THE SKY LAB ERA AND THE SHUTTLE ERA

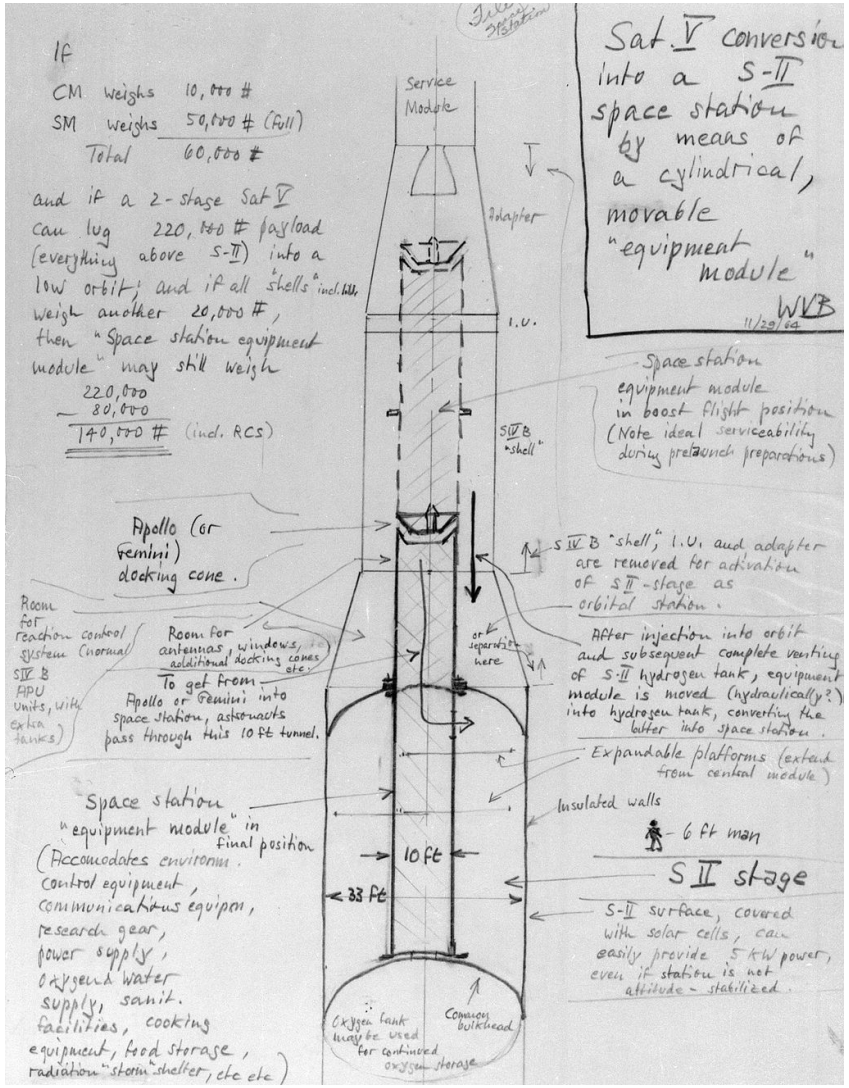
1973-1979

1981-2011

Call sign	Skylab
Crew	3 per mission (9 total)
Launch	May 14, 1973 17:30:00 UTC
Launch pad	Kennedy Space Center LC-39A
Reentry	July 11, 1979 16:37:00 UTC near Perth, Australia

Skylab was the United States' first space station from 1973 to 1979, when it fell back to Earth amid huge worldwide media attention.

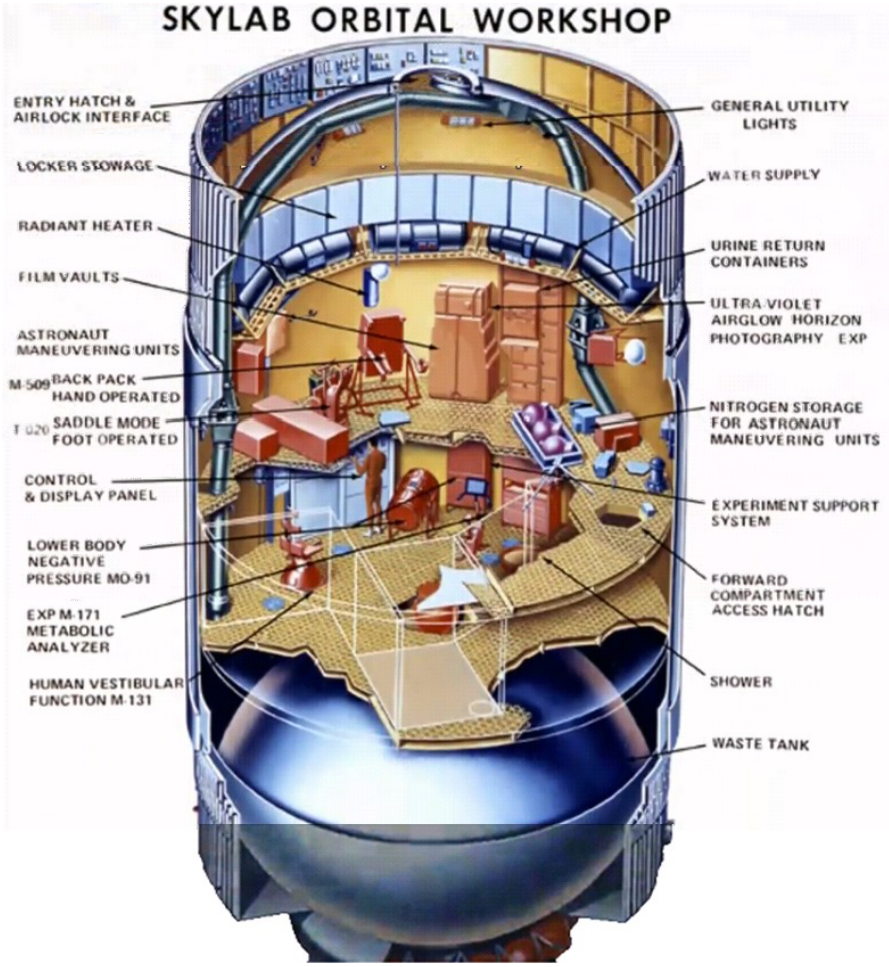
Launched and operated by NASA, **Skylab** included a workshop, a solar observatory, and other systems necessary for crew survival and scientific experiments.



Von Braun's original concept design, 1964

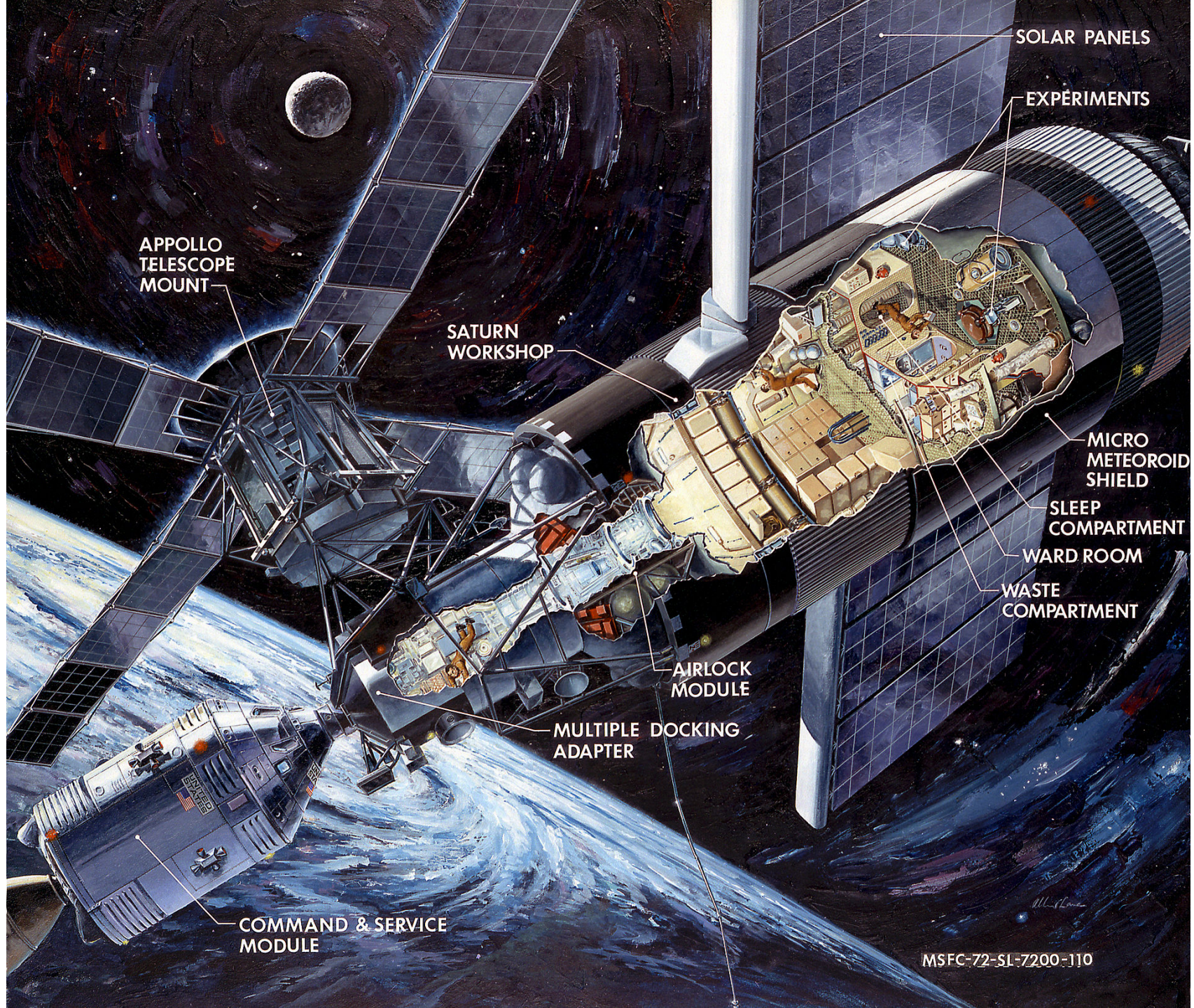
The SKY LAB MISSIONS

Mission	Emblem	Commander	Science Pilot	Pilot	Launch date	Landing date	Duration (days)
Skylab 1 *SL-1*		*unmanned launch of space station*			1973-05-14 17:30:00 UTC	1979-07-11 16:37:00 UTC	2248.96
Skylab 2 *SL-2* (*SLM-1*)		Pete Conrad	Joseph Kerwin	Paul Weitz	1973-05-25 13:00:00 UTC	1973-06-22 13:49:48 UTC	28.03
Skylab 3 *SL-3* (*SLM-2*)		Alan Bean	Owen Garriott	Jack Lousma	1973-07-28 11:10:50 UTC	1973-09-25 22:19:51 UTC	59.46
Skylab 4 *SL-4* (*SLM-3*)		Gerald Carr	Edward Gibson	William Pogue	1973-11-16 14:01:23 UTC	1974-02-08 15:16:53 UTC	84.04

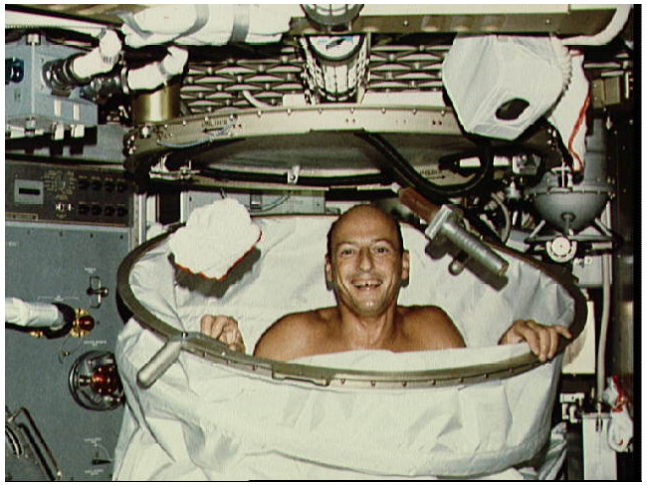


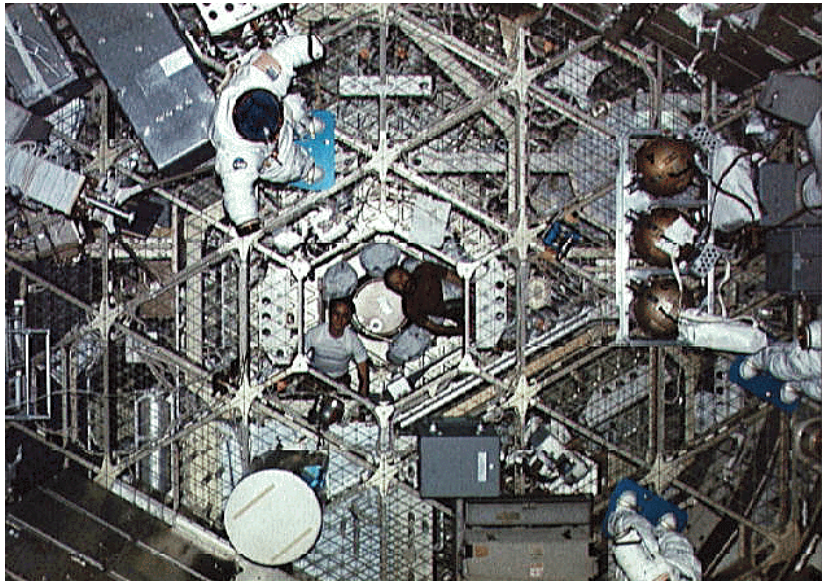
Skylab was not simply a place of habitation; it was a place of elaborate and technical science experiments for which when the bulk of data was returned, such as on films that had to be physically returned to Earth began the process of analyzing scientific and engineering data as each mission was completed.

Skylab's solar observatory was one major aspect of study, and solar science was significantly advanced by the telescope; it observed the Sun as never before. As Skylab finished up NASA's focus had shifted to development of the Space Shuttle, which had the promise of reducing the cost of space access compared to the previous launch systems

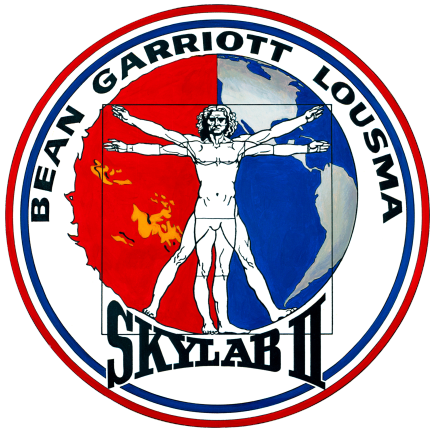

SOLAR PANELS
EXPERIMENTS
APPOLLO TELESCOPE MOUNT
SATURN WORKSHOP
MICRO METEOROID SHIELD
SLEEP COMPARTMENT
WARD ROOM
WASTE COMPARTMENT
AIRLOCK MODULE
MULTIPLE DOCKING ADAPTER
COMMAND & SERVICE MODULE
MSFC-72-SL-7200-110

The crew rendezvoused with Skylab on the fifth orbit. After making substantial repairs, including deployment of a parasol sunshade that cooled the inside temperatures to 23.8 degrees C (75 degrees F), the workshop was in full operation by June 4. In orbit, the crew conducted solar astronomy and Earth resources experiments, medical studies and five student experiments. The mission completed 404 orbits and 392 experiment hours, as well as three EVAs totaling six hours, 20 minutes.

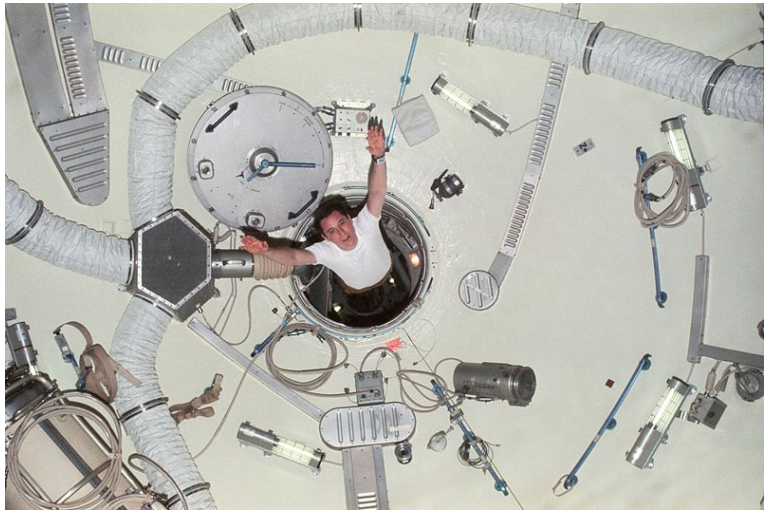




Continued maintenance of the space station, and extensive scientific and medical experiments. Completed 858 Earth orbits and 1,081 hours of solar and Earth experiments, as well as three EVAs totaling 13 hours, 43 minutes.



Last of the Skylab missions that included observation of the comet Kohoutek and numerous experiments. Completed 1,214 Earth orbits and four EVAs totaling 22 hours, 13 minutes.



SKYLAB EXPERIMENTS

MEDICAL

M071 MINERAL BALANCE
M073 BIOASSAY OF BODY FLUIDS
M074 SPECIMEN MASS MEASUREMENT
M078 BONE MINERAL MEASUREMENT
M092 IN-FLIGHT LOWER BODY NEGATIVE PRESSURE
M093 VECTORCARDIOGRAM
M111 CYTOGENETETIC STUDIES OF BLOOD
M112 MAN'S IMMUNITY IN VITRO ASPECTS
M113 BLOOD VOLUME AND RED CELL LIFE SPAN
M114 RED BLOOD CELL METABOLISM
M115 SPECIAL HEMATOLOGIC EFFECTS
M131 HUMAN VESTIBULAR FUNCTION
M133 SLEEP MONITORING
M151 TIME AND MOTION STUDY
M171 METABOLIC ACTIVITY
M172 BODY MASS MEASUREMENT
S015 ZERO-g SINGLE HUMAN CELL
S071 CIRCADIAN RHYTHM-POCKET MICE
S072 CIRCADIAN RHYTHM-VINEGAR GNAT

APOLLO TELESCOPE MOUNT

S052 WHITE LIGHT CORONAGRAPH
S054 X-RAY SPECTROGRAPHIC TELESCOPE
S055A UV SCANNING POLYCHROMATOR SPECTROHELIOMETER
S056 DUAL X-RAY TELESCOPES
S082A XUV CORONAL SPECTROHELIOGRAPH
S082B UV SPECTROGRAPH

SCIENCE

S009 NUCLEAR EMULSION
S019 UV STELLAR ASTRONOMY
S020 UV X-RAY SOLAR PHOTOGRAPHY
S063 UV AIRGLOW HORIZON PHOTOGRAPHY
S073 GEGENSCHEIN ZODIACAL LIGHT
S149 PARTICLE COLLECTION
S150 GALACTIC X-RAY MAPPING
S183 ULTRAVIOLET PANORAMA
S228 TRANSURANIC COSMIC RAYS
S230 MAGNETOSPHERIC PARTICLE COMPOSITION
S201 XUV ELECTRONICGRAPHIC CAMERA
S232 BARIUM PLASMA OBSERVATION
S233 COMET KOHOUTEK PHOTOGRAPHY

TECHNOLOGY

D008 RADIATION IN SPACECRAFT
D024 THERMAL CONTROL COATINGS
M415 THERMAL CONTROL COATINGS
M479 ZERO-g FLAMMABILITY
M512 MATERIALS PROCESSING FACILITY
M551 METALS MELTING
M552 EXOTHERMIC BRAZING
M553 SPHERE FORMING
M555 GALLIUM ARSENIDE CRYSTAL GROWTH
M516 CREW ACTIVITIES / MAINTENANCE STUDY
M518 MULTIPURPOSE FURNACE SYSTEM
M556 VAPOR GROWTH OF II-VI COMPOUNDS
M557 IMMISCIBLE ALLOY COMPOSITIONS
M558 RADIOACTIVE TRACER DIFFUSION
M559 MICROSEGREGATION IN GERMANIUM
M560 GROWTH OF SPHERICAL CRYSTALS
M561 WHISKER-REINFORCED COMPOSITES
M562 INDIUM ANTIMONIDE CRYSTALS
M563 MIXED M V CRYSTALS GROWTH
M564 METAL AND HALIDE EUTECTICS
M565 SILVER GRIDS MELTED IN SPACE
M566 COPPER-ALUMINUM EUTECTICS
T003 IN-FLIGHT AEROSOL ANALYSIS
T025 CORONAGRAPH CONTAMINATION MEASUREMENT
T027 ATM CONTAMINATION MEASUREMENT
T053 EARTH LASER BEACON

EARTH RESOURCES EXPERIMENT PACKAGES

S190A MULTISPECTRAL PHOTOGRAPHIC FACILITY
S190B EARTH TERRAIN CAMERA
S191 INFRARED SPECTROMETER
S192 MULTISPECTRAL SCANNER
S193 MICROWAVE RADIOMETER/SCATTEROMETER AND ALTIMETER
S194 L-BAND RADIOMETER

OPERATIONS

M487 HABITABILITY & CREW QUARTERS
M509 ASTRONAUT MANEUVERING EQUIPMENT
T013 CREW VEHICLE DISTURBANCE
T020 FOOT CONTROLLED MANEUVERING UNIT
T002 MANUAL NAVIGATION SIGHTINGS

STUDENTS EXPERIMENTS

ED11 ATMOSPHERIC ABSORPTION OF HEAT
ED12 VOLCANO STUDY*
ED21 LIBRATION CLOUDS*
ED22 OBJECTS WITHIN MERCURY'S ORBIT*
ED23 UV FROM QUASARS*
ED24 X-RAY STELLAR CLASSES
ED25 X-RAYS FROM JUPITER*
ED26 UV FROM PULSARS*
ED31 BACTERIA AND SPORES**
ED32 IN-VITRO IMMUNOLOGY**
ED41 MOTOR SENSORY PERFORMANCE**
ED52 WEB FORMATION**
ED61 PLANT GROWTH**
ED62 PLANT PHOTOTROPISM**
ED63 CYTOPLASMIC STREAMING**
ED72 CAPILLARY STUDY**
ED74 MASS MEASUREMENT**
ED76 NEUTRON ANALYSIS**
ED78 LIQUID MOTION IN ZERO-G**

*DATA ONLY
** HDWE FAB. REQUIRED

TOTAL 94

MSFC-73-SL-7200-136 E

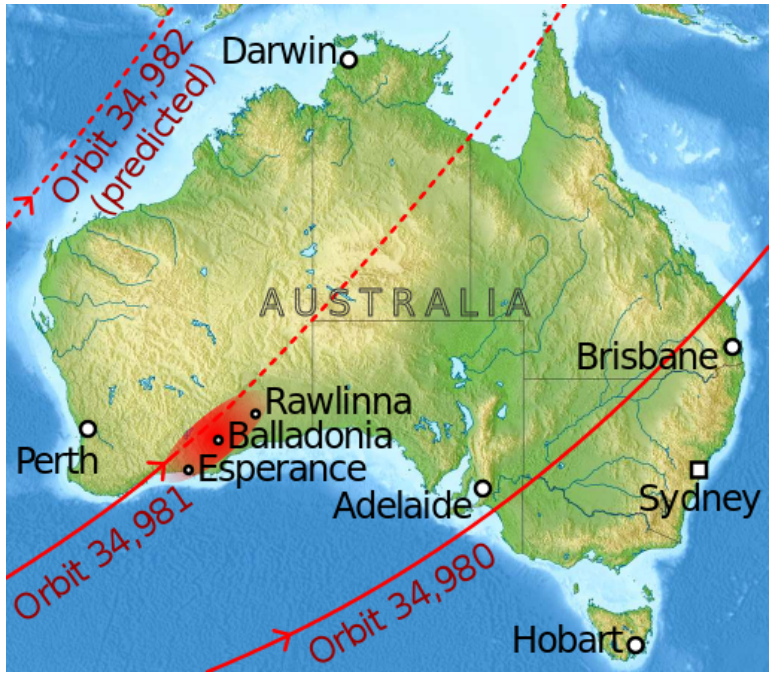
If the Space Shuttle had been built in time, it was planned that it would be used to move Skylab to a higher orbit, adding five or more years of operational life.

3 proposals: “push” the station, “tow” the station, or attached a booster to the station. The booster was the one most seriously considered.

The End of Skylab

NASA calculated debris would land in Indian Ocean and that the odds of station re-entry debris hitting any human were 1 to 152, which when multiplied by 4 billion becomes 1 in 600 billion for a specific human

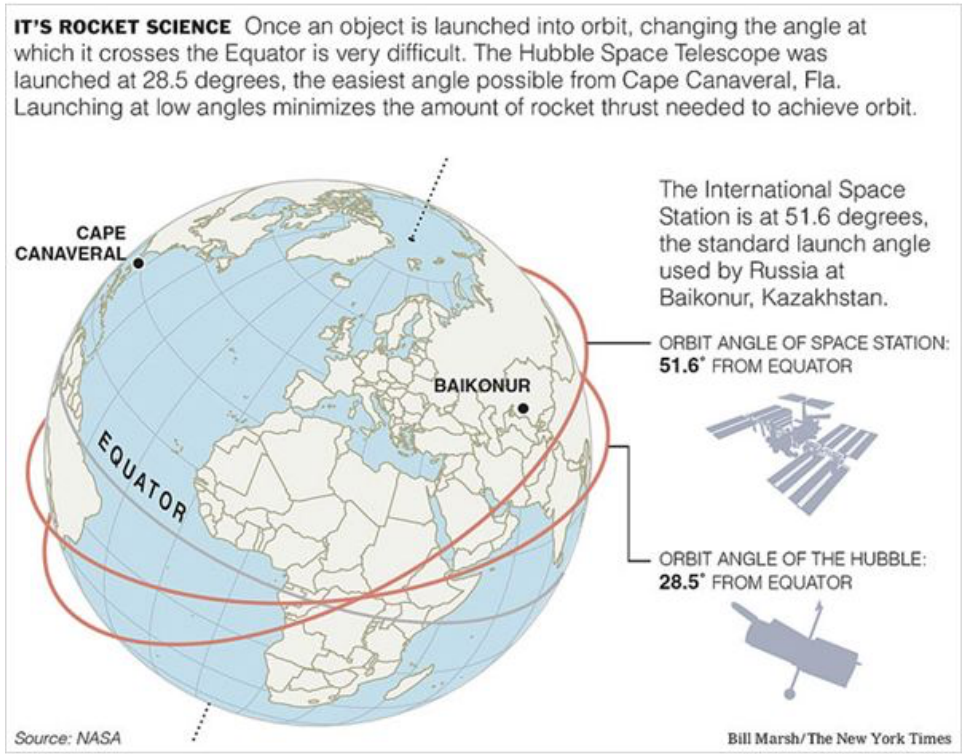
Due to a 4% calculation error, debris landed about 300 miles southeast of Perth, Australia.



146 mi from Las Cruces to Socorro
615 mi from Las Cruces to Denver

Typical **orbital paths** for **space shuttle** missions covered regions between 57 degrees north and 57 degrees south of the equator and **altitudes of between 155 and 600 miles** depending on the mission profile.

Orbital speeds were on the order of 17,500 mph, resulting in one **orbit** approximately every 90 minutes.



STS-1

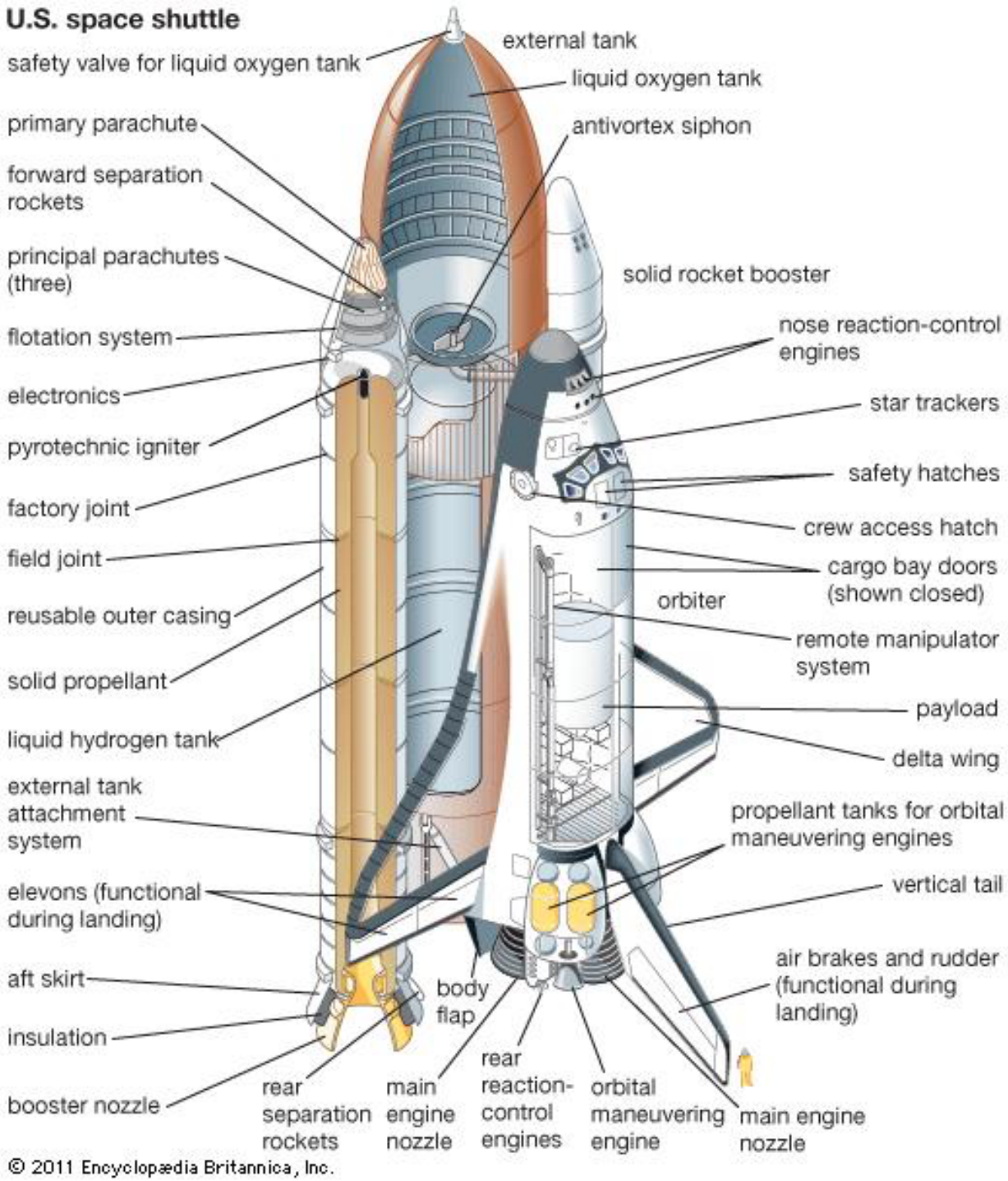

Columbia
YOUNG · CRIPPEN


Explorer

STS-135


FERGUSON HURLEY MAGNUS WALHEIM
STS
135


Atlantis


U.S. space shuttle
safety valve for liquid oxygen tank
external tank
liquid oxygen tank
antivortex siphon
primary parachute
forward separation rockets
principal parachutes (three)
solid rocket booster
flotation system
nose reaction-control engines
electronics
star trackers
pyrotechnic igniter
safety hatches
factory joint
crew access hatch
field joint
cargo bay doors (shown closed)
orbiter
reusable outer casing
remote manipulator system
solid propellant
payload
liquid hydrogen tank
delta wing
external tank attachment system
propellant tanks for orbital maneuvering engines
elevons (functional during landing)
vertical tail
aft skirt
air brakes and rudder (functional during landing)
body flap
insulation
booster nozzle
rear separation rockets
main engine nozzle
rear reaction-control engines
orbital maneuvering engine
main engine nozzle
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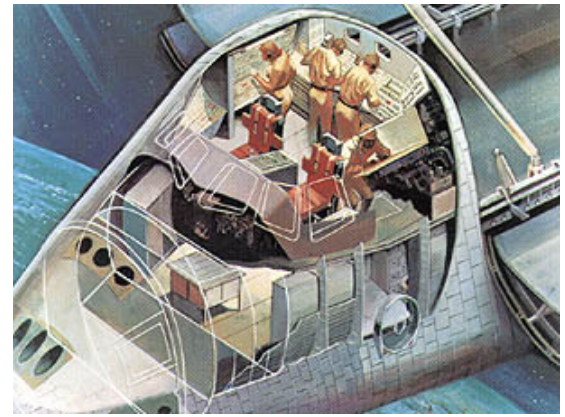
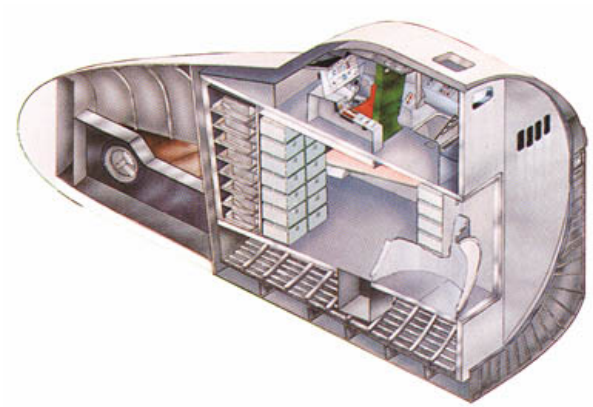
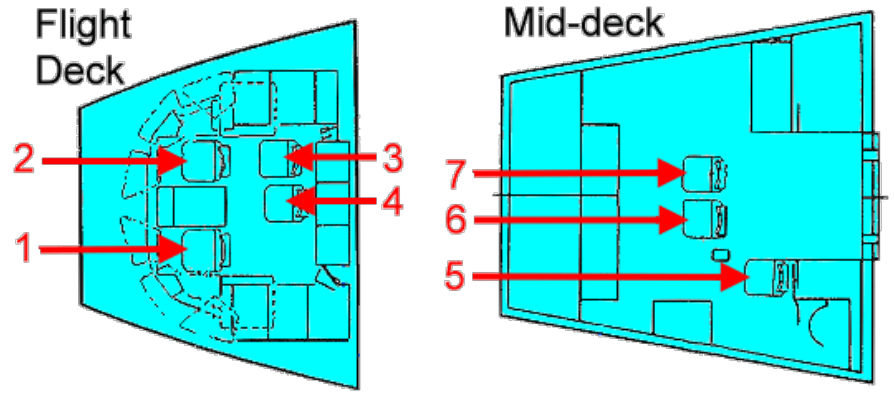
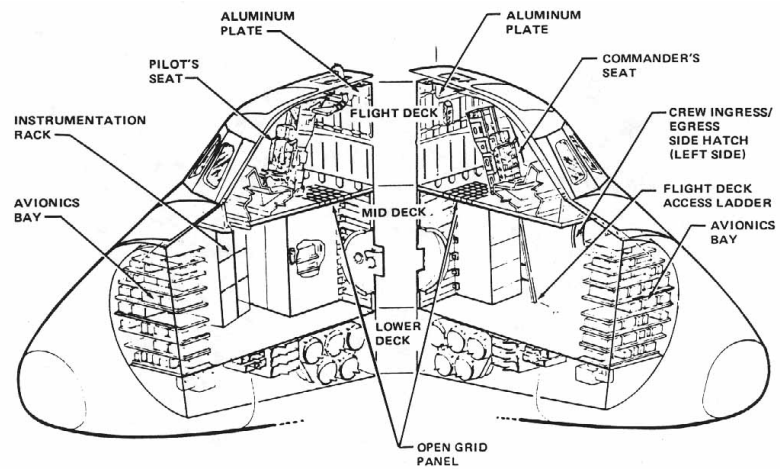
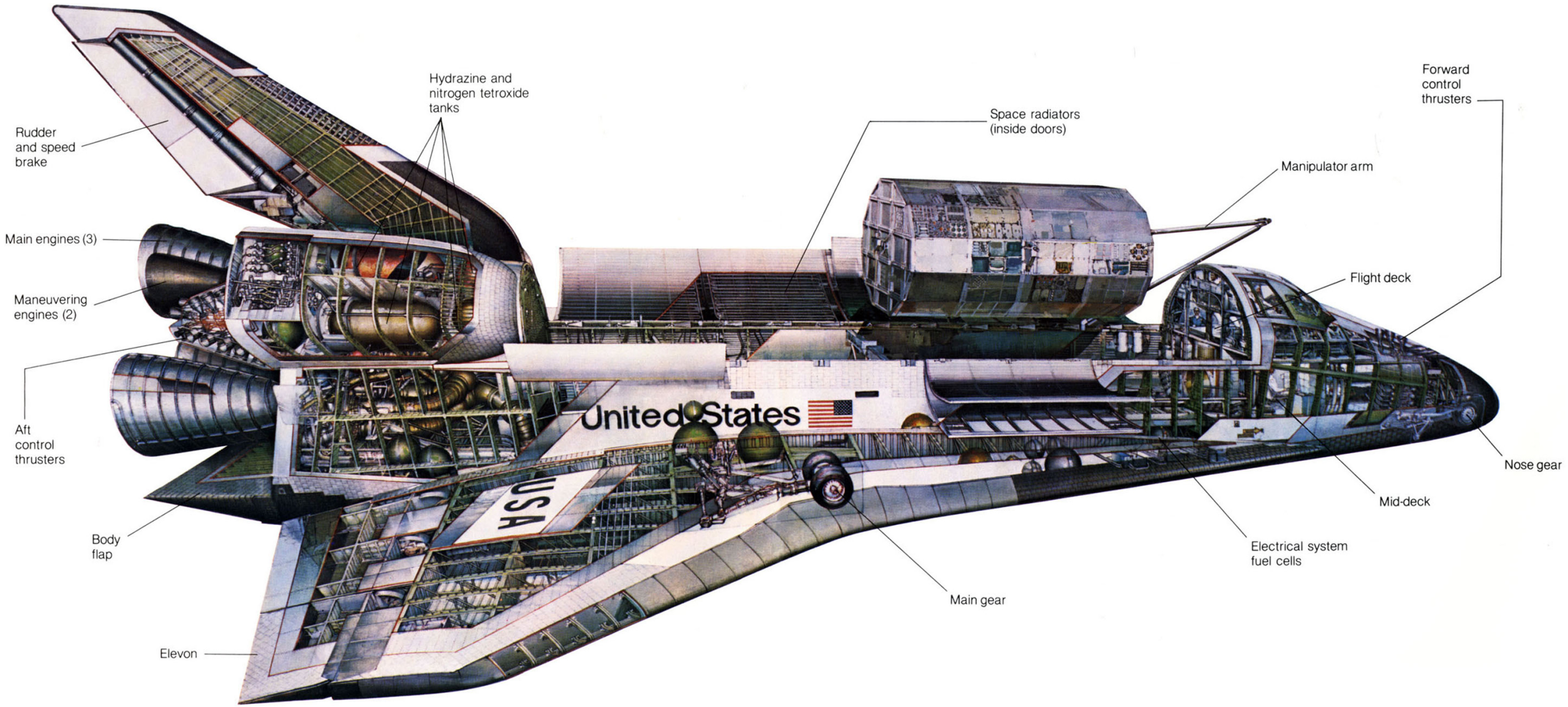


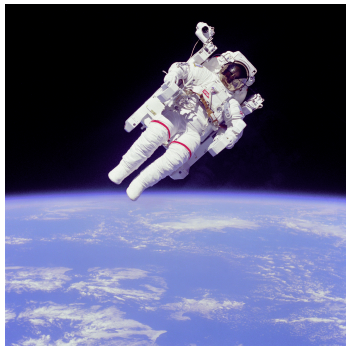


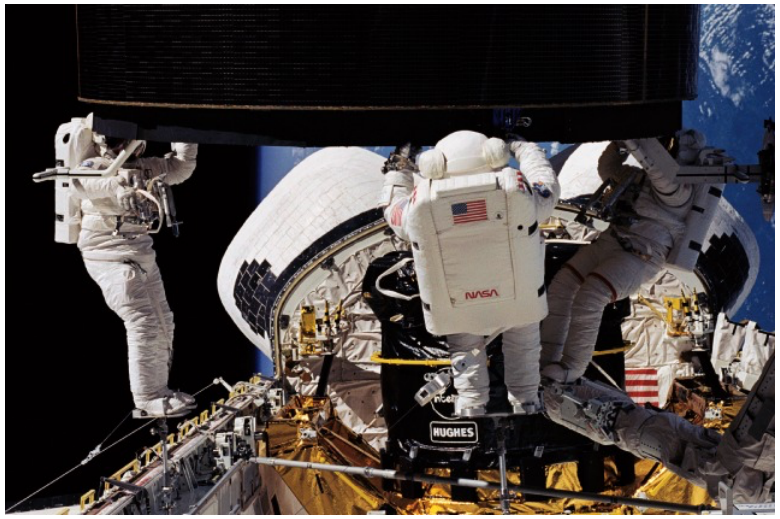

Flight Deck
2
3
4
1
Mid-deck
7
6
5

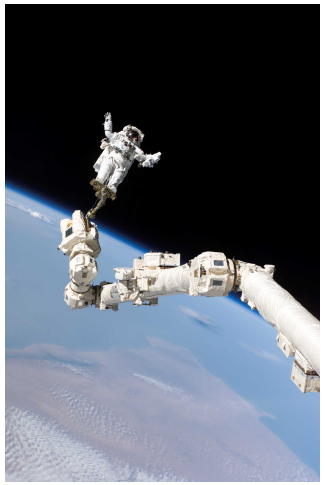

ALUMINUM PLATE
ALUMINUM PLATE
PILOT'S SEAT
COMMANDER'S SEAT
INSTRUMENTATION RACK
FLIGHT DECK
CREW INGRESS/ EGRESS SIDE HATCH (LEFT SIDE)
FLIGHT DECK ACCESS LADDER
AVIONICS BAY
MID DECK
AVIONICS BAY
LOWER DECK
OPEN GRID PANEL

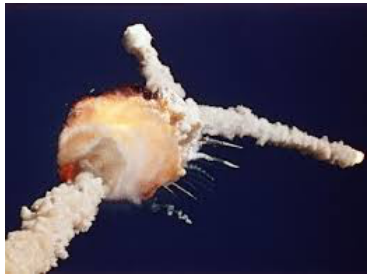

Rudder and speed brake
Hydrazine and nitrogen tetroxide tanks
Space radiators (inside doors)
Forward control thrusters
Manipulator arm
Main engines (3)
Flight deck
Maneuvering engines (2)
Aft control thrusters
United States
USA
Nose gear
Mid-deck
Body flap
Electrical system fuel cells
Main gear
Elevon

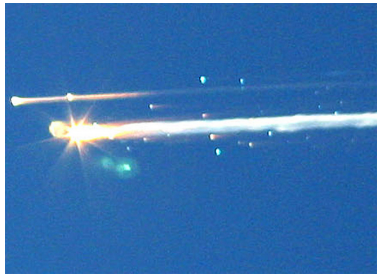

collectSPACE



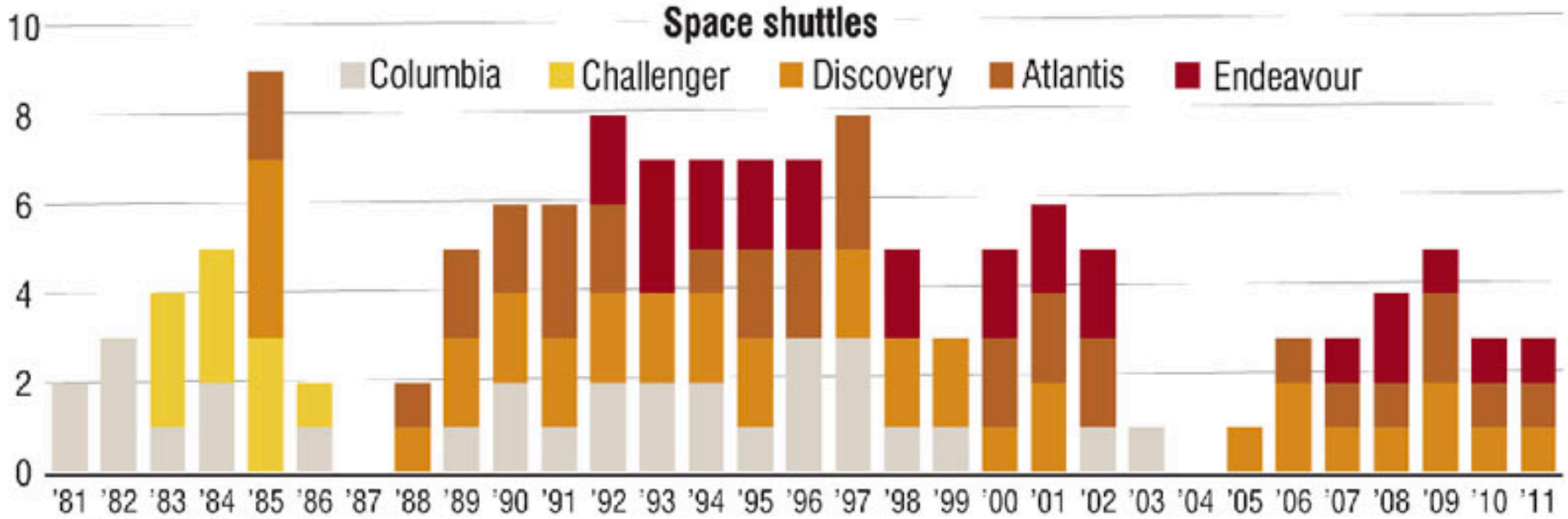


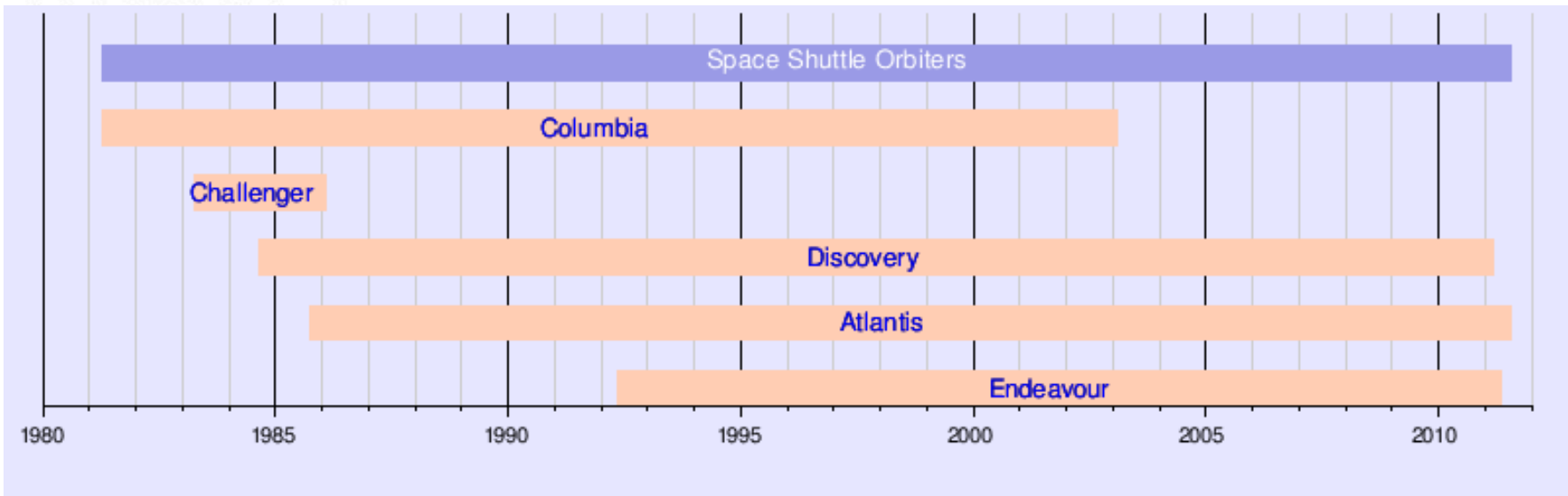






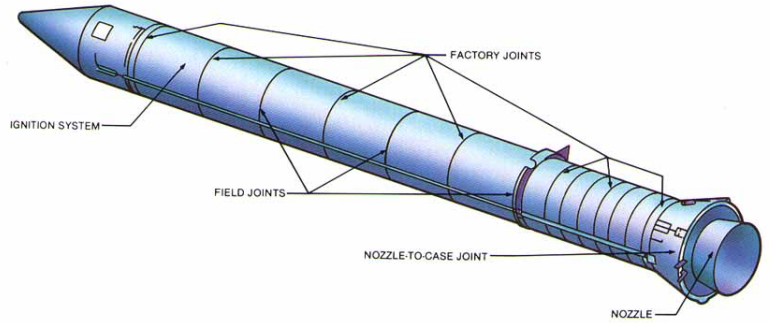
NUMBER OF SPACE SHUTTLE LAUNCHES



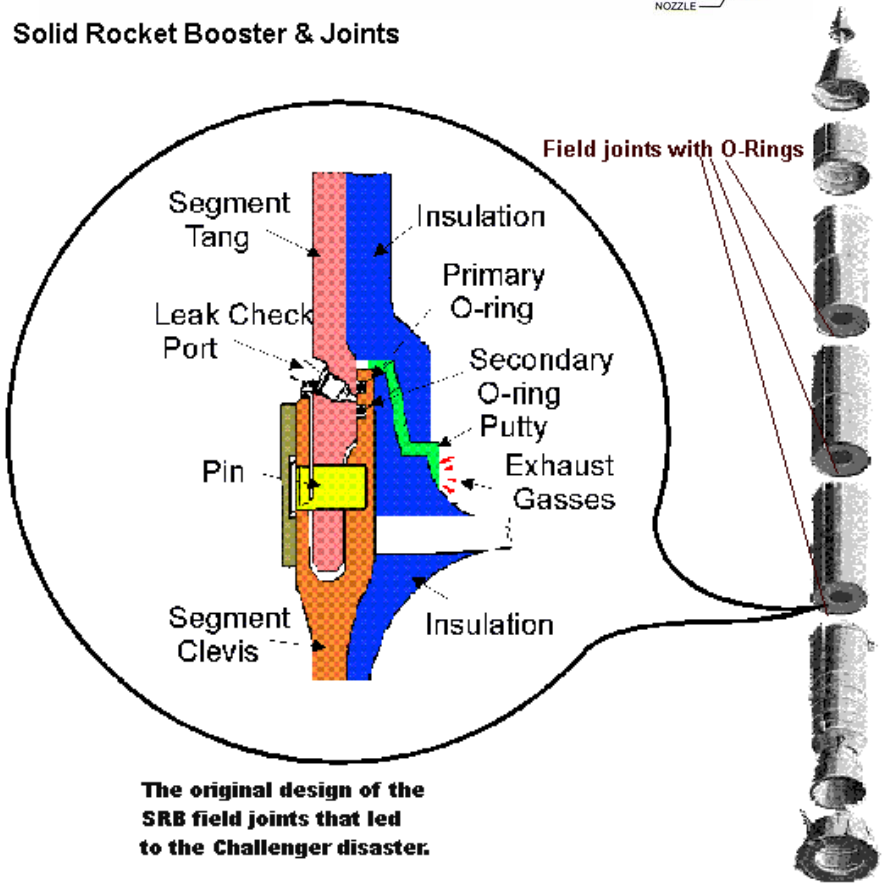


http://www.nytimes.com/interactive/science/space/0705-shuttle-30-years.html?_r=0

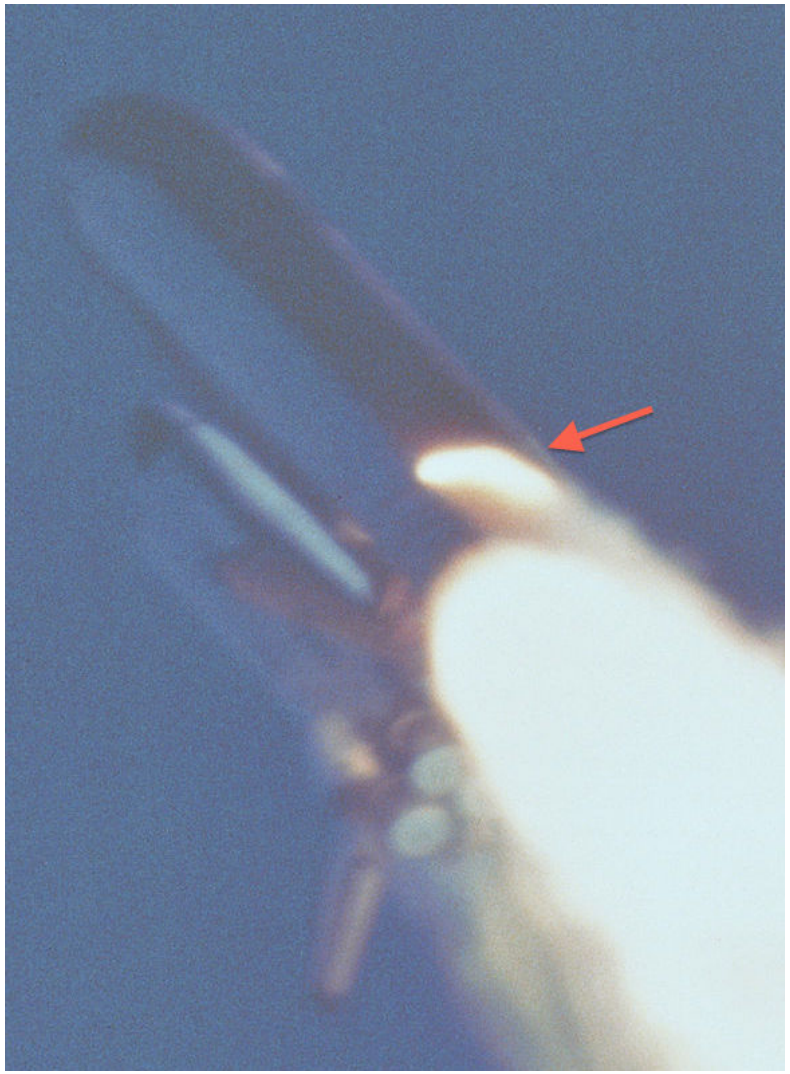
CHALLENGER JANUARY 28, 1986



Solid Rocket Booster & Joints

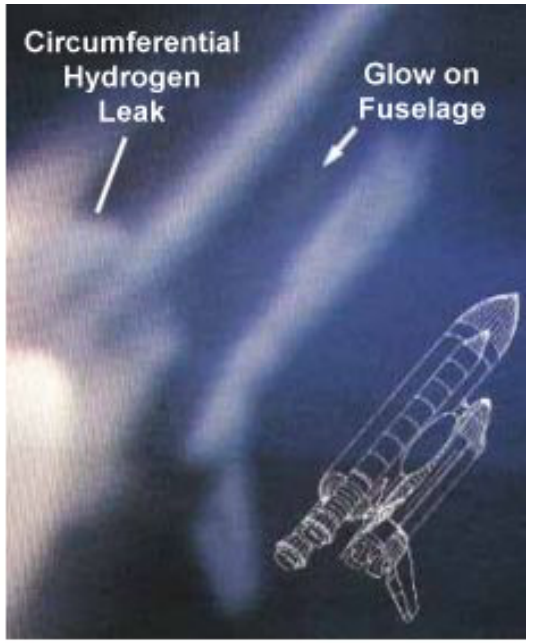


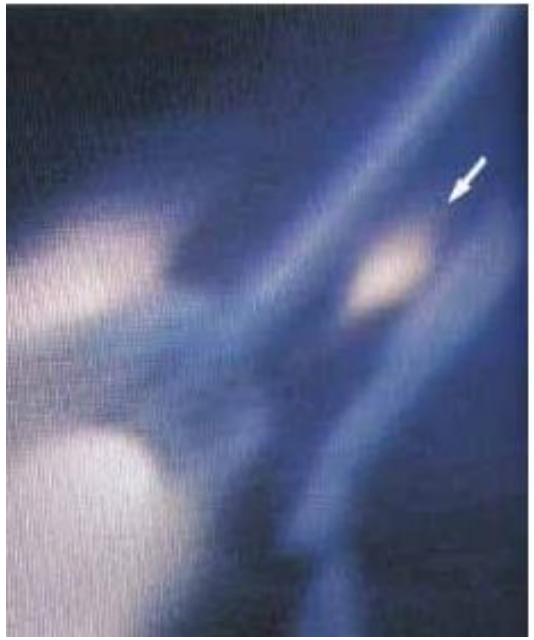
The original design of the SRB field joints that led to the Challenger disaster.

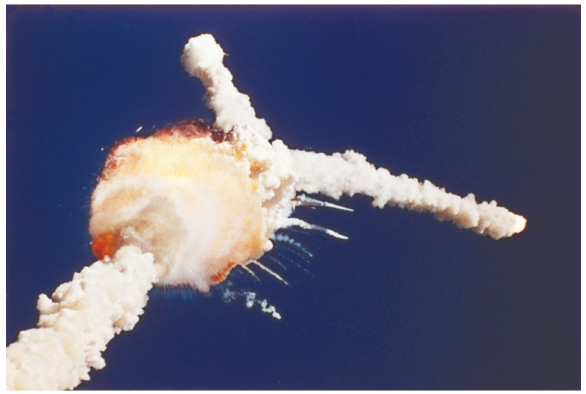



Hydrogen
Leak

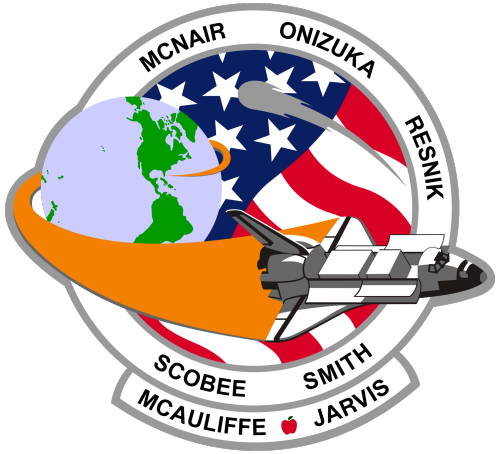

Hydrogen
Leak


Circumferential
Hydrogen
Leak
Glow on
Fuselage



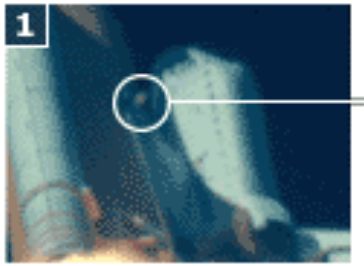


“Uh oh”, Michael J. Smith, T +73 sec



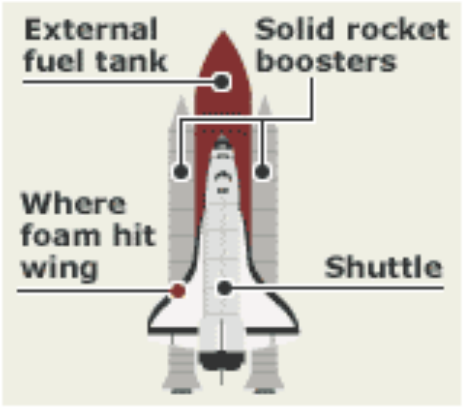
- Francis R. Scobee, Commander
- Michael J. Smith, Pilot
- Ronald McNair, Mission Specialist
- Ellison Onizuka, Mission Specialist
- Judith Resnik, Mission Specialist
- Gregory Jarvis, Payload Specialist
- Christa McAuliffe, Payload Specialist, Teacher

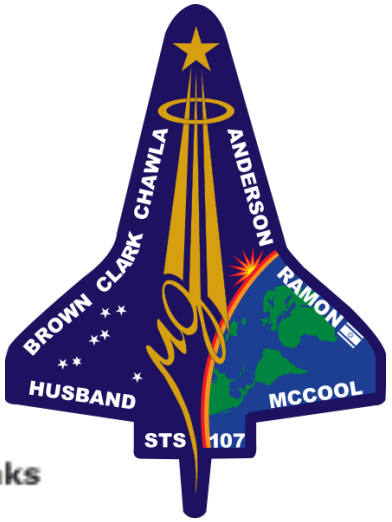
COLUMBIA FEBRUARY 1, 2003



Piece of lightweight insulating foam breaks off fuel tank

Foam hits left wing and disintegrates



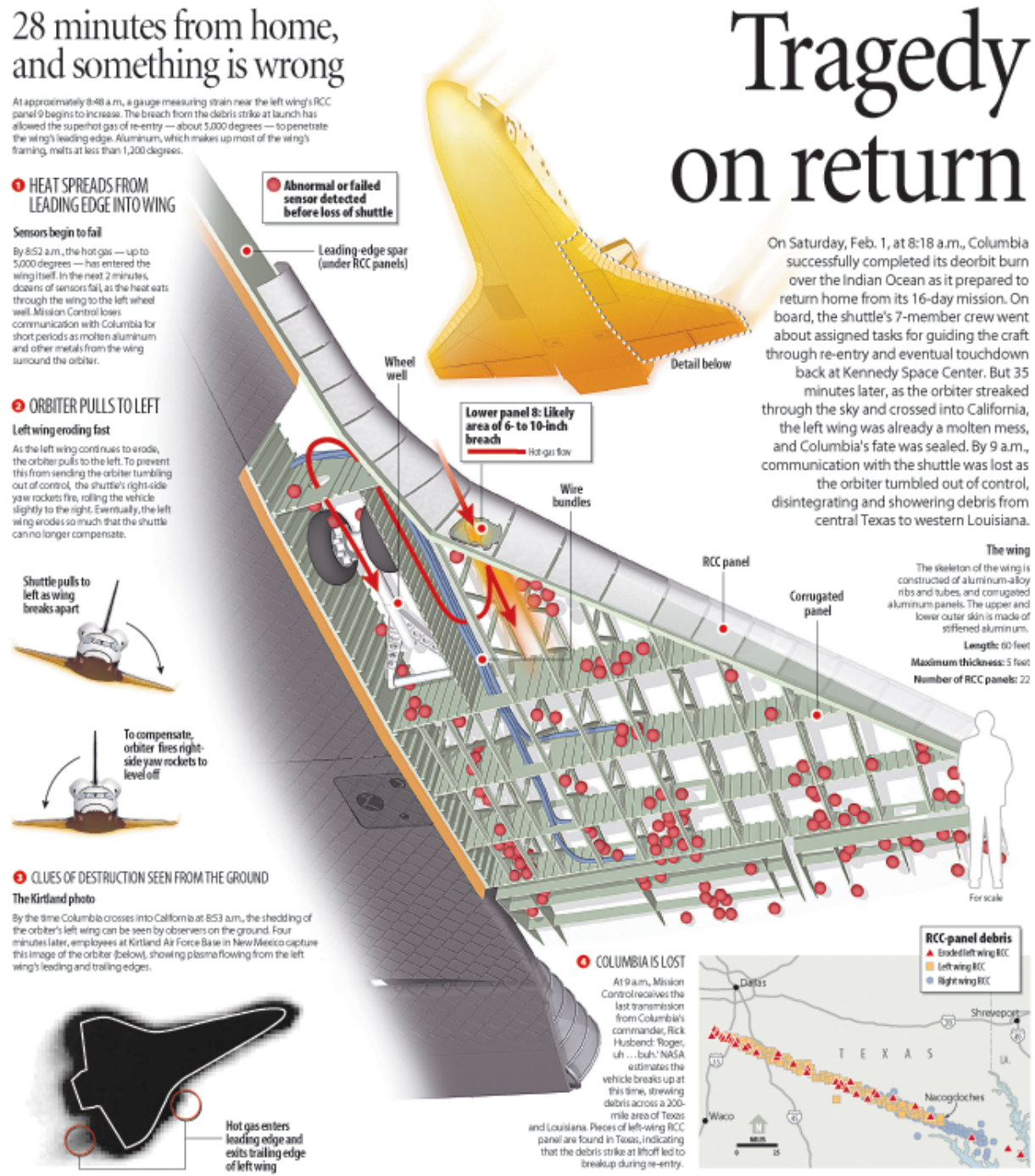


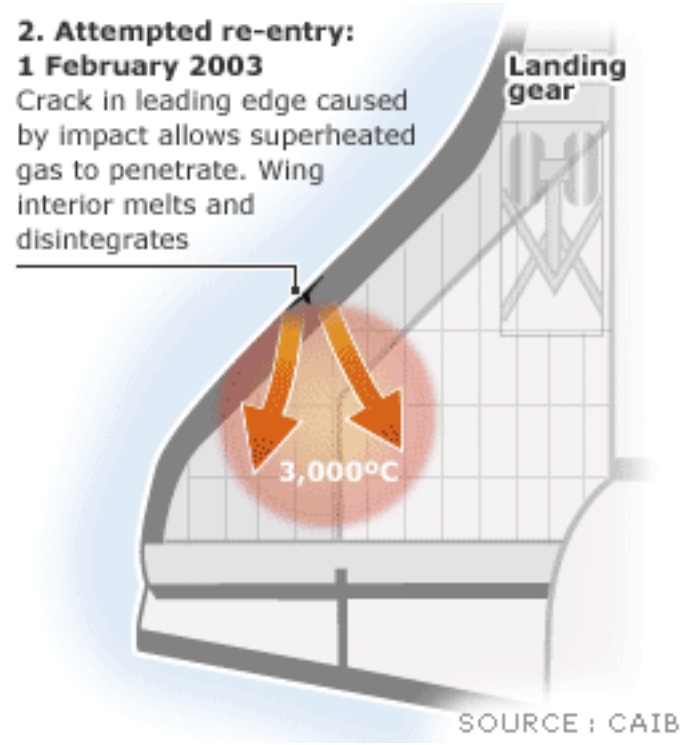
Tragedy on return

On Saturday, Feb. 1, at 8:18 a.m., Columbia successfully completed its deorbit burn over the Indian Ocean as it prepared to return home from its 16-day mission. On board, the shuttle's 7-member crew went about assigned tasks for guiding the craft through re-entry and eventual touchdown back at Kennedy Space Center. But 35 minutes later, as the orbiter streaked through the sky and crossed into California, the left wing was already a molten mess, and Columbia's fate was sealed. By 9 a.m., communication with the shuttle was lost as the orbiter tumbled out of control, disintegrating and showering debris from central Texas to western Louisiana.

28 minutes from home, and something is wrong

At approximately 8:48 a.m., a gauge measuring strain near the left wing's RCC panel 9 begins to increase. The breach from the debris strike at launch has allowed the superhot gas of re-entry — about 5,000 degrees — to penetrate the wing's leading edge. Aluminum, which makes up most of the wing's framing, melts at less than 1,200 degrees.

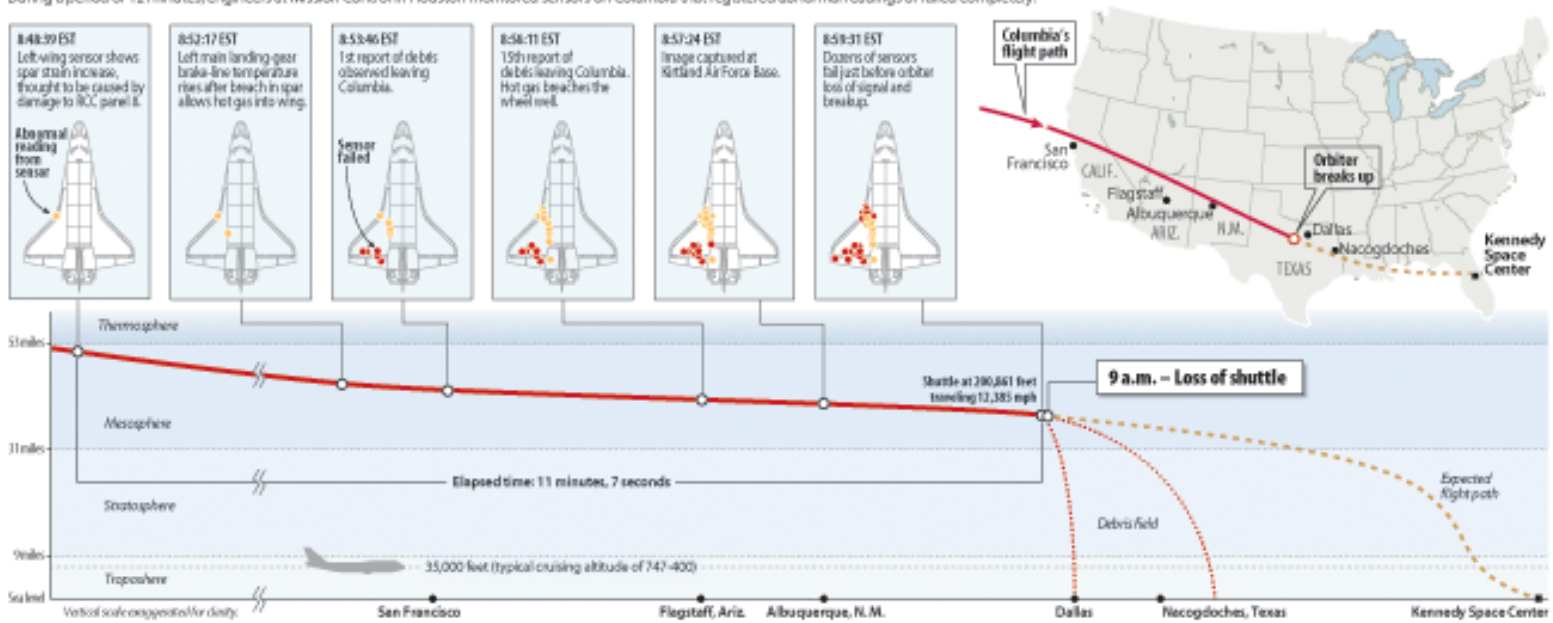




SOURCE : CAIB

Re-entry timeline

During a period of 12 minutes, engineers at Mission Control in Houston monitored sensors on Columbia that registered abnormal readings or failed completely.



LOTTERY, PAGE A2
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FEBRUARY 2, 2003
THE WEATHER
Today: Cloudy, with light rain likely, windy, 20
Tomorrow: Breezy, cloudy, chance of drizzle, 40
FULL REPORT: PAGE D12

Space shuttle Columbia lost on reentry; 7 astronauts dead

A fiery trail streaked across the sky as the space shuttle Columbia broke apart yesterday over Texas. An amateur photographer captured this image from his backyard in Tyler.

SHUTTLE ERA SOARS TO END

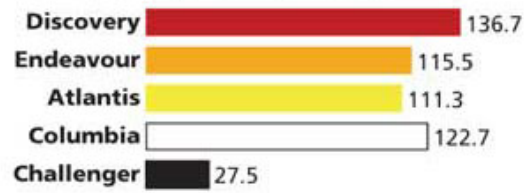
Space shuttle Atlantis is scheduled to lift off at 11:26 a.m. today, if weather permits. **STORY, A4**

Follow the launch online with photos, updates and videos at IndyStar.com.

MILES FLOWN

The five orbiters flew a combined 537.1 million miles, a distance that would more than reach Jupiter (390.7 million miles) or equal 5.8 trips to the sun (93 million miles).

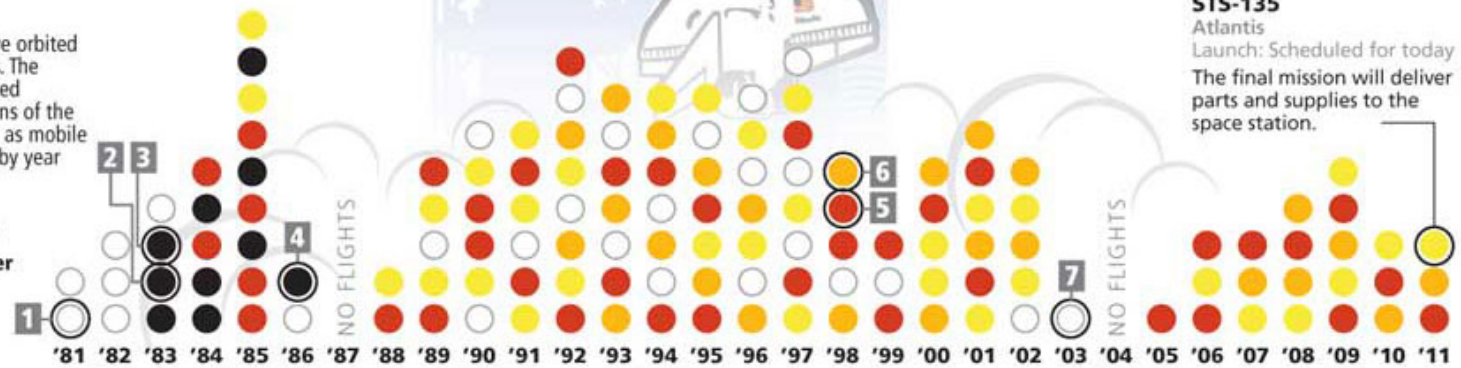
Distance flown, in millions of miles:



SHUTTLE LAUNCHES

Through 134 missions, the shuttles have orbited Earth 20,952 times in 1,320 flight days. The shuttle missions have deployed and fixed satellites and telescopes, hauled sections of the International Space Station and served as mobile laboratories. At right, shuttle launches by year and key milestones in the program:

Discovery · Endeavour · Atlantis · Columbia · Challenger



STS-135
Atlantis
Launch: Scheduled for today
The final mission will deliver parts and supplies to the space station.

1 STS-1
Columbia
April 12-14, 1981
First shuttle to reach orbit and safely return to Earth.

2 STS-7
Challenger
June 18-24, 1983
Sally Ride becomes first U.S. woman in space.

3 STS-8
Challenger
Aug. 30-Sept. 5, 1983
Guion Bluford becomes first African-American in space.

4 STS-51L
Challenger
Jan. 28, 1986
Challenger blows up 73 seconds after launch, killing seven crew.

5 STS-95
Discovery
Oct. 29-Nov. 7, 1998
John Glenn, senator and Mercury veteran, flies on shuttle as oldest astronaut.

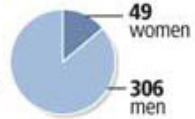
6 STS-88
Endeavour
Dec. 4-15, 1998
International Space Station assembly begins.

7 STS-107
Columbia
Jan. 16-Feb. 1, 2003
Columbia disintegrates 16 minutes before scheduled landing, killing seven crew.

CREW FLOWN

The number of crew members who have flown on each shuttle:

Including the crew of STS-135, 355 individuals will have flown on a shuttle.



CREW BY NATION

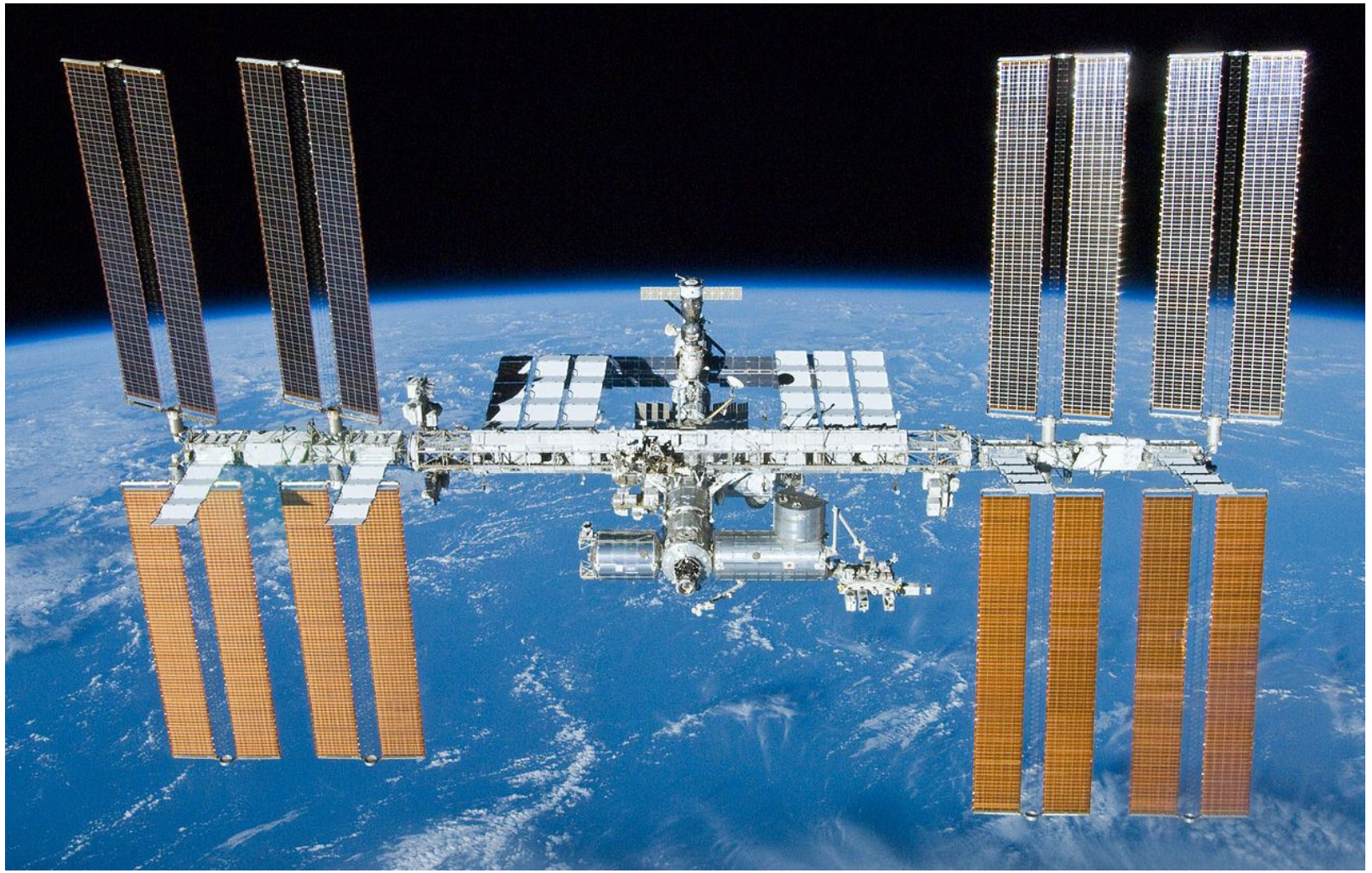
Astronauts representing 16 nations have flown on a space shuttle. At right, nations represented more than once:

USA	RUS	CAN	JPN	FRA	GER	ITA
293	20	8	7	7	6	5

Source: NASA

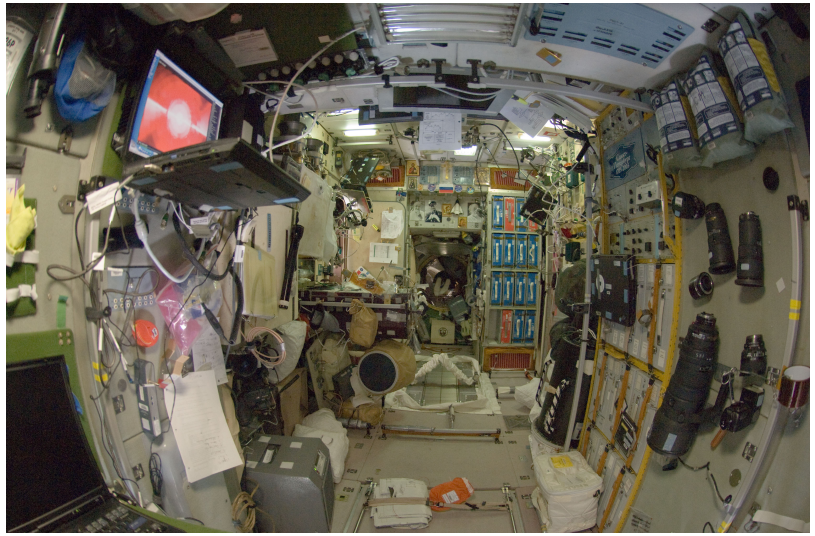
STEPHEN J. BEARD / The Star

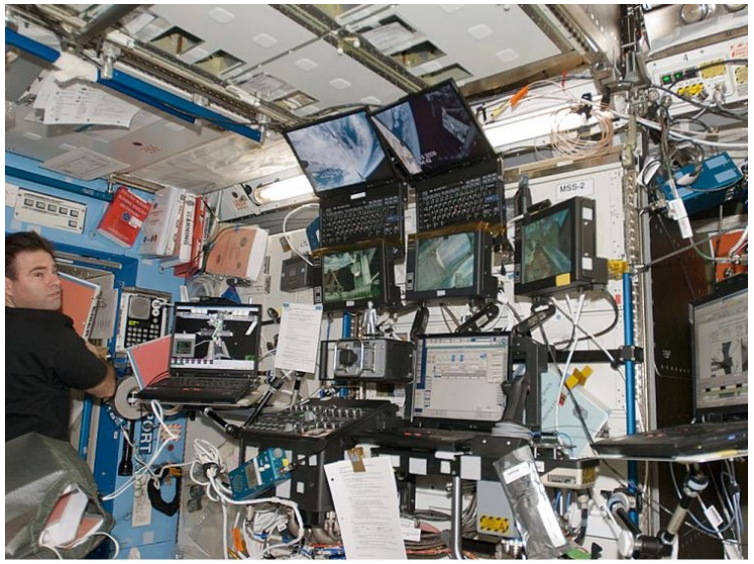
DURING THE SHUTTLE ERA, WE BUILT THE INTERNATIONAL SPACE STATION!



http://www.space.com/31010-building-the-international-space-station.html

https://en.wikipedia.org/wiki/List_of_International_Space_Station_expeditions





A space lab is born

Twelve years and $150 billion in the making, the International Space Station is finally complete and ready to reach its research potential

1998
28 January: The 15 governments involved in the ISS sign a treaty of cooperation

1998
20 November: Zarya, the first ISS module, is launched

2001
30 April: Dennis Tito, the first space tourist, arrives at the ISS

2003
1 February: Columbia is destroyed on re-entry to Earth's atmosphere. Space shuttle flights halted for more than 2 years

2008
3 April: ESA's uncrewed Jules Verne cargo craft docks with the ISS

2009
29 May: Station crew increased to six

2010
1 Febuary: NASA announces plan to operate the ISS to 2020

2011
1 March: The Leonardo module docks with the ISS, completing NASA's portion of the station

2011
13 July: NASA selects non-profit group CASIS to help run research labs on the ISS

2011
27 October: Cosmonaut Sergey Volkov submits a research paper to the journal *EPL* from the ISS

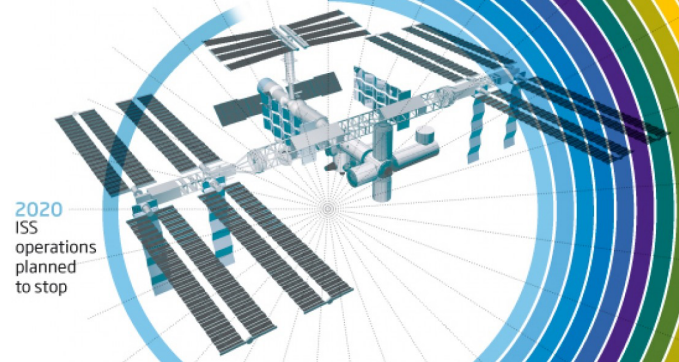
2012
24 March: Fragments of Russian satellite pass close to the ISS. Crew enter their Soyuz lifeboats

2012
25 May: SpaceX's Dragon capsule, the first commercial space vehicle, docks with the ISS

2015
Russian OKA-T free-flying lab due to launch

2020
ISS operations planned to stop

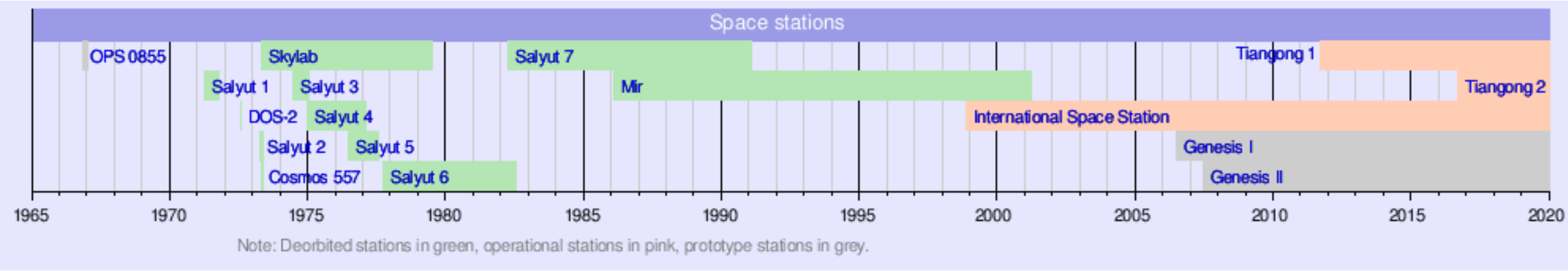
ISS partners are assessing extending the station's life to 2028



The ISS is 72 x 108 metres, roughly the same size as a soccer pitch, and weighs ~450 tonnes

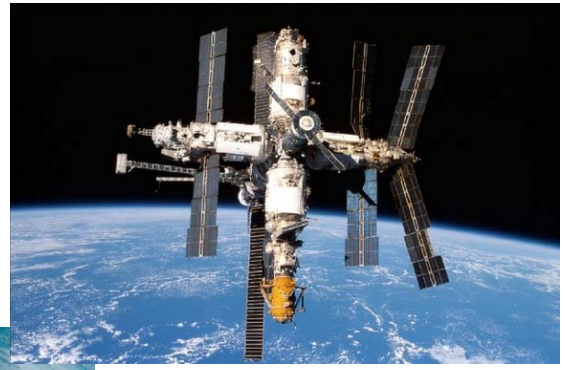
It completes 15.7 orbits of Earth per day

205 people of 15 nationalities have visited the ISS



SKYLAB

MIR

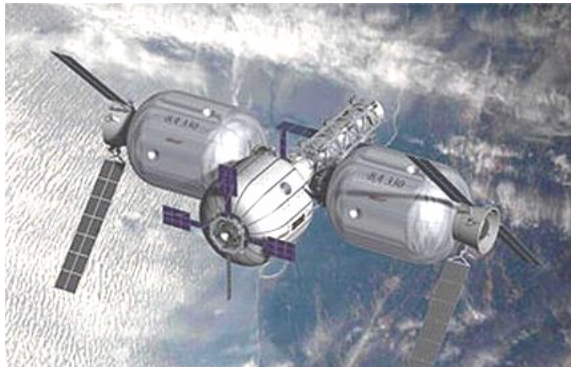


TAINGONG 1

TAINGONG 2

SALYUT 6

GENESIS 1



GENESIS 2