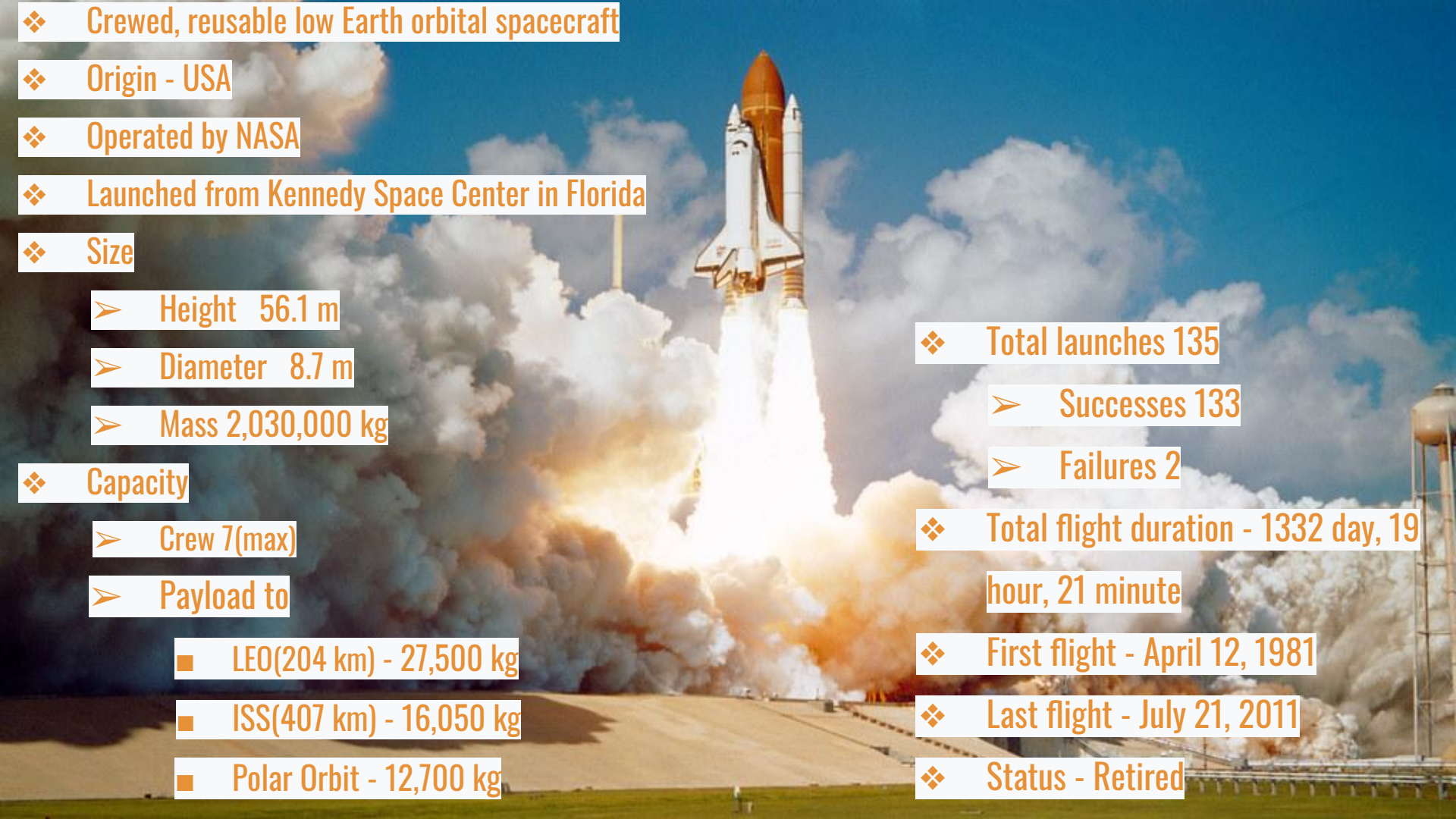
Space Shuttle



Elene Saralidze

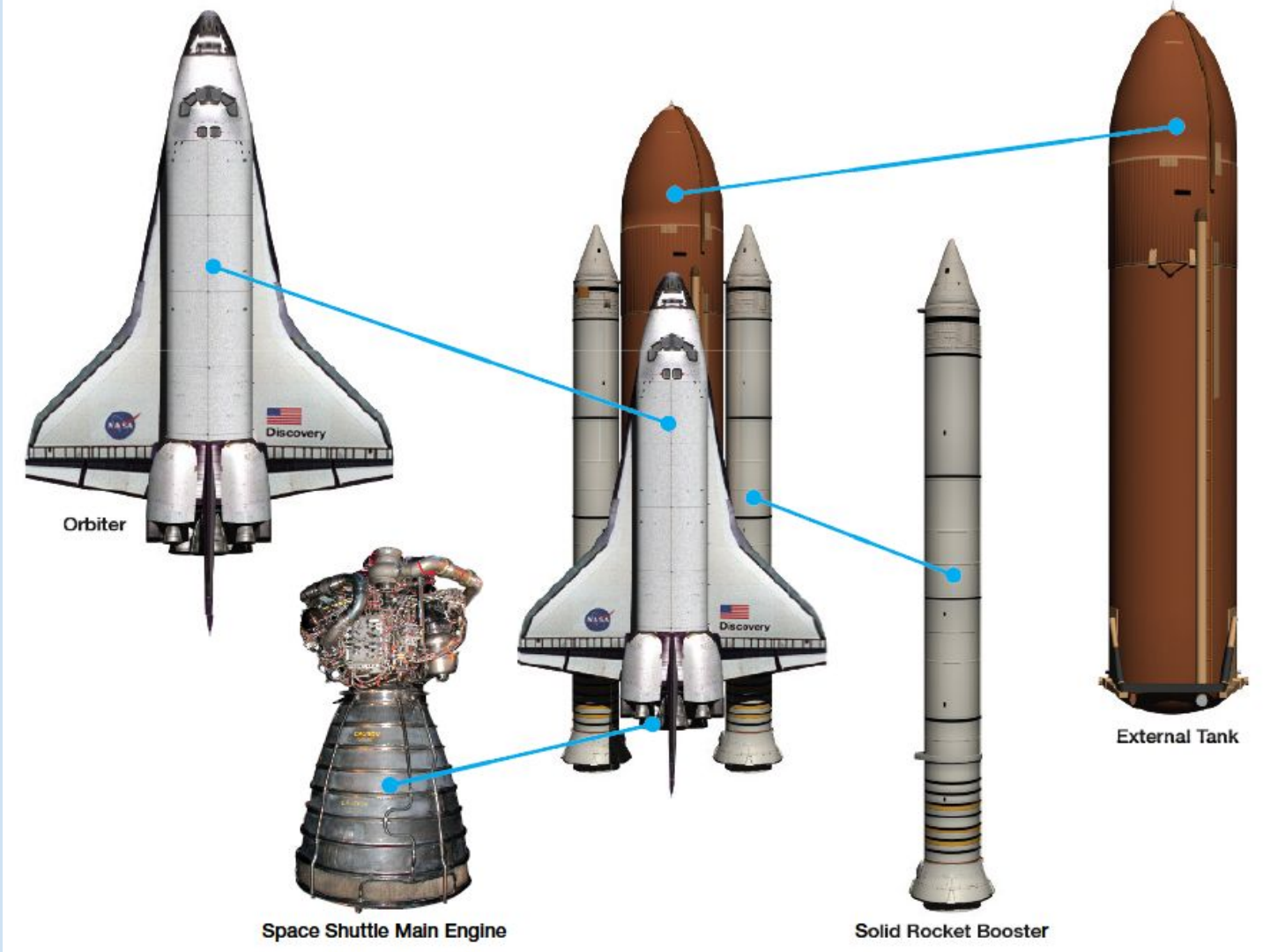


- Crewed, reusable low Earth orbital spacecraft
- Origin - USA
- Operated by NASA
- Launched from Kennedy Space Center in Florida
- Size
  - Height 56.1 m
  - Diameter 8.7 m
  - Mass 2,030,000 kg
- Capacity
  - Crew 7(max)
  - Payload to
    - LEO(204 km) - 27,500 kg
    - ISS(407 km) - 16,050 kg
    - Polar Orbit - 12,700 kg

- Total launches 135
  - Successes 133
  - Failures 2
- Total flight duration - 1332 day, 19 hour, 21 minute
- First flight - April 12, 1981
- Last flight - July 21, 2011
- Status - Retired

Main Components of Shuttle:

- Orbiter
- Main Engine
- Two Boosters
- External Tank



Orbiter

Carries astronauts and payloads

Built 6

37.1 m long, wingspan 23.8m, width 17.86 m

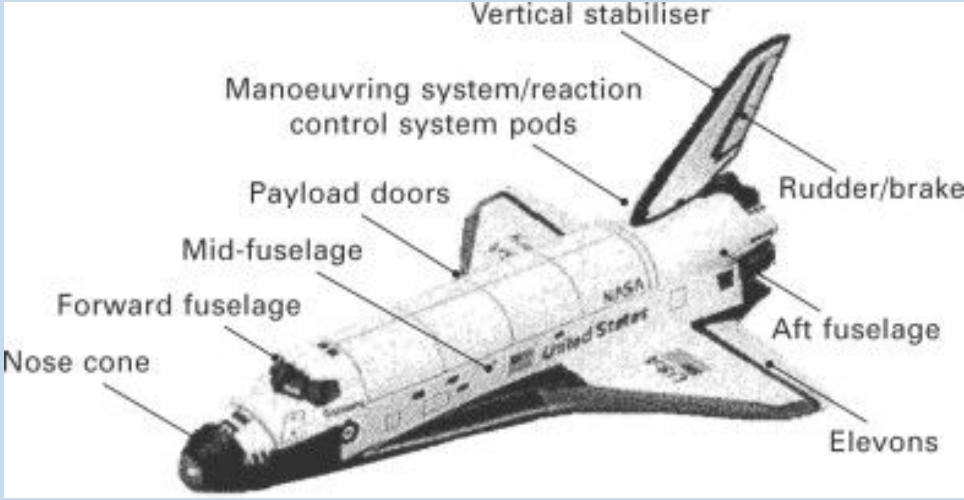
Payload bay doors were 18.3m in length and 4.5m in diameter.

Dry mass 78,000 kg.

Maximum speed 27.870 km/h

Range(Operational altitude) 190-960 km

Had the Thermal Protection System(TPS) that protected the orbiter during 1,650 degree celsius heat of atmospheric reentry



Tile type TPS

Identification number which tells batch and location

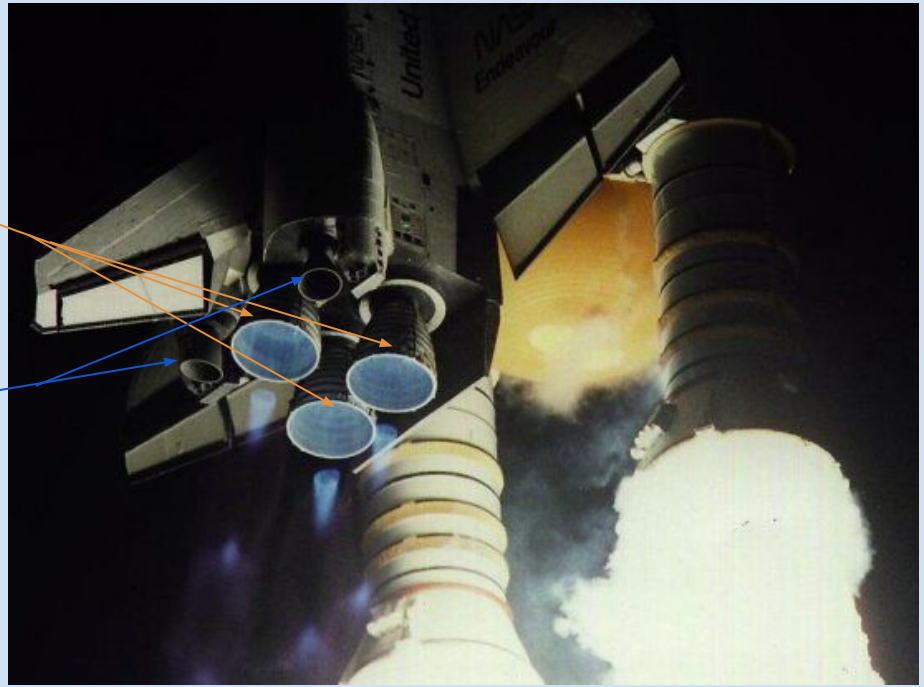
Tile is covered with a black-glazed coating of borosilicate

Silicon-rubber glue

Black HRSI tile
Composition: 10% silica fiber, 90% air

Engines

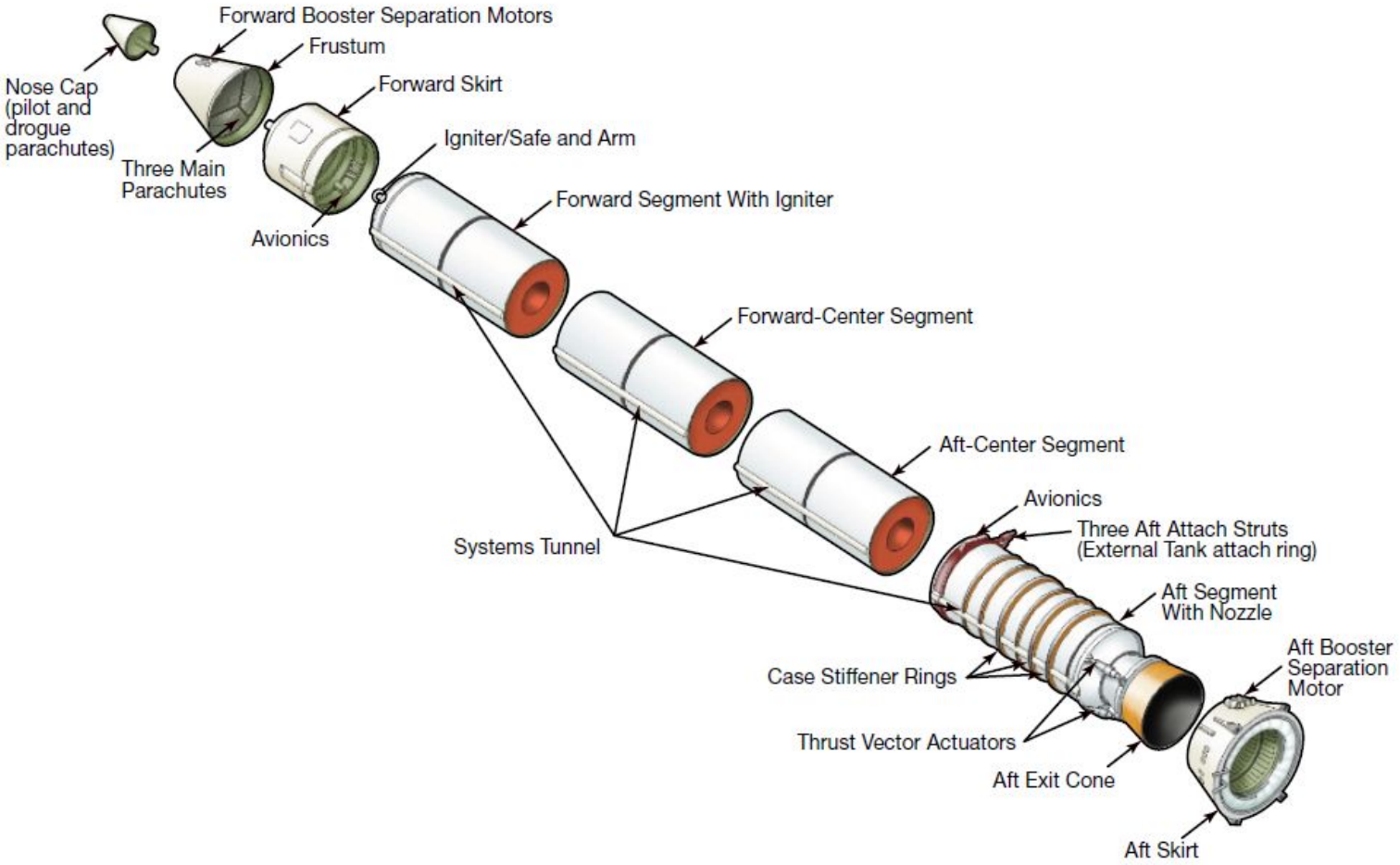
- Main Engine
  - Provides thrust for liftoff
  - Engines - 3
  - Length 4.3 m, Diameter 2.4 m
  - Dry weight 3.527 kg
  - Burn time 480 sec
  - Liquid oxygen/Liquid hydrogen
- Orbital Maneuvering Engine
  - Provides thrust for orbital insertion
  - 2 Engines
  - Length 6.6 m
  - Burn time 150-250 sec
  - Fuel MMH/Dinitrogen tetroxide



Solid Rocket Booster

- The two SRBs provided the main thrust to lift the shuttle off the launch pad.
- Height 45.46 m
- Diameter 3.71 m
- Empty mass 91,000 kg
- Propellant 500,000 kg
- Burn time 127 sec

Components


Forward Booster Separation Motors
Frustum
Nose Cap (pilot and drogue parachutes)
Forward Skirt
Igniter/Safe and Arm
Three Main Parachutes
Forward Segment With Igniter
Avionics
Forward-Center Segment
Aft-Center Segment
Avionics
Three Aft Attach Struts (External Tank attach ring)
Systems Tunnel
Aft Segment With Nozzle
Aft Booster Separation Motor
Case Stiffener Rings
Thrust Vector Actuators
Aft Exit Cone
Aft Skirt

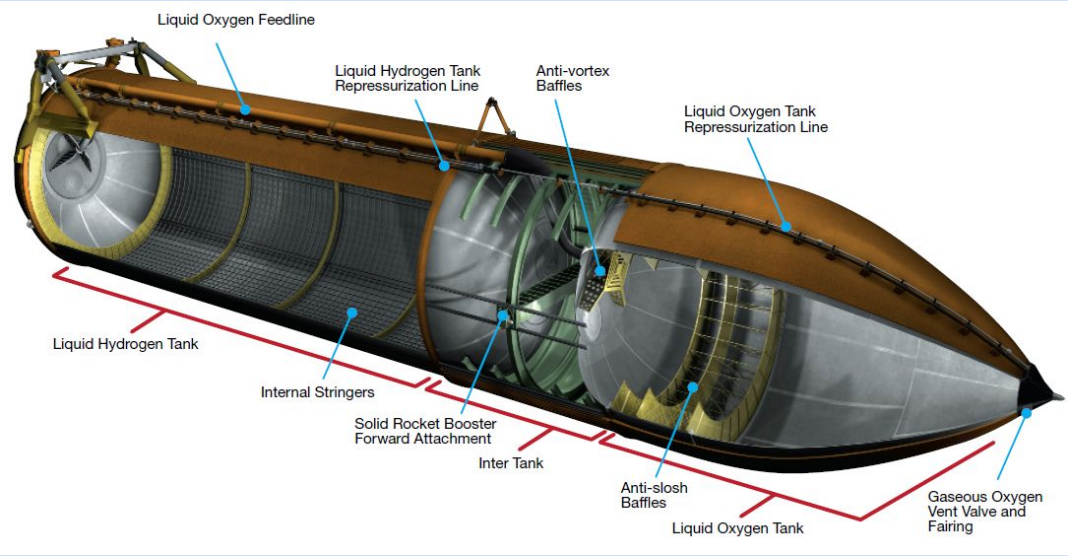
External Tank

The ET contained two internal tanks - one for the storage of liquid hydrogen and the other for the storage of liquid oxygen.

The bigger one held 102,737 kg of hydrogen. the oxygen tank, located at the top of the ET and held 619,160 kg of oxygen.

Both tanks provided the fuel to the main engines required to provide the thrust for the vehicle to achieve a safe orbit.

During powered flight and ascent to orbit, the ET provided about 180,000 L/min of hydrogen and 67,000 L/min of oxygen.



- Size
  - Height - 46.9 m
  - Diameter - 8.4 m
  - Gross mass - 760,000 kg

First flight April 12, 1981
Last flight January 16 - February 1, 2003
28 missions

First flight April 4, 1983
Last flight January 28, 1986
10 missions

First flight September 5, 1983
Last flight February 24 - March 9, 2011
39 missions

First flight 3-5 October, 1985
Last flight 8-21 July, 2011
33 missions

First flight May 7, 1992
Last flight May 16, 2011
25 missions

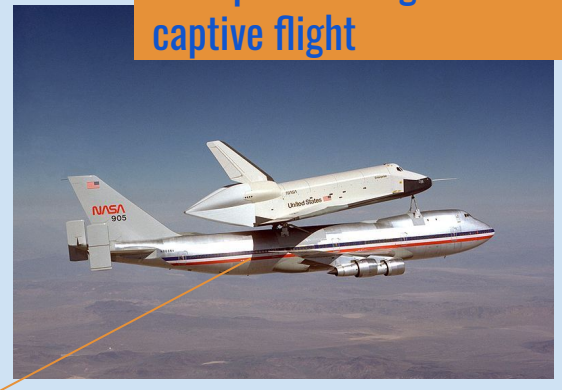
Approach and landing test(ALT)

Space Shuttle Enterprise performed atmospheric test flights

Crew 1: Gordon Fullerton(Pilot), Fred Haise(Commander)
Crew 2: Joe Engle(Commander), Richard Truly(Pilot)

- 3 Taxi tests - February 15, 1977
- 5 Captive-inert flight (unpowered and uncrewed) Enterprise remained mated to the SCA
- 3 Captive-active flight (powered and crewed) Enterprise remained mated to the SCA.
- 5 Free-flights - September 13 - October 26, 1977

Enterprise during the captive flight



Shuttle Carrier Aircraft(SCA)

Enterprise During the free flight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First flight

STS-1(space transportation system - 1) was the first orbital spaceflight of NASA's Space Shuttle program

Orbiter - Space Shuttle Columbia

Mission type - test flight

Crew members - John W. Young, Robert L. Crippen

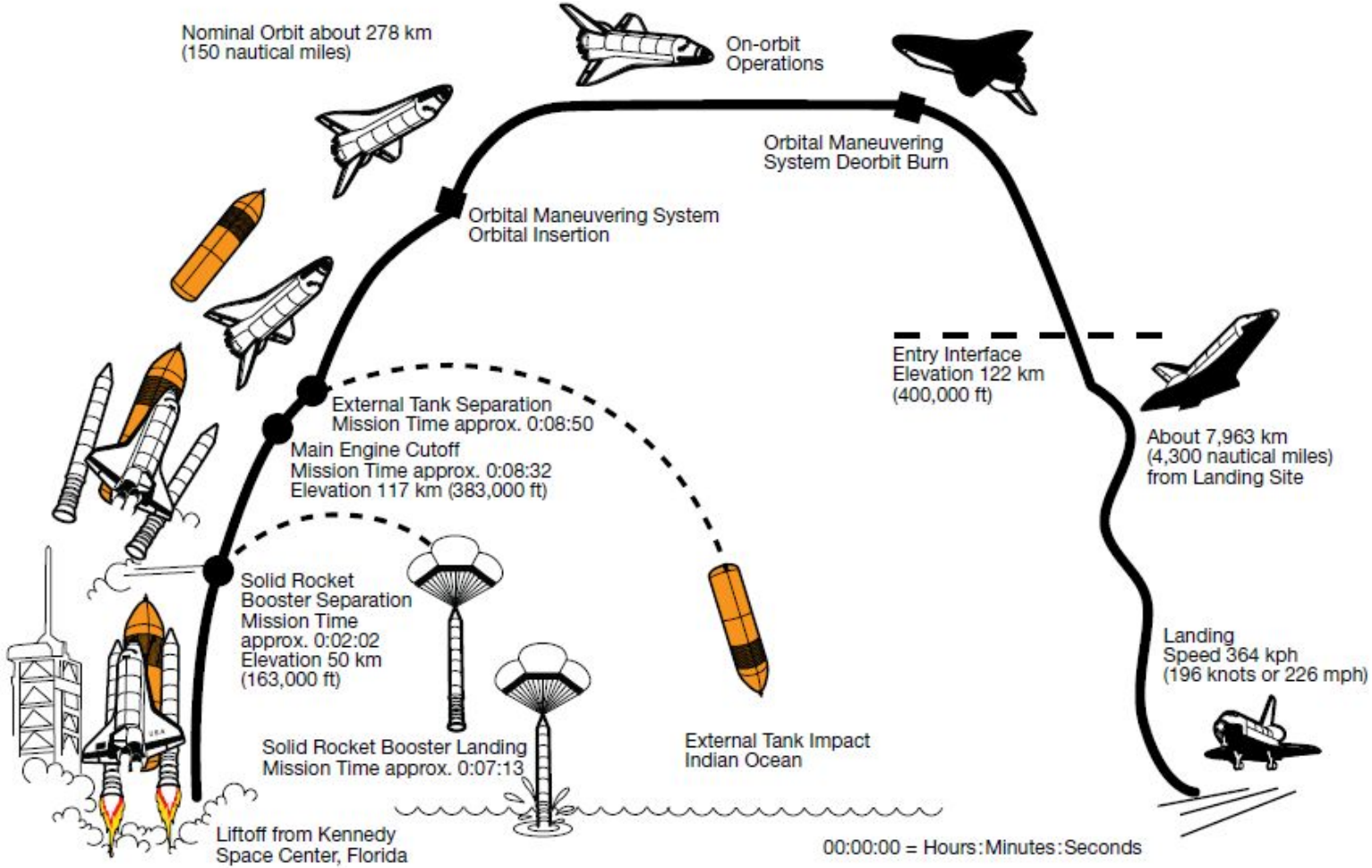
Mission duration - 2 day, 6 hours, 20 minutes, 53 seconds

Launch date - 12 April, 1981

Landing date - 14 April, 1981

John Young and Robert Crippen

Typical Flight Profile



Failures

Space Shuttle Challenger disaster

Date - January 28, 1986

Challenger broke apart 73 seconds into its flight

The failure was caused by the failure of the left booster

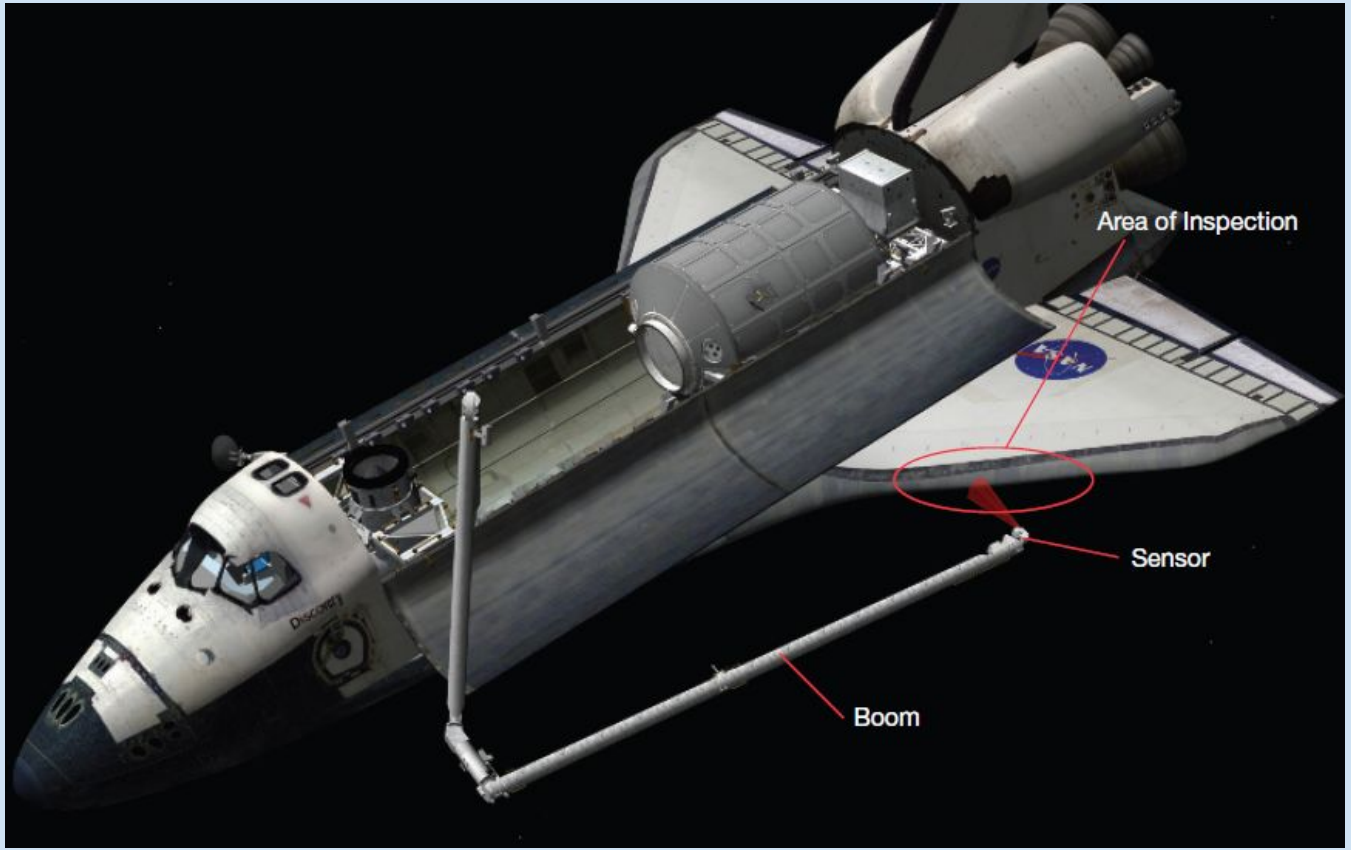
Space Shuttle Columbia disaster

Date - February 1, 2003

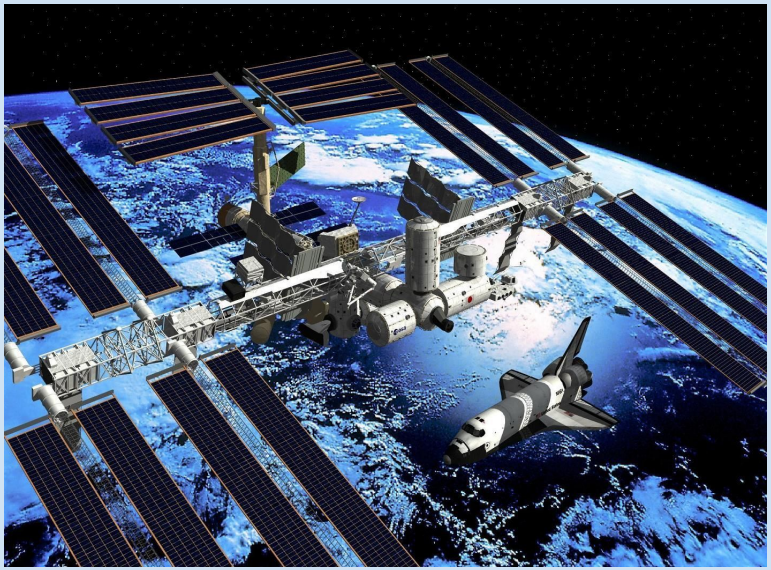
During the launch a piece of foam insulation broke off from the ET and struck the left wing of the orbiter

When Columbia reentered the atmosphere of Earth the damage allowed hot atmospheric gasses to penetrate the heat shield and destroy the internal wing structure

The orbiter boom sensor system - was built for inspections after the Columbia accident



Space Shuttle provided several missions on the Hubble Space Telescope



Space shuttle missions involved carrying large payloads to various orbits including segments to be added to the ISS

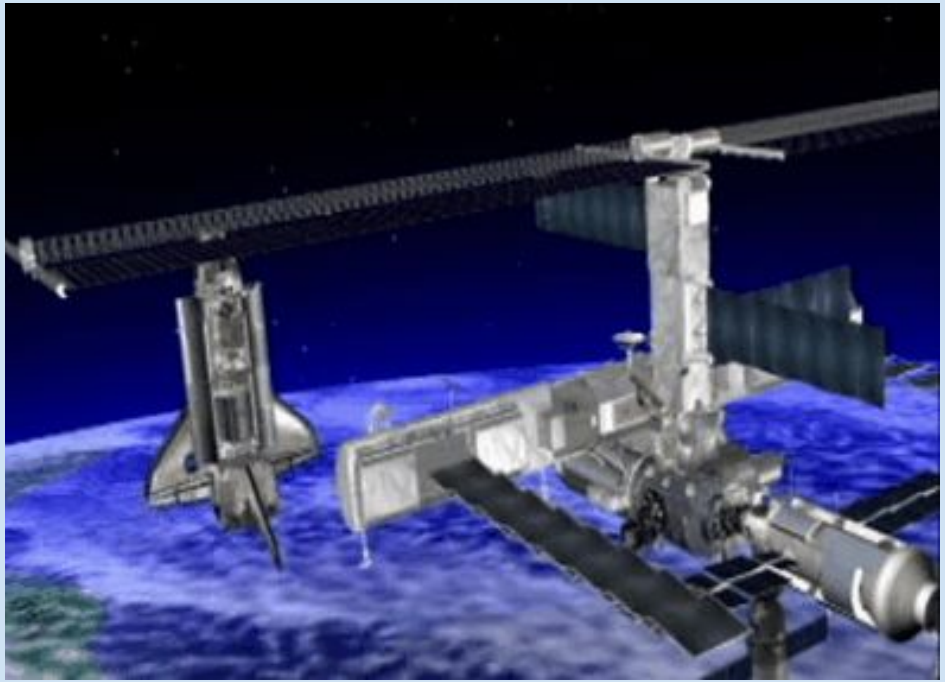
The orbiter also recovered satellites and other payloads from orbit and returned them to Earth

Docking

The Shuttle wasn't designed to physically dock with anything, but it needed to dock with large vehicles: the International Space Station and Mir

New tools such as the laser sensor provided highly accurate range and range rate informations for crew

The Shuttle was never meant to be piloted to these degree of accuracy, but innovative engineering and training made these dockings universal



Landing