NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION

STS-51B

PRESS KIT
APRIL 1985

FIRST OPERATIONAL SPACELAB MISSION
SPACELAB 3

STS-51B INSIGNIA

S84-44372 -- The space shuttle Discovery and its science module payload are featured in the insignia for the STS-51B/Spacelab 3 mission. The seven stars of the constellation Pegasus surround the orbiting spaceship above the flag-draped Earth. The artwork was done by Carol Ann Lind.

The NASA insignia design for space shuttle flights is reserved for use by the astronauts and for other official use as the NASA Administrator may authorize. Public availability has been approved only in the form of illustrations by the various news media. When and if there is any change in this policy, which we do not anticipate, it will be publicly announced.

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CHALLENGER CARRIES FIRST OPERATIONAL SPACELAB MISSION

The launch of Space Shuttle mission 51-B/Spacelab 3 will usher in an era of routine flights for Spacelab, NASA's modular, reusable research facility. The mission marks the first operational flight for the European Space Agency-developed space lab oratory. Fifteen experiments will be conducted during the 7-day Spacelab 3 mission. This mission's main objective is to provide a high quality microgravity environment for delicate materials processing and fluid experiments.

Space Shuttle flight 51-B/Spacelab 3 is scheduled for launch from Launch Complex 39, Pad A, at Kennedy Space Center, FL, on April 29, 1985, 12 Noon EDT. Spacelab will operate inside the orbiter Challenger, circling Earth at an altitude of 190 nautical miles with an orbital inclination of 57 degrees.

NASA's Marshall Space Flight Center in Huntsville, Ala., is responsible for overall management of the Spacelab 3 mission. The European Space Agency (ESA) designed and developed Spacelab to serve as part of America's Space Transportation System, the Space Shuttle. Spacelab includes various standardized parts, such as habitable modules, pallets and airlocks that can be assembled to meet the needs of a particular mission.

Spacelab 3 consists of a long habitable module, where scientists will work in a shirtsleeve environment, and an experiment support structure, a lightweight carrier bridging the payload bay for experiments requiring direct exposure to space.

The module operated flawlessly during the first Spacelab mission in November 1983, and the support structure has been used to carry experiments during several previous Shuttle missions.

Scientific research will begin immediately after Spacelab is activated, 5 hours after launch. Spacelab 3 supports 15 investigations in five research disciplines: materials science, life sciences, fluid mechanics, atmospheric physics and astronomy. Twelve experiments were developed by U.S. scientists, two by French scientists and one by Indian scientists. Two of the experiments, one in astronomy and one in materials science, are reflights of Spacelab 1 experiments.

Some of the experiments are performed in reusable "minilab" facilities inside the habitable module. Five such units being flown for the first time on this mission include two crystal growth facilities, an animal housing complex for primates and rodents, and two units for investigating fluid behavior in low gravity.

During the mission, scientists will conduct a variety of experiments to validate theories, stimulate new ideas for applications on Earth and answer basic questions about the nature of the universe. Spacelab 3 is called the "microgravity mission" because it is uniquely designed to provide a smooth, stable ride through space, reducing gravity and gravity-like forces to a minimum. For this mission, delicate crystal growth and fluid mechanics experiments which are dependent on a lack of gravity have been clustered near the spacecraft's center of gravity, the most stable part of the vehicle. To further reduce gravity effects and disruptive forces such as thruster firings, the Shuttle will maintain a "gravity gradient" attitude for most of the mission.

The Shuttle will be maneuvered into a gravity gradient attitude at approximately 18 hours into the mission and remain in this position until science operations are completed.

The tail of the orbiter will be pointed down toward the center of the Earth, and the starboard (right) wing will be pointed in the direction of travel.

During the first 17 hours of the mission an astronomy experiment, requiring a number of spacecraft maneuvers to point at celestial objects, will be operated from the Spacelab scientific airlock.

For the second time in American space flight history, crew members will perform scientific investigations continuously around the clock. Two of the scientists who developed Spacelab 3 experiments will conduct onboard research during the mission. As payload specialists, Dr. Lodewijk van den Berg, a materials scientist from EG&G Energy Management Corp., Goleta, CA, and Dr. Taylor Wang, a fluid physicist from the NASA's Jet Propulsion Laboratory, Pasadena, CA, will be the second pair of career scientists to work aboard Spacelab.

Scientific research will also be performed by three NASA mission specialists: Dr. Don Lind, a high-energy astrophysicist, and Drs. Norman Thagard and William Thornton, both medical doctors making their second Shuttle flights. Mission commander of the seven-member crew is Robert Overmyer, a veteran NASA astronaut who served as pilot on the fifth Shuttle mission. Assisting him is pilot Frederick Gregory, on his first space mission.

This is the second NASA mission in which scientists who developed Spacelab experiments participate actively in guiding the mission. These scientists helped train and select the pay load specialists and worked closely with the management team to plan the mission. During the flight, they will participate directly from the Payload Operations Control Center (POCC) at NASA's Johnson Space Center, Houston.

Throughout the mission, all Spacelab 3 science operations will be managed from the POCC at Johnson. Members of the Marshall mission management team, along with investigator teams who developed the Spacelab 3 experiments, will monitor, direct and control experiment operations from the ground control center. The orbiter Challenger and basic Spacelab systems will be controlled from the Mission Control Center, located in the same building as the POCC.

The Tracking and Data Relay Satellite System (TDRSS) will handle most of the communications and data transmissions between the spacecraft and the ground. NASA's worldwide Ground Spacecraft Tracking and Data Network (GSTDN), operated by the Goddard Space Flight Center, Greenbelt, MD, will be used when TDRSS coverage is not available. A special Spacelab Data Processing Facility at Goddard will handle the steady flow of scientific and engineering data.

Following deactivation of Spacelab and prior to reentry, the crew will deploy two Getaway Special (GAS) satellites: the Northern Utah Satellite (NUSAT) and the Global Low Orbiting Message Relay Satellite (GLOMR). This is the first time satellites have been deployed from the can-shaped GAS containers.

The satellites are mounted on the port (left) side of the orbiter payload bay in the vicinity of the Spacelab 3 tunnel. Both satellites are for Earth observations and will not be retrieved. After 7 days of around-the-clock scientific operations, Challenger will return Spacelab 3 to the Kennedy Center. Reentry will begin with the firing of the Shuttle's Orbital Maneuvering System engines as the orbiter makes its 108th revolution of the Earth. Landing is set for 8:53 a.m. EDT, on Runway 15.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

BRIEFING SCHEDULE

Time (EDT)	Briefing	Location
T-1 Day		
9:00 a.m.	Spacelab 3 Mission Overview	KSC
10:00 a.m.	Spacelab 3 Science Overview	KSC
11:00 a.m.	STS-51B Mission Overview	KSC
11:30 a.m.	Deployable GAS satellites	KSC
11:45 a.m.	NUSAT	KSC
12:00 Noon	GLOMR	KSC
1:30 p.m.	Pre-Launch Press Conference	KSC
T-Day		
1:00 p.m. (approximate)	Post Launch Briefing	KSC
Launch Through End of Mission		
Times announced on NASA Select	Flight director change-of-shift briefings. The Spacelab 3 mission manager will join the flight director at one change-of shift briefing each day.	JSC
12:00 Noon (approximate)	Science Summary Briefings	JSC
Landing Day		
10:00 a.m. (approximate)	Post Landing Briefing	KSC
1:30 p.m.	Life Sciences Status Briefing	KSC

GENERAL INFORMATION

Each day there will be as many as three change-of-shift briefings by the Shuttle flight director. The Spacelab 3 mission manager will participate in one of these briefings daily. Additionally, there will be one science summary briefing by the mission scientist. Media representatives at Johnson Space Center can attend these briefings. At other NASA centers, reporters can monitor the briefings on NASA television via satellite and ask questions via two-way audio circuits. A transcript of each flight director briefing will be available at NASA news centers.

NASA Select Television Schedule

The television schedules will be updated daily to reflect any changes in the mission. The schedule for television transmissions from Challenger and Spacelab and for mission briefings, will be available during the mission at Ames Research Center, Johnson Space Center, Kennedy Space Center, Lewis Research Center, Marshall Space Flight Center and NASA Headquarters. These transmissions also will be carried by RCA Satcom F-1R Transponder 18 (full transponder).

NASA Select Television and Audio Release circuits will also feature special science updates between 9:00 a.m. and 9:00 p.m. EDT each day. These periodic reports from the POCC Users Rooms will focus on cadre members and investigators discussing experiment progress. The reports are intended to augment the real-time science information available to media. These reports will be conducted by Drs. Byron Lichtenberg and Michael Lampton (Spacelab 1 and Earth Observations Mission payload specialists).

Satcom F-1R is located at 139 degrees west longitude. Transponder 18 transmits on a frequency of 4060.0 MHz. The system will be operational from T-4 hours on launch day through T+4 hours on landing day.

Mission Audio and Video

The media will have access to real-time audio and video transmitted from the spacecraft to ground control centers. Media may obtain real-time Spacelab 3-to-POCC communications over the Air-to-Ground 1 circuit (A/G-1). A/G-2 will be used as the Orbiter- Mission Control Center voice circuit. Occasionally, the A/G will be shared by the MCC and POCC. In addition, Public Affairs commentary on the progress of the mission is broadcast on the Mission Audio channel.

Transcripts

Only transcripts of the flight director change-of-shift briefings will be available at the NASA news centers. Transcripts of air-to-ground transmissions have been discontinued.

SHUTTLE MISSION 51-B -- QUICK LOOK FACTS

Crew:	Robert F. Overmyer, Commander Frederick D. Gregory, Pilot Don L. Lind, Mission Specialist 1 Norman E. Thagard, Mission Specialist 2 William E. Thornton, Mission Specialist 3 Lodewijk van den Berg, Payload Specialist (PSM - materials science expert) Taylor G. Wang, Payload Specialist (PSF - fluids expert)
Orbiter:	Challenger (OV-099)
Launch Site:	LC-39, Pad A, Kennedy Space Center, FL
Launch Date/Time:	April 29, 1985, 12 Noon EDT
Window:	60 minutes
Orbital Inclination:	57.0 degrees
Altitude:	190 nautical mile circular orbit, gravity gradient
Mission Duration:	7 days, land on flight day 7
Orbits:	108 full orbits, land on 109
Landing Date/Time:	May 6, 1985, 8:58 a.m. EDT
Landing Sites:	Primary: Kennedy Space Center, FL Weather Alternate: Edwards Air Force Base, CA Trans-Atlantic Landing: Zaragoza/Moron, Spain Abort-Once-Around: Space Harbor, White Sands, NM
Cargo and Payloads:	15 investigations in five discipline areas: materials science, life sciences, fluid mechanics, atmospheric physics and astronomy; three experiments in Shuttle middeck; 10 experiments in Spacelab long module; two experiments on experiment support structure; and two Getaway Special canisters.
Spacelab 3 module:	MPESS (Mission Peculiar Equipment Support Structure) VWFC (Very Wide Field Camera) AFT (Autogenic Feedback Training) ATMOS (Atmospheric Trace Molecules Spectroscopy) BTS (Biotelemetry System) DEMS (Dynamic Environment Measuring System) DDM (Drop Dynamics Module) FES (Fluid Experiment System) GFFC (Geophysical Fluid Flow Cell) IONS (Ionization States of Solar and Galactic Cosmic Ray Heavy Nuclei) MICG (Mercuric Iodide Crystal Growth) RAHF-VT (Research Animal Holding Facility -- Verification Test) UMI (Urine Monitoring Investigation) VCGS (Vapor Crystal Growth System) GAS -- NUSAT (Northern Utah Satellite) GAS -- GLOMR (Global Low Orbiting Message Relay Satellite)

Highlights/Mission Objectives: To conduct applications, science and technology investigations that require the low-gravity environment of Earth orbit and extended duration stable vehicle attitude with emphasis on materials processing.

First deploy of free-flyers from Getaway Specials.

Crew will operate on two 12-hour shifts a day during flight.

First operational Spacelab mission.

Flight Synopsis: 51-B mission timeline calls for rotating shifts. Two teams, Gold and Silver, will work alternating shifts of 11 to 12 hours. The Silver team comprises the PLT, MS2 and PSM (materials science expert); the Gold team, the CDR, MS1, MS3 and PSF (fluids expert).

Launch/Entry Seating: The commander and pilot will occupy their normal flight deck seats. MS2 (Thagard) will assume the role of flight engineer and sit on the flight deck behind and between the commander and pilot. MS1 (Lind) will sit on the flight deck to the right of MS2. MS3 and the payload specialists will sit on the middeck.

Contingency EVA Crewmen: Pilot and MS2

STS-51B TRAJECTORY SEQUENCE OF EVENTS

Event	Orbit	Tig MET (d/h:m)	Burn Duration (min:sec)	Delta V (fps)	Post Burn Apogee/Perigee (n mi)
Launch		0/00:00			
Main Engine Cutoff (MECO)		0/00:09			
OMS-1		0/00:10	2:17	228	
OMS-2		0/00:46	2:27	242	189x189
Spacelab activation		0/02:10			
Experiment ops		0/05:00			
Trim-1		0/12:30			
Gravity gradient		0/18:05			
Cease experiment ops		6/08:00			
GLOMR deploy		6/09:35			
NUSAT deploy		6/10:00			
Spacelab deactivation		6/15:20			
Deorbit	108	6/19:54	3:00	318	
Entry interface	108	6/20:28			
Landing	109	6/20:58			

MAJOR SCIENCE EVENTS SUMMARY

Flight Day 1
Ascent
Payload Bay Doors open
Activate Spacelab Systems
Enter Spacelab
Activate Payload Experiments
Perform all Very Wide Field Camera astronomical observations Maneuver to Gravity Gradient Attitude for remainder of payload operations (136 hours)
Start 3 crystal growth experiments
Observe first large animal group living in a space habitat Perform ATMOS calibrations
Control space adaptation syndrome with first use of autogenic feedback training

Flight Day 2
First systematic observations of aurora from space
First study of fluids using the Drops Dynamics Module and Geophysical Fluid Flow Cell facilities
First observation of crystals growing in space

Flight Day 3
Begin cosmic ray studies with Ions instrument
Complete 29-hour growth of first Fluid Experiment System (FES) crystal
Begin 62-hour growth of second FES crystal

Flight Day 4
Begin 70-hour growth of second set of crystals in the French Mercury Iodide Crystal Growth System
Continued experiment operations in all disciplines

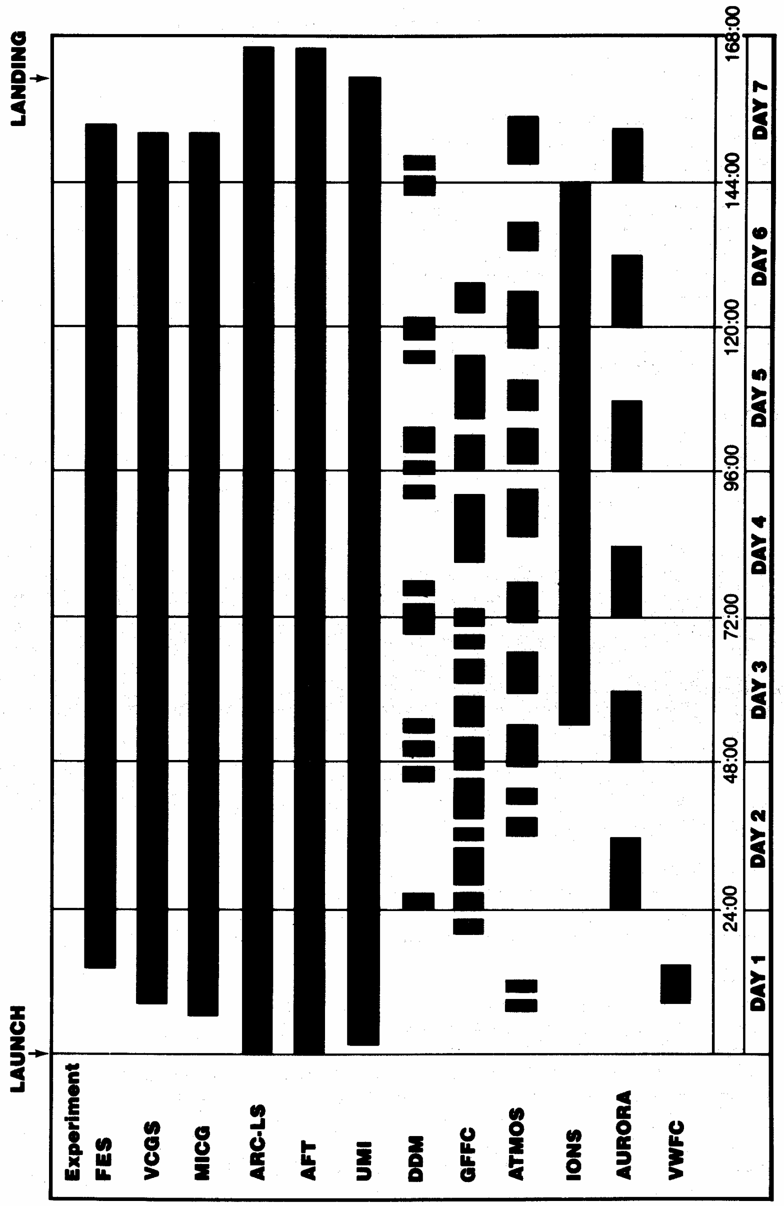
Flight Day 5
Payload operations in all science disciplines

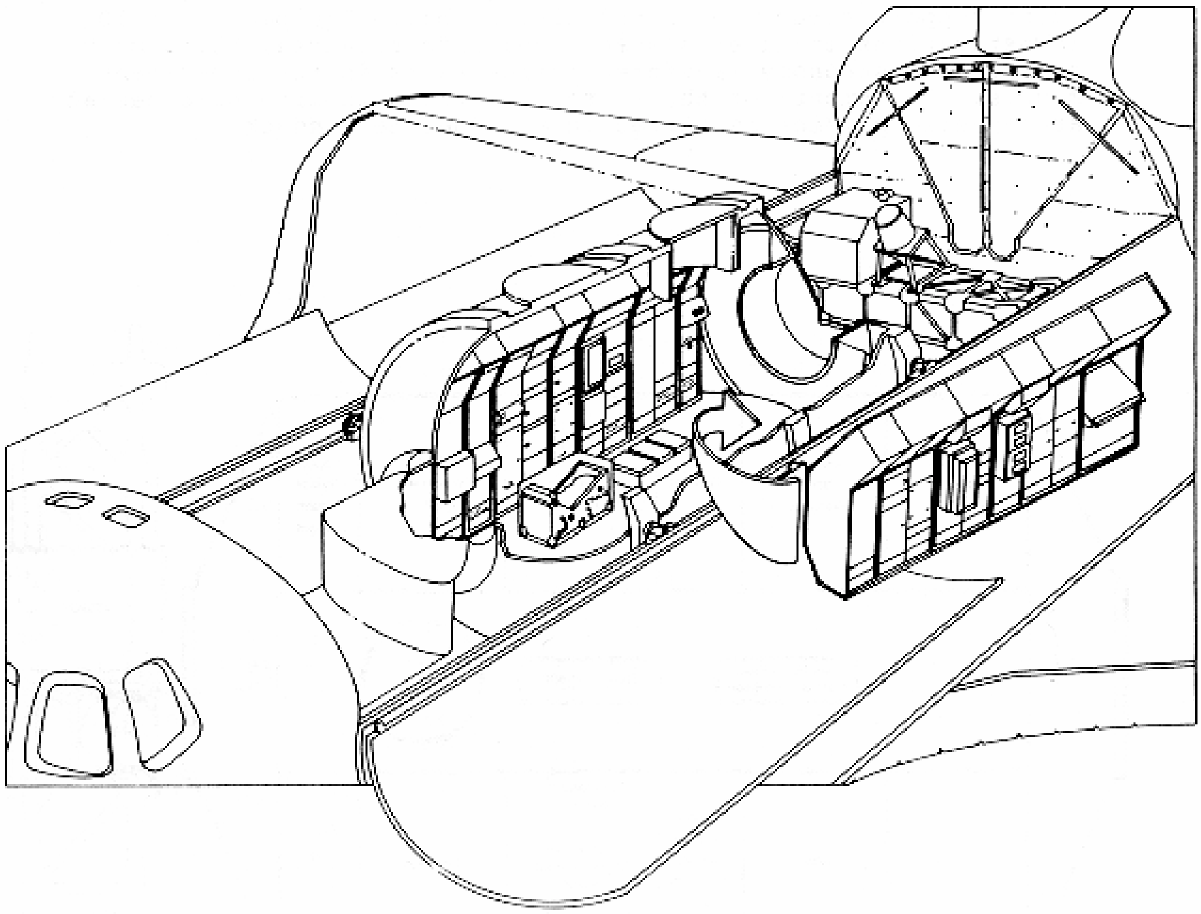
Flight Day 6
Second FES crystal ends growth period
Third FES crystal begins 19-hour growth period
Continued payload operations in all disciplines

Flight Day 7
Experiment operations completed; equipment stowed
Payload experiment deactivation
Spacelab systems deactivation
Deploy NUSAT and GLOMR Getaway Special satellites
Preparation for deorbit, reentry and landing

Flight Day 8
Flight extension day: landing at KSC/125 A (7 days, 21 hours, 24 minutes, MET)

Flight Day 9
Flight extension 2 days: landing at KSC/140 A (8 days, 20 hours, 15 minutes, MET)

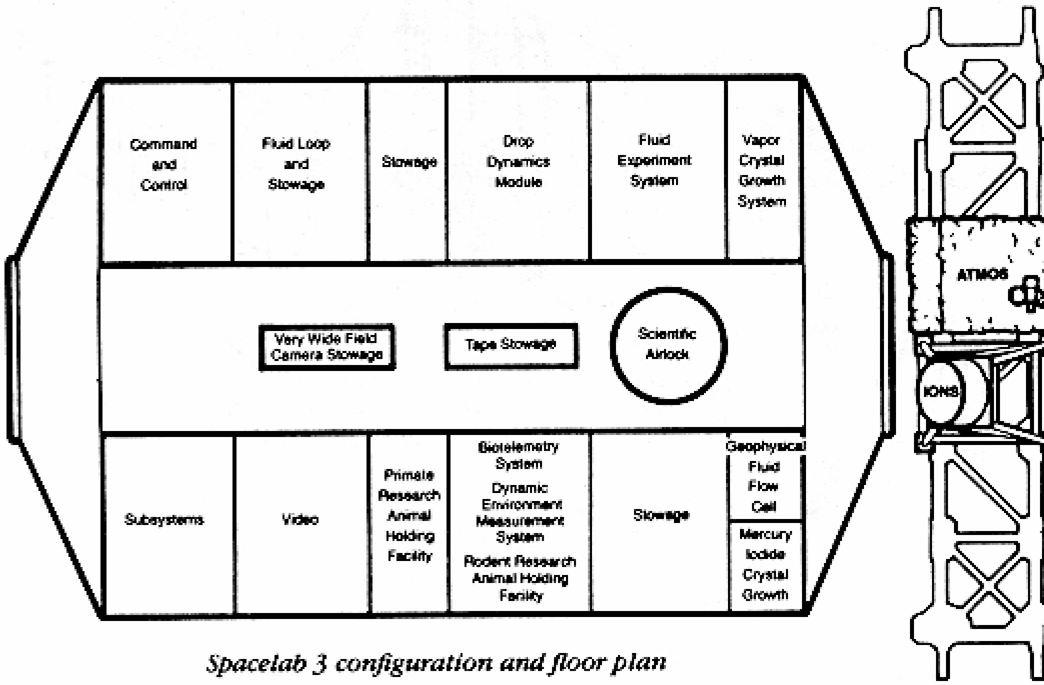

LAUNCH
LANDING
Experiment
FES
VCGS
MICG
ARC-LS
AFT
UMI
DDM
GFFC
ATMOS
IONS
AURORA
VWFC
24:00
48:00
72:00
96:00
120:00
144:00
168:00
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
DAY 6
DAY 7



CUTAWAY OF SPACELAB 3 MODULE

CONFIGURATION AND FLOOR PLAN

Spacelab 3 is composed of an experiment support structure and a long, habitable module. Two instruments for atmospheric observations and astronomical viewing are located on the experiment support structure in the payload bay. Equipment for 10 investigations in materials science, life sciences, fluid mechanics, and astronomy is stored inside racks in the experiment module. Equipment for three investigations in life sciences and atmospheric physics is stored in the Shuttle middeck.



Spacelab 3 configuration and floor plan

MISSION 51-B GETAWAY SPECIAL PAYLOADS

Two small satellites are carried in standard Getaway Special (GAS) containers mounted on the port (left) side of the orbiter payload bay in the vicinity of the Spacelab 3 tunnel.

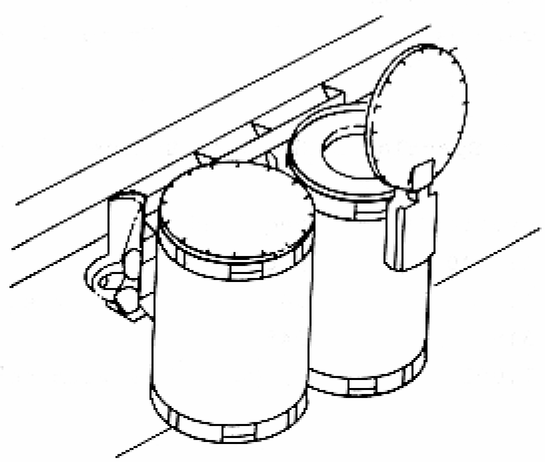
To avoid interfering with Spacelab 3 operations, the satellites are deployed on the seventh day of the mission after all other experiments are completed. The satellites are ejected by the crew via a standard Autonomous Payload Controller located in the orbiter aft flight deck. Upon receiving the proper command, a Full Diameter Motorized Door Assembly on the GAS canister opens and a spring-loaded device pushes the satellite from the container at a rate of 3 1/2 feet per second.

Northern Utah Satellite (NUSAT)

NUSAT is an air traffic control radar system calibrator. It will measure antenna patterns for ground-based radars operated in the United States and in member countries of the International Civil Aviation Organization. The 115-pound, 26-sided polyhedron satellite has an expected lifetime of six months. NUSAT was built by Morton Thiokol, Inc., Brigham City, Utah, for a university team headed by Weber State College, Ogden, Utah, in coordination with the Federal Aviation Administration.

Global Low Orbiting Message Relay Satellite (GLOMR)

The GLOMR satellite is a data relay, communications space craft and is expected to remain in orbit for approximately 1 year. The purpose of the 150-pound, 62-side polyhedron satellite is to demonstrate the ability to read signals and command oceanographic sensors; locate oceanographic and other ground sensors, and relay data from them to customers. GLOMR was designed and built by Defense Systems, Inc., McLean, VA.



Mission Statistics Summary

	Pounds
Spacelab 3 Payload Module	13,827
Module Experiments	4,449
Total Module	18,276
Equipment Support Structure	2,535
Tunnel	2,665
Total Spacelab 3 Payload	23,476
NUSAT and GAS Canister	433
GLOMR and GAS Canister	477
Orbiter at Liftoff	246,200
Total Vehicle at Liftoff	4,503,634
Orbiter and Spacelab Combined Weight at Landing	211,853

Spacelab Module Dimensions

Diameter	13 feet
Length	23 feet
Spacelab Tunnel inside diameter	40 inches
Experiment Computer Memory	64,000 or 64k (16 bit words)
Central Processing Unit	320,000 or 320k instructions/second
Data Handling Orbiter/TDRSS	Up to 50 megabits/second
Onboard storage capacity	Up to 32 megabits/second

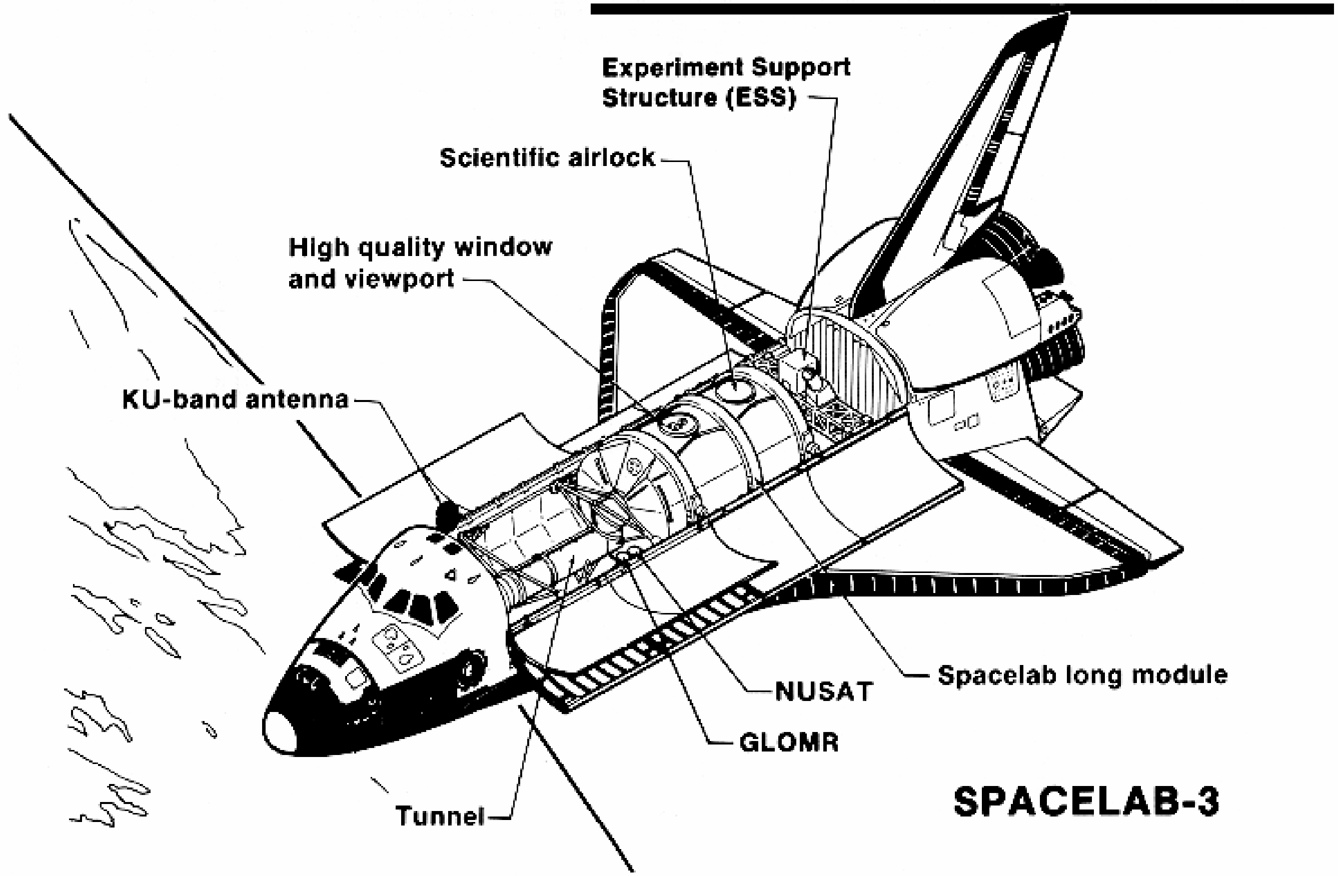
Spacelab 3 Resource Status

	Available	Required	Margin
Mass	11,440	9,070	+2,370 lb.
Volume	16	14	+2 equivalent racks
Crew Time	315	248	+67 hours
Electrical	1,091	1,100	+9 with contingency days

NASA

S-83-02403F

National STS Program
STS 51-B Cargo Configuration



SPACELAB-3

MISSION CYCLE

Spacelab Preparations

Preparations for the Spacelab 3 launch began on Dec. 13, 1983, with the arrival at Kennedy Space Center of the module used during the Spacelab 1 mission. Spacelab 1 racks and experiment equipment was removed at the KSC Operations and Checkout building. The Spacelab module required hardly any modifications before it could be used for Spacelab 3. A high quality window adapter assembly used during Spacelab 1 was removed because the window was not needed for Spacelab 3 investigations.

As scientific instruments and equipment arrived at the Kennedy Center, they were tested and then integrated into the four single racks and eight double racks used inside the module. An atmospheric science instrument and an astronomy instrument were mounted on an experiment support structure, a lightweight carrier used to expose instruments directly to space.

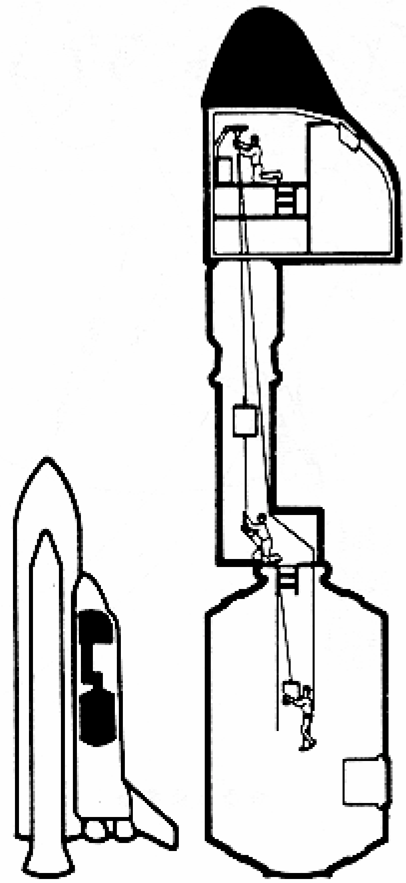
Initial integration activities climaxed in March 1984 with the successful completion of Mission Sequence Testing designed to verify the compatibility of experiments with each other and with simulated Spacelab support subsystems. The crew and scientists who developed Spacelab 3 experiments were active participants in integration and testing. The integrated Spacelab experiment support structure was moved into place behind the shell of the module, and experiment racks were moved into the module in May 1984.

Since the module performed flawlessly during the first Spacelab mission, there was no need for placing it in the Cargo Integration Test Equipment (CITE) stand to verify that it was compatible with the Shuttle. (The CITE duplicates the mechanical and electronic systems of the orbiter.) On March 27, 1985, Spacelab 3 was transferred from the Operations and Checkout Building to the Orbiter Processing Facility (OPF) and installed in the payload bay of the orbiter Challenger. Spacelab experiments were operated by remote control from the Johnson Space Center Payload Operations Control Center (POCC) during an end-to- end test on March 30 and 31 this year. Commands initiated at consoles at JSC were processed through the POCC and Mission Control Center computers en route to the Spacelab, which was mounted inside the Challenger at Kennedy. Countdown tests continue on both Spacelab and Challenger until the launch scheduled for April 29, 1985.

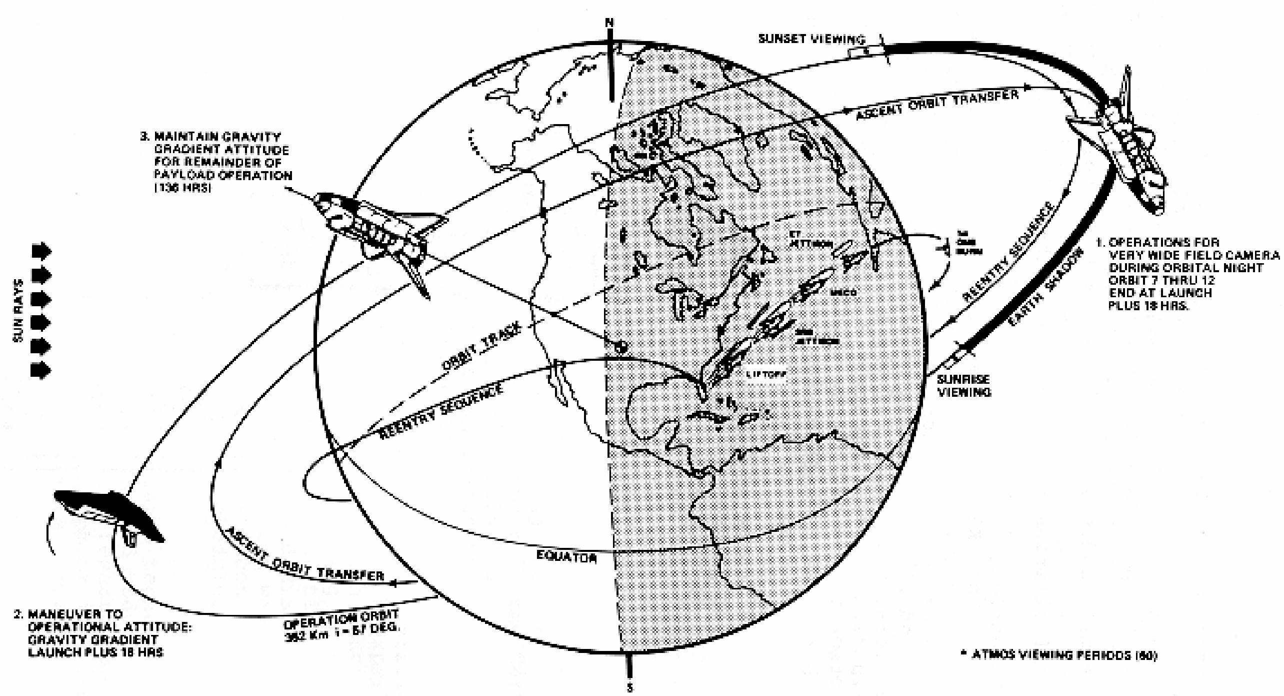
A few hours before the launch of this mission technicians will enter the Shuttle and use a specially designed module vertical access kit (MVAK) to load animals into the research animal holding facilities. Hoisting personnel and equipment into and out of Spacelab on the launch pad is an elaborate procedure that has been carefully planned and rehearsed for first use on the Spacelab 3 Mission. Two MVAK teams have been fully trained at Kennedy Space Center.

Approximately 28 hours before launch, the loading team will install the access kit inside the vertical Shuttle/Spacelab. The MVAK is a system of ropes, pulleys and platforms that allows the team to transport payloads from the middeck, through the Spacelab tunnel and into the Spacelab module. Approximately 2 hours before animal loading, a technician will be hoisted into the module where he will turn on the primate and rodent research animal holding facilities to ensure proper thermal conditioning.

Scientists will give flight animals a preflight checkout in Hangar L. When KSC technicians confirm that the animal housing complex is ready, scientists will transport the animals in their flight cages to the launch pad. The trip will take about 45 minutes and will be made in an air conditioned animal transporter van especially designed for the mission. Actual loading of the animals requires approximately 2 hours and should be completed 1 hour prior to the end of the animal's awake cycle to provide a quiet period of adaptation following the handling phase.



SPACELAB 3 MISSION PROFILE



LAUNCH WINDOW

The launch window for the 51-B/Spacelab 3 mission opens April 29, 1985, at 12 Noon EDT, for 1 hour, closing at 1:00 p.m. EDT. For several months, the launch window opens again at the same time each day.

The launch window opening was calculated to provide the maximum number of viewing opportunities for an atmospheric science instrument that makes observations during orbital sunrise and sunset. Once the launch window was determined, the Spacelab 3 animals were trained so that their circadian rhythms would match the flight schedule. Twenty hours before launch, the animals are loaded inside the Shuttle.

LANDING AND POST-LANDING OPERATIONS

Kennedy Space Center is responsible for ground operations of the orbiter once it has rolled to a stop on the runway at KSC. Immediately after landing, the flight crew begins "safing" vehicle systems, and the ground recovery crew makes its way toward Challenger. Specially garbed technicians determine that any residual hazardous vapors are below significant levels before other safing operations proceed. A mobile wind machine is positioned near the vehicle to disperse highly concentrated levels of toxic vapor, should they exist.

Once the initial safety assessment is made, access vehicles are positioned around the rear of the orbiter so that lines from the ground purge and cooling vehicles can be connected to the umbilical panels on the aft end of Challenger. Freon line connections are completed and coolant begins circulating through the umbilicals to aid in heat rejection and protect the orbiter's electronic equipment. Other lines provide cooled, humidified air to the payload bay and other cavities to remove any residual toxic or explosive fumes and provide a safe environment inside Challenger.

A mobile white room is moved into place around the crew hatch once it is verified that there are no concentrations of toxic gases around the forward part of the vehicle. The crew is expected to leave Challenger about 30 to 40 minutes after landing. As the crew exits, technicians enter the orbiter and complete the vehicle safing activity.

Post-landing operations associated with the Spacelab 3 payload include removal of certain time-critical items, such as tape and film, 1 hour after landing. The animals are removed from Spacelab approximately 3 hours after landing. They are then immediately transported to Hangar L. Additional data and specimens, such as crystals, will be removed between 16 and 24 hours after landing.

Residual fuel cell cryogenics are drained and unused pyrotechnic devices are disconnected. Then the orbiter is transported to the KSC Operations and Checkout Building where removal and de-integration of Spacelab proceeds in nearly reverse order of assembly. The Spacelab module and other equipment will be taken immediately to checkout areas where it will be prepared for upcoming missions.

SPACELAB 3 INVESTIGATIONS

Spacelab 3 is a multi-disciplinary mission with 15 investigations in five areas of scientific research: materials science, life sciences, fluid mechanics, atmospheric physics and astronomy. Twelve of the investigations were developed by U.S. scientists, two by French scientists and one by Indian scientists.

Spacelab 3 investigations were selected by a peer review process on the basis of their intrinsic scientific merit and suitability for flight on the Shuttle. Proposals for experiments came through several channels, including NASA announcements of opportunities that solicited research ideas from the worldwide scientific community. The principal investigators for each experiment then formed an Investigator Working Group (IWG). Chaired by the Spacelab 3 mission scientist, Dr. George Fichtl of Marshall Space Flight Center, this group provided science requirements for the mission. In addition, they helped train the four Spacelab 3 payload specialists and recommended two to perform their experiments in space.

A brief synopsis of each experiment follows. More detailed information on each experiment is contained in the publication "Spacelab 3" (Pub. #17M484) available at all NASA news centers.

Materials Science

The mission's three materials processing experiments use novel techniques for growing crystals in space. Scientists have predicted that the low gravity space environment will be ideal for growing improved crystals that can be used in infrared detectors and other high technology devices. The gravity gradient attitude is required for this mission specifically to facilitate these experiments.

Solution Growth of Crystals in Zero-Gravity/Fluid Experiment System (FES) -- Dr. Ravindra B. Lal, Department of Physics and Applied Physics, Alabama A&M University, Huntsville. Three triglycine sulfate crystals are grown by solution for 29, 62 and 19 hours in the FES, located in a double rack inside the module. The first holograms and video record of crystals growing in space are made.

Mercuric Iodide Growth/Vapor Crystal Growth System (VCGS) -- Wayne F. Schnepple, EG&G Energy Measurements, Inc., Goleta, CA. A mercuric iodide crystal is grown by vapor transport for 137 hours in the VCGS, located in a single rack next to the FES. The FES and VCGS share a video system that allows the scientist to carefully monitor crystal growth.

Mercury Iodide Crystal Growth (MICG) -- Dr. Robert Cadoret, Laboratoire de Cristallographie et de Physique, Les Cezeaux, France. Mercury iodide seed crystals are grown at different pressures in a two-zone furnace to analyze the effects of weightlessness on vapor transport. The furnace is located in the upper part of a single rack inside the module. Similar crystals were grown on Spacelab 1; this experiment goes a step further in an attempt to grow seed crystals, the nucleus of material from which a crystal is grown.

Life Sciences

The six Spacelab 3 life science investigations examine animal and human biological processes in the space environment. Four of the investigations are primarily engineering verification tests on four parts of the Ames Life Sciences Payload. The other two examine how the crew adapts to space flight.

Ames Research Center Life Sciences Payload (ARCLSP) -- Drs. Paul X. Callahan and Christopher L. Schatte, Ames Research Center, Mountain View, CA. Four investigations have the primary objective of verifying that the facilities listed below are useful tools for space animal research. A secondary objective is to monitor the behavior of the first large contingent of animals living in a space environment.

Primate Research Animal Holding Facility: houses two monkeys in individual cages in a single rack inside the module.

Rodent Research Animal Holding Facility: houses 24 rats in individual cages in a double rack inside the module.

Biotelemetry System (BTS): monitors the output of sensors surgically implanted in four rats before the flight. Data on basic physiological functions, such as heart rate, muscle activity, and body temperature, are sent via a dedicated computer to scientists on the ground who monitor the animal's well being.

Dynamic Environment Measurement System (DEMS): measures noise, vibration and acceleration in the immediate vicinity of the animal housing complex during launch and reentry.

Autogenic Feedback Training (AFT) -- Dr. Patricia S. Cowings, Ames Research Center, Mountain View, CA. First use of autogenic feedback training, a technique used to control bodily processes voluntarily; may help astronauts control space adaptation syndrome (space motion sickness). Several crew members wear garments with electrodes and instruments for recording physiological functions.

Urine Monitoring Investigation (UMI) -- Dr. Carolyn S. Leach-Huntoon, Johnson Space Center, Houston. A urine collection system attached to the waste management system in the Shuttle middeck operates throughout the mission. Samples are prepared for postflight analysis.

Fluid Mechanics

Before spaceflight, scientists could only predict how fluids would behave in a low gravity environment. Spacelab 3 gives them a quiet microgravity lab for experiments to test these theories.

Dynamics of Rotating and Oscillating Free Drops/Drop Dynamics Module (DDM) -- Dr. Taylor G. Wang, Jet Propulsion Laboratory, Pasadena, CA. Using the DDM, located in a double rack inside the Spacelab module, scientists perform experiments that test the ability to manipulate drops acoustically in micro gravity. Information from this experiment could influence the development of containerless materials processing techniques in which materials are processed without touching a container that could contaminate them.

Geophysical Fluid Flow Cell Experiment (GFFC) -- Dr. John E. Hart, University of Colorado, Boulder. A model, located in the lower half of a single rack, is used to simulate fluid flows in oceans and planetary and solar atmospheres. Gravity distorts fluid flows in terrestrial models.

Atmospheric and Astronomical Observations

Earth's atmosphere filters atmospheric constituents and obscures our view of celestial objects. Above the atmosphere, Spacelab gives instruments a global view of processes occurring there and a clear view of the stars.

Atmospheric Trace Molecules Spectroscopy (ATMOS) -- Dr. C. B. Farmer, Jet Propulsion Laboratory, Pasadena, CA. With a clear view from the experiment support structure, ATMOS gains the precise spectral information needed to study the composition and variability of the upper atmosphere and examines the qualities and quantities of natural atmospheric and man-produced constituents.

Auroral Imaging Experiment -- Dr. Thomas J. Hallinan, Geophysical Institute, University of Alaska, Fairbanks. From the orbiter windows, the first systematic photographs, videotapes and films of the aurora will be made to gain better insight into energetic particle processes occurring in our atmosphere.

Studies of the Ionization of Solar and Galactic Cosmic Ray Heavy Nuclei -- Dr. Sukumar Biswas, Tata Institute of Fundamental Research, Bombay, India. Also known as Ions or Anuradha, this investigation uses a newly designed detector mounted on the experiment support structure to determine the composition and intensity of energetic ions from the sun and other galactic sources.

Very Wide Field Camera (VWFC) -- Dr. Georges Courtes, Laboratoire d'Astronomie Spatiale, Marseilles, France. This camera successfully made high-quality ultraviolet images of celestial objects during the Spacelab 1 mission. It will continue to make an ultraviolet survey of the sky from the scientific airlock during the first day of the Spacelab 3 mission.

PAYLOAD SPECIALISTS

Payload specialists are NASA's newest breed of space workers. The first payload specialists made their debut during the Spacelab 1 mission in 1983. Since then, payload specialists have flown on other Shuttle missions.

Payload specialists are career scientists and engineers that are identified and selected by their peers to fly into space and devote themselves to conducting experiments. After the mission, they return to their previous position at the institution sponsoring their research. Usually, they are intimately connected with the mission and are the principal or co-investigator for one or more of the mission's experiments.

A Spacelab 3 Investigator Working Group, consisting of all the principal investigators for each Spacelab experiment, nominated and selected four payload specialist candidates. The principal investigators helped train the candidates to perform experiments in their laboratories and later named the flight and alternate payload specialists.

The working group selected Dr. Lodewijk van den Berg, a materials scientist at EG&G Energy Management Corp., and Dr. Taylor Wang, a fluid mechanics expert at Jet Propulsion Laboratory (JPL), to fly as payload specialists for this mission. They also named two other payload specialists, Dr. Mary Helen Johnston, a materials scientist at Marshall Space Flight Center, and Dr. Eugene Trinh, a fluid mechanics expert at JPL, as alternate payload specialists.

Johnston and Trinh will serve as flight backups and as members of the mission management and science team responsible for controlling and directing experiment operations from the Payload Operations Control Center (POCC) at Johnson.

Payload Specialist Training

All four Spacelab 3 payload specialist candidates underwent two basic types of training: mission independent and mission dependent.

Mission Dependent Training is associated with Spacelab 3 experiments and payload operations. Since the payload specialist's main duty is to operate experiments, it is the longest part of the training program. Much of this training was provided by the individual Spacelab 3 principal investigators in their laboratories. Marshall Space Flight Center provided training in operating the integrated payload at the Payload Crew Training Complex inside a high-fidelity mockup of the Spacelab 3 module. The crew was also familiarized with actual flight hardware during integration tests at the Kennedy Center.

Mission Independent Training is associated with learning the fundamental skills necessary to live and work safely aboard the Shuttle/Spacelab. Johnson Space Center provided most of this training in such areas as familiarization with space-living conditions as well as medical, emergency and survival operations. Kennedy Space Center provided launch and landing site training.

MISSION SUPPORT

Payload Operations Control Center

The Payload Operations Control Center (POCC), located in Building 30 at Johnson Space Center, is the command post for the control and management of Spacelab 3 scientific payload activities during the mission. The POCC is similar to the Mission Control Center (MCC), which has overall responsibility for the flight and operation of the orbiter. POCC and MCC personnel coordinate their efforts to ensure a successful mission.

Members of the Marshall mission management team and principal investigators with their research teams work in the POCC in either three 8-hour shifts or two 12-hour shifts. Using POCC equipment, they monitor, control and direct experiment operations aboard Spacelab. The POCC, which covers an area of just over 4,000 square feet, is situated adjacent to the flight control room on the second floor of the MCC. It is composed of a payload control room, a mission planning room and six user rooms. The payload control room or "front room" houses the part of the mission management team who track the overall science mission. Other members of the mission management team support operations from the "back room."

Individual experiment teams have work stations in the user rooms. Each user room contains three work stations, each having a computer terminal and keyboard, a floppy disk unit and a hard copy unit for the users' own payload monitoring and control. In addition, science teams may have set up their own experiment equipment.

Command and data links between the POCC and Spacelab enable scientists to follow the progress of their experiments, assess and respond to real-time information and be actively involved in the investigative process. Spacelab 3 scientists can communicate with the crew via voice and text or graphic links, and they can send automated commands directly to the onboard computer to control their experiments.

The capabilities of the POCC include data processing. Multiplexed Spacelab 3 data are received at up to 48 megabits per second and converted into separate channels. These channels are routed to recorders, to the experimenters' ground support equipment or to experiment consoles for display.

POCC Positions

The following is a general description of the cadre personnel working in the Spacelab 3 POCC front room at the Johnson Center.

POD (Payload Operations Director) -- is the senior member of the mission manager's cadre team in the POCC; oversees Spacelab 3 mission operations and directs the payload operations team and science crew.

MSCI (Mission Scientist) -- represents scientists with experiments on the flight and interfaces with the mission manager and the POD with respect to mission science operations and accomplishments.

CIC (Crew Interface Coordinator) -- manages POCC use of air-to-ground voice loop and serves as a focal point for communications with payload crew; enables and coordinates principal investigator communication with payload crew.

APS (Alternate Payload Specialist) -- assists the payload operations team and payload crew in devising solutions to problems, troubleshooting and changing crew procedures when necessary; advises the mission scientist of possible impacts or problems and assists the CIC in direct voice contact with the payload crew.

PAP (Payload Activity Planner) -- directs the mission replanning activity by receiving proposed changes to the mission timeline and coordinating them with the POCC operations team; assesses proposed changes to the current timeline and advises the POD of potential impacts to the timeline.

PAO (Public Affairs Officer) -- provides Spacelab 3 mission commentary and serves as the main source of Spacelab payload information.

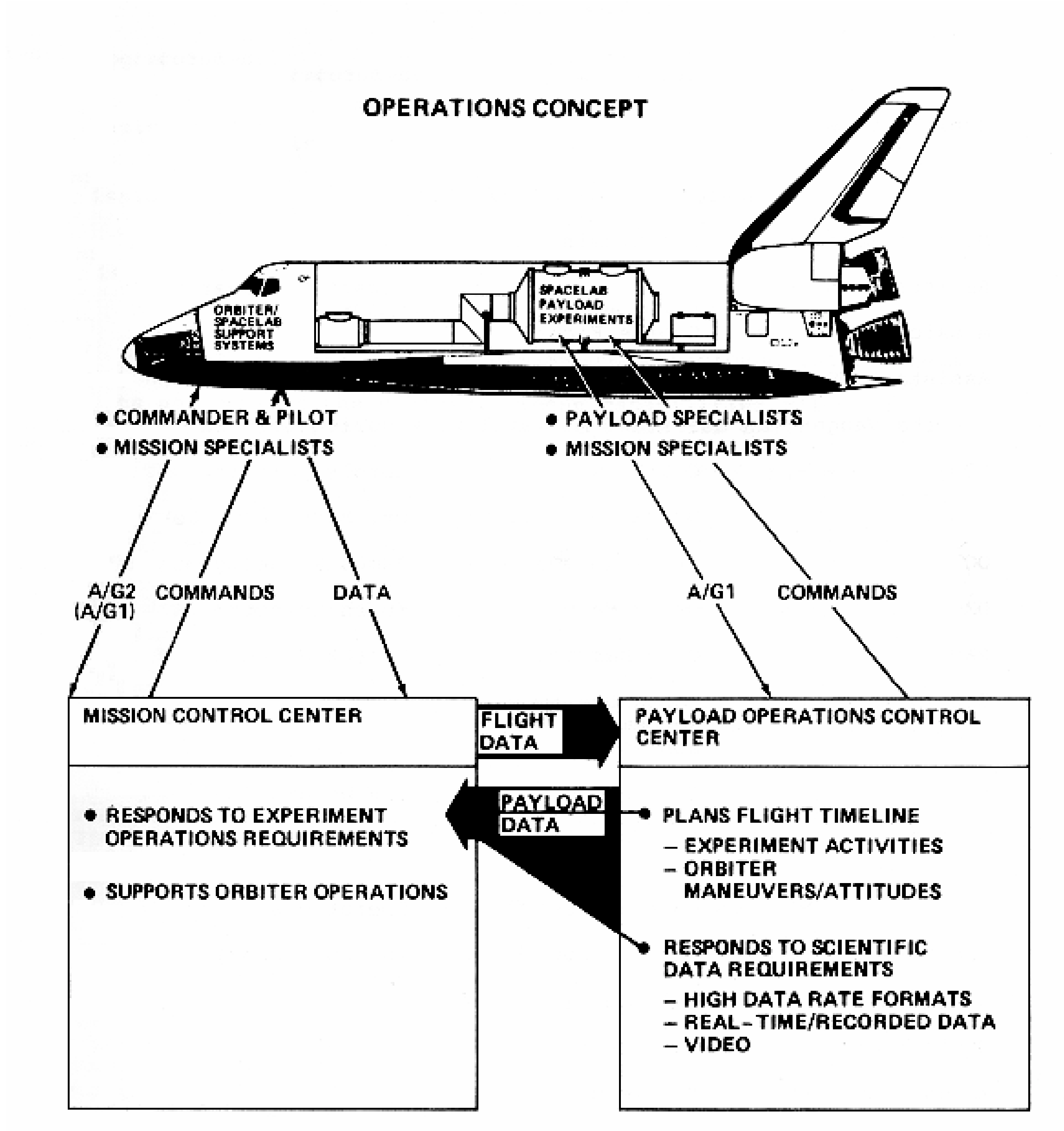
OPS (TV Operations Controller) -- serves as the focus within the POCC for Spacelab payload inflight television and photographic operations, specifically with regard to scene development of flight crew activities.

MUM (Mass Memory Unit Manager) -- initiates experiment command uplinks to the Spacelab after receiving data set changes from the POCC operations team.

OC (Operations Controller) -- coordinates the activities of the payload operations team to efficiently accomplish POCC functions required to support the real-time execution of the approved mission timeline; assesses proposed crew timeline alteration and coordinates the implementation of approved actions with the POCC cadre positions.

PAYCOM (Payload Command Controller) -- configures the POCC for ground command operation and controls the flow of experiment commands from the POCC as required; troubleshoots any problems in the rejection of those commands. Advises OC on command systems status.

DMC (Data Management Coordinator) -- is responsible for maintaining and coordinating the flow of payload data to and within the POCC for the cadre and principal investigators; assesses proposed real-time changes to the experiment time line and payload data requirements which affect the payload downlink data.


OPERATIONS CONCEPT
ORBITER/ SPACELAB SUPPORT SYSTEMS
SPACELAB PAYLOAD EXPERIMENTS
• COMMANDER & PILOT
• MISSION SPECIALISTS
• PAYLOAD SPECIALISTS
• MISSION SPECIALISTS
A/G2 (A/G1)
COMMANDS
DATA
A/G1
COMMANDS
MISSION CONTROL CENTER
FLIGHT DATA
PAYLOAD OPERATIONS CONTROL CENTER
• RESPONDS TO EXPERIMENT OPERATIONS REQUIREMENTS
• SUPPORTS ORBITER OPERATIONS
PAYLOAD DATA
• PLANS FLIGHT TIMELINE
– EXPERIMENT ACTIVITIES
– ORBITER MANEUVERS/ATTITUDES
• RESPONDS TO SCIENTIFIC DATA REQUIREMENTS
– HIGH DATA RATE FORMATS
– REAL-TIME/RECORDED DATA
– VIDEO

SPACELAB 3 SHIFT OPERATIONS

12-hour shifts	Gold	Silver
Payload Crew	MS1 (Lind) MS3 (Thornton) PSF (Wang)	MS2 (Thagard) PSM (van den Berg)
Orbiter Crew	CDR (Overmyer)	PLT (Gregory)

Spacelab 3 POCC Shift Operations

Mission Manager	Joe Cremin	
Assistant MM		Robert McBrayer
Mission Scientist	George Fichtl	
Assistant MS		Kelly Hill

*Otha Vaughn (an assistant MS) will work during both shifts

POD	Clark Owen	Carolyn Griner
APS	Dr. Eugene Trinh	Dr. Mary Helen Johnston
OC	Steve Noneman	James Riquelmy
DMC	David Mann	Keith Cornett
PAP	O.M. Hardage	Robert Jackson
CIC (3 shifts)	Debra Underwood Ken Smith Ron Porter	
MUM	Tina Melton	Van Woodruff
TV OPS	John Harrison	Rip Koken

Mission Control Center Shift Operations

Orbit Team 1 FD	Gary E. Coen (Lead Flight Director)
Orbit Team 2 FD	William D. Reeves
Orbit Team 3 FD	G. Al Pennington
Ascent/Entry FD	T. Cleon Lacefield

SPACELAB 3 MANAGEMENT

Program Manager	Robert A. Schmitz, NASA Headquarters
Program Scientist	Dr. John Theon, NASA Headquarters
Mission Manager	Joe Cremin, Marshall Space Flight Center
Mission Scientist	Dr. George Fichtl, Marshall Space Flight Center

COMMUNICATIONS AND DATA HANDLING

For any successful Shuttle mission, the ground control team must be able to track the spacecraft, communicate with the astronauts and command the orbiter. These capabilities allow them to oversee the condition of the spacecraft and its crew.

The Spacelab 3 mission is much more complex than many other Shuttle missions because vast amounts of data must be collected from Spacelab. To accommodate the need for additional information, a unique communications and data handling network has been established for Shuttle/Spacelab missions.

NASA handles 51-B/Spacelab 3 tracking and communications through the large communications satellite, Tracking and Data Relay Satellite System (TDRSS), and the Ground Space Tracking and Data Network (GSTDN) at 11 ground stations that can communicate with a spacecraft when it is in view. TDRSS and GSTDN link the Shuttle/Spacelab to Johnson Space Center and Goddard Space Flight Center in Greenbelt, MD.

During the Spacelab 3 mission, TDRSS will be used to relay commands and data to and from the experiments aboard Spacelab 3. The GSTDN will supplement TDRSS and provide routine, real-time tracking and communications with the Shuttle orbiter and its crew.

The NASA Communications Network (NASCOM), managed by Goddard, provides the voice and data communications links connecting the network. During the flight, Spacelab 3 data flows from the Shuttle orbiter to TDRS-1 which transmits to the TDRSS ground station at White Sands, NM. The data could also flow from the orbiter to one of the GSTDN stations. In either case, the data is transmitted to a commercial satellite which sends the data to the Spacelab data processing facilities at the Goddard and Johnson centers.

The data sent to the Johnson Center is usually in the form of computer readouts or video. Investigator teams working around the clock at work stations in the Johnson control center can analyze this data real-time. Data received during the early phase of the mission may help plan observations or experiments for the rest of the flight.

The Spacelab Data Processing Facility (SLDPF) at Goddard was developed specifically to handle the large volume of science data transmitted from Spacelab to the ground. Each of the 15 Spacelab 3 investigations can generate up to 50 megabits of data per second. The Goddard data facility separates and records data by experiment. After the mission, this facility distributes data to each investigator. The data may be in varied forms, such as video tapes, computer tapes or audio tapes. The facility also records data from other Shuttle payloads which use the onboard data system.

HUNTSVILLE OPERATIONS SUPPORT CENTER

The Huntsville Operations Support Center (HOSC), located at the Marshall Space Flight Center, monitors the Shuttle during prelaunch and launch at the Kennedy Center and supports the Johnson Center monitoring of Spacelab 3 systems and payload operations during the mission.

During the 51-B premission testing, countdown, and launch, real-time data is transmitted from the Shuttle to consoles in the HOSC, which are manned by Marshall and contractor engineers. They evaluate and help solve any problems that occur with Marshall developed Space Shuttle propulsion system elements, which includes the main engines, external tank and solid rocket boosters. They also monitor the overall main propulsion system and range safety system.

During the 7-day mission, support center personnel will monitor Spacelab's temperatures, pressures, electrical measurements and onboard computer system. HOSC scientists and engineers will view onboard crew activities via closed-circuit television, monitor air-to-ground communications and monitor experiment systems computers. If a problem is detected, the appropriate individuals in the Spacelab action center are notified. The information is then relayed via direct communications with the Payload Operations Control Center and Flight Control Rooms within the Mission Control Center at Johnson.

STS-51B CREWMEMBERS

S84-43852 -- These seven men have been training for NASA's STS-51B (Spacelab-3) mission scheduled for launch in late April 1985. In the front row are astronauts Robert F. Overmyer, left, commander; and Frederick D. Gregory, pilot. In the back row, left to right, are Don L. Lind, mission specialist; Taylor G. Wang, payload specialist; Norman E. Thagard and William E. Thornton, both mission specialists; and Lodewijk van den Berg, payload specialist.

BIOGRAPHICAL DATA

The seven-member Spacelab 3 crew has a range of diverse specialties. It includes: two astronaut pilots, commander Robert Overmyer and pilot Frederick Gregory; three mission specialist- astronauts, Drs. Don Lind, Norman Thagard and William Thornton; and two payload specialist-scientists, Drs. Lodewijk van den Berg and Taylor Wang.

As members of NASA's career astronaut corps, the commander and pilot are responsible for operating the Shuttle. Also members of the astronaut corps, the mission specialists were selected both for their engineering skills and their scientific backgrounds in the fields of life sciences and physics. They have responsibilities for operating both Shuttle/Spacelab systems and experiments. The Spacelab 3 payload specialists, career scientists responsible only for doing science in space, were specifically selected for their expertise in materials science and fluid mechanics.

The crew will work in 12-hour shifts. The Gold Team -- Overmyer, Thornton, Lind and Wang -- works from morning to evening (day shift). The Silver Team -- Gregory, Thagard and van den Berg -- works from evening to morning (night shift).

ROBERT F. OVERMYER, 49, Colonel, USMC, is mission commander. Born in Lorain, Ohio, he became a NASA astronaut in 1969. Overmyer was the pilot for STS-5 -- the first fully operational flight of the Space Transportation System. He served as support crewmember for Apollo 17 and was launch capsule communicator. He also was support crewmember for the Apollo-Soyuz Test Project and NASA capsule communicator in the mission control center in Moscow.

Overmyer received a bachelor of science degree in physics from Baldwin Wallace College in 1958 and a master of science in aeronautics from the U.S. Naval Postgraduate School in 1964.

He entered active duty with the Marine Corps in 1958. He was assigned to Marine Attack Squadron 214 in 1959, then to Naval Postgraduate School to study aeronautical engineering. He has more than 6,500 flight hours with over 5,000 in jet aircraft.

FREDERICK D. GREGORY, 44, Colonel, USAF, is pilot. A native of Washington, DC, he was graduated from the United States Air Force Academy with a bachelor of science degree. He received a master's in information systems from George Washington University.

Gregory trained as a helicopter pilot and retrained as a fighter pilot, flying F-4 Phantoms. He was a research engineering test pilot for the Air Force and NASA from 1971 to 1978. Special honors include the Air Force Distinguished Flying Cross, Meritorious Service Medal, Air Medal with 15 oak leaf clusters and National Society of Black Engineers' Distinguished National Scientist Award.

Gregory became a NASA astronaut in 1978. He has logged over 5,100 hours flight time and holds FAA commercial and instrument certificates for single and multi-engine airplanes and helicopters.

BIOGRAPHICAL DATA

DON L. LIND, 54, PhD, a native of Midvale, Utah, is one of three mission specialists. He was selected as an astronaut in 1966. Before this he had been with Goddard Space Flight Center involved in experiments to determine the nature and properties of low-energy particles within the Earth's magnetosphere and interplanetary space.

Lind received a bachelor of science degree with high honors in physics from the University of Utah and a doctor of philosophy in high energy nuclear physics from the University of California, Berkeley.

Lind served four years on active duty with the Navy at San Diego and later aboard the carrier USS Hancock. He has logged more than 4,400 hours flying time -- 3,900 hours in jets.

NORMAN E. THAGARD, 41, MD, a mission specialist, became an astronaut in 1978. He served as mission specialist during the seventh Space Shuttle mission in 1983, conducting various medical tests and collecting data on physiological changes associated with adaptation to space.

Thagard's hometown is Jacksonville, FL. He received bachelor and master of science degrees in engineering science from Florida State University. He received a doctor of medicine at the University of Texas Southwestern Medical School.

A captain in the Marine Corps, Thagard flew 163 combat missions in Vietnam. He was awarded 11 Air Medals, the Navy Commendation Medal with Combat V, the Marine Corps "E" Award, the Vietnam Service Medal and the Vietnam Cross of Gallantry with Palm. He has logged 1,600 hours flying time, the majority in jet aircraft.

WILLIAM E. THORNTON, 55, MD, a native of Faison, NC, is a mission specialist. He became a NASA scientist astronaut in 1967 after conducting space medicine research at the USAF Aerospace Medical Division at Brooks Air Force Base, San Antonio. He served as mission specialist on STS-8.

Thornton received a bachelor of science degree in physics and a doctorate in medicine from the University of North Carolina. Other Air Force assignments include officer-in-charge of the instrumentation lab at the Flight Test Air Proving Ground and consultant to the Air Proving Ground Command.

As a member of the Astronaut Office operations missions development group, Thornton developed crew procedures and techniques for deployable payloads and maintenance of crew conditions in flight. He developed the Shuttle treadmill for in-flight exercise and other on-board devices. As mission specialist on STS-8, he made continuous measurements and carried out investigations of the space adaptation syndrome. Thornton has logged more than 2,600 hours flying time in jet aircraft and is a clinical instructor in the Department of Medicine, University of Texas Medical Branch, Galveston.

BIOGRAPHICAL DATA

LODEWIJK VAN DEN BERG, 53, PhD, payload specialist materials science expert, is a native of Sluiskil, the Netherlands. He received a master of science in chemical engineering from Technical University, Delft, the Netherlands, master of science in applied science and doctor of philosophy in applied science from the University of Delaware. He is a U.S. citizen.

A chemical engineer and senior scientist, van den Berg is with EG&G Corporation, Goleta, CA. He has more than 20 years research and management experience preparing crystalline materials, the growth of single crystals of chemical compounds and investigation of associated defect chemistry and electronic properties. He is responsible for the operation of a crystal growing facility at EG&G and is co-investigator on the Spacelab 3 mission Vapor Crystal Growth System (VCGS) experiment.

He is an international authority on vapor growth techniques with emphasis on mercuric iodide crystals and its application in the nuclear industry as gamma ray detectors.

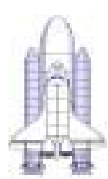
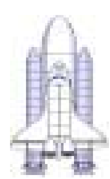
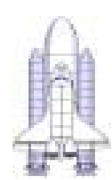
TAYLOR G. WANG, 44, PhD, is a payload specialist fluids expert. Born in Shanghai, China, Wang is a physicist with the Jet Propulsion Laboratory (JPL), Pasadena, CA. He received bachelor and master of science degrees in physics, and a doctor of philosophy in physics from the University of California, Los Angeles. He is a U.S. citizen.

Wang joined JPL as a senior scientist. Currently program manager for materials processing in space, he has been responsible for the inception and development of containerless processing technology and dynamics of liquid drops and bubbles research.

Wang has conducted precursor drop dynamics experiments in ground-based laboratories using acoustic levitation systems, neutral buoyancy systems and drop towers, and in the near weight less environment of NASA's KC-135 aircraft.

Wang is the principal investigator on the Spacelab 3 Drop Dynamics Module experiments.

SHUTTLE FLIGHTS AS OF APRIL 1985
16 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM

STS-9 11/28/83 - 12/08/83	STS-41G 10/05/84 - 10/13/84	
STS-5 11/11/82 - 11/16/82	STS-41C 04/06/84 - 04/13/84	
STS-4 06/27/82 - 07/04/82	STS-41B 02/03/84 - 02/11/84	STS-51D 04/12/85 - 04/19/85
STS-3 03/22/82 - 03/30/82	STS-8 08/30/83 - 09/05/83	STS-51C 01/24/85 - 01/27/85
STS-2 11/12/81 - 11/14/81	STS-7 06/18/83 - 06/24/83	STS-51A 11/08/84 - 11/16/84
STS-1 04/12/81 - 04/14/81	STS-6 04/04/83 - 04/09/83	STS-41D 08/30/84 - 09/05/84
OV-102 Columbia (6 flights)	**OV-099 Challenger (6 flights)**	**OV-103 Discovery (4 flights)**