

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

**SPACE SHUTTLE
MISSION
STS-40**

**PRESS KIT
MAY 1991**



SPACELAB LIFE SCIENCES-1 (SLS-1)

STS-40 CREW INSIGNIA

STS040-S-001 -- The STS-40 insignia makes a contemporary statement focusing on human beings living and working in space. Against a background of the universe, each of the seven Shuttle crew members is represented by one of seven silver stars interspersed about the orbital path of the Space Shuttle Columbia. The orbiter's flight path forms a double-helix designed to represent the DNA molecule common to all living creatures. It affirms the ceaseless expansion of human life and American involvement in space while simultaneously emphasizing the medical and biological studies to which this flight is dedicated. Above Columbia, the phrase "Spacelab Life Sciences I" defines both the shuttle mission and its payload. In the upper center portion of the patch, silhouetted against the blue darkness of the heavens, stands Leonardo da Vinci's Vitruvian man. With one foot on Earth and arms extended to touch the shuttle's orbit, he serves as a powerful embodiment of the extension of human inquiry from the boundaries of Earth to the limitless laboratory of space. Studily poised amid the stars, he serves to link scientists on Earth to the scientists in space asserting the harmony of efforts which produce meaningful scientific space flight missions. At the center of the patch is a brilliant red and yellow Earth-limb linking Earth to space and radiating from a native American symbol for the sun. At the frontier of space, this traditional symbol for the sun vividly links America's past to America's future. Beneath the orbiting shuttle, darkness of night rests peacefully over the United States. Drawn by artist Sean Collins, the STS-40 space shuttle insignia was designed by the crew members for the flight.

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.

PHOTO CREDIT: NASA or National Aeronautics and Space Administration.

SPACELAB LIFE SCIENCES 1 INSIGNIA



S86-27614 -- The Space Shuttle Columbia is at the center of the Spacelab Life Sciences 1 insignia. The various elements serve to deliver the message of the dedication of this mission to medical and biological studies, a first for manned spaceflight. A crew of five NASA astronauts and the payload specialists will be split into shifts to maximize the exposure to space environment for variegated and thorough biological and medical experiments during the scheduled ten-day mission. The crew will maintain a constant communications link with scientists on Earth, considered by the flight crew to be an integral part of the overall mission, as well. NOTE: After this patch was designed, the SLS-1 mission was assigned to fly as NASA's STS-40 flight, scheduled for May 1991.

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FIRST SPACELAB DEDICATED TO LIFE SCIENCES HIGHLIGHTS STS-40

Shuttle mission STS-40, the 41st flight of the Space Shuttle and the 11th flight of Columbia, will conduct the Spacelab Life Sciences (SLS-1) mission, the first Spacelab dedicated to life sciences research.

The launch of the SLS-1 mission is currently scheduled for no earlier than 9:20 a.m. EDT on May 24. The mission will be flown at an altitude of 160 by 150 nautical miles and at an inclination of 39 degrees to the Equator.

During the SLS-1 mission, the STS-40 crew will perform experiments which will explore how the heart, blood vessels, lungs, kidneys and hormone-secreting glands respond to microgravity, the causes of space sickness and changes in muscles, bones and cells during the microgravity environment of space flight and in the readjustment to gravity upon returning to Earth. The experiments performed on Columbia's crew and on laboratory animals will provide the most detailed and interrelated physiological measurements acquired in the space flight environment since the Skylab program flights in 1973 and 1974.

Other payloads on the SLS-1 mission include 12 experiments being flown under NASA's Get Away Special program. The experiments, enclosed in canisters on a bridge in the Shuttle's cargo bay, will investigate such topics as materials science, plant biology and cosmic radiation.

The NASA Orbiter Experiments Program will fly 7 experiments on the STS-40 orbiter that will provide an opportunity for researchers to gather data on a full-scale lifting vehicle, the STS-40 orbiter, during atmospheric entry.

The mission is planned to last 9 days, 3 hours and 30 minutes, concluding with a landing at Edwards Air Force Base, Calif., at 12:50 p.m. EDT, June 2. The Commander for this flight of Columbia will be Marine Corps Col. Bryan D. O'Connor. Air Force Lt. Col. Sidney M. Gutierrez will serve as Pilot. Mission specialists for STS-40 are James P. Bagian, MD; Tamara E. Jernigan, Ph.D.; and Margaret Rhea Seddon, MD. The payload specialists are Francis Andrew Gaffney, MD, and Millie Hughes-Fulford, Ph.D..

Following the STS-40 mission, Columbia will return to Kennedy Space Center, Fla., where the Spacelab will be removed. The orbiter will then go to Palmdale, Calif., for nearly 6 months to undergo major modifications and inspections at Rockwell International Corp. Columbia is next scheduled to fly on STS-50, the U. S. Microgravity Laboratory mission, in June 1992.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

MEDIA SERVICES

NASA Select Television Transmissions

NASA Select television is available on Satcom F-2R, Transponder 13, located at 72 degrees west longitude; frequency 3960.0 MHz, audio 6.8 MHz.

The schedule for television transmissions from the orbiter and for the change-of-shift briefings from Johnson Space Center, Houston, will be available during the mission at Kennedy Space Center, Fla.; Marshall Space Flight Center, Huntsville, Ala.; Johnson Space Center; and NASA Headquarters, Washington, DC. The television schedule will be updated to reflect changes dictated by mission operations.

Television schedules also may be obtained by calling COMSTOR, 713/483-5817. COMSTOR is a computer data base service requiring the use of a telephone modem. A voice update of the television schedule may be obtained by dialing 202/755-1788. This service is updated daily at noon EST.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA news center.

Briefings

A mission press briefing schedule will be issued prior to launch. During the mission, change-of-shift briefings by the off-going flight director will occur at approximately 8-hour intervals.

STS-40 QUICK LOOK

Launch Date:	May 24, 1991
Launch Site:	Kennedy Space Center, Fla., Pad 39B
Launch Window:	8:00 a.m. - 10:00 a.m. EDT
Orbiter:	Columbia (OV-102)
Orbit:	160 by 150 nautical miles
Inclination:	39 degrees
Landing Date/Time:	11:00 a.m. - 1:00 p.m. PDT, June 2, 1991
Primary Landing Site:	Edwards Air Force Base, CA
Abort Landing Sites:	Return to Launch Site: Kennedy Space Center, FL Transoceanic Abort Landing - Ben Guerir, Morocco Abort Once Around - White Sands Space Harbor, NM
Crew:	Bryan D. O'Connor, Commander Sidney M. Gutierrez, Pilot James P. Bagian, Mission Specialist 1 Tamara E. Jernigan, Mission Specialist 2 M. Rhea Seddon, Mission Specialist 3 Francis A. (Drew) Gaffney, Payload Specialist 1 Millie Hughes-Fulford, Payload Specialist 2
Cargo Bay Payloads:	Spacelab Life Sciences-1 (SLS-1) Get Away Special (GAS) Bridge experiments
Middeck Payloads:	Physiological Monitoring System (PMS) Urine Monitoring System (UMS) Animal Enclosure Modules (AEM)

SUMMARY OF MAJOR ACTIVITIES

Flight Day 1

Ascent
OMS 2 engine firing
Spacelab activation
Metabolic experiment operations
Echocardiograph operations

Flight Day 2

Baroreflex tests
Pulmonary function tests
Echocardiograph activities
Cardiovascular operations
Ames Research Center operations

Flight Day 3

Ames Research Center operations
Rotating dome operations
Echocardiograph activities
DTOs

Flight Day 4

Baroreflex/Pulmonary function tests
Ames Research Center operations

Flight Day 5

Pulmonary function tests
Cardiovascular operations
Echocardiograph activities

Flight Day 6

Rotating dome operations
Echocardiograph activities
Cardiovascular operations
Ames Research Center operations

Flight Day 7

DTOs
Ames Research Center operations

Flight Day 8

Baroreflex tests
Echocardiograph
Cardiovascular operations

Flight Day 9

Pulmonary function tests
Flight control systems checkout
Echocardiograph tests
Cardiovascular operations
Cabin stow
Partial Spacelab deactivation

Flight Day Ten

Spacelab deactivation
Deorbit preparation
Deorbit burn
Landing

SPACE SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, orbiter and its payload. Abort modes include:

- Abort-To-Orbit (ATO) -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical mile orbit with orbital maneuvering system engines.
- Abort-Once-Around (AOA) -- Earlier main engine shutdown with the capability to allow one orbit around before landing at either Edwards Air Force Base, Calif.; the Shuttle Landing Facility (SLF) at Kennedy Space Center, Fla.; or White Sands Space Harbor (Northrup Strip), NM.
- Transatlantic Abort Landing (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at either Ben Guerir, Morocco; Moron or Zaragoza, Spain.
- Return-To-Launch-Site (RTL) -- Early shutdown of one or more engines, and without enough energy to reach Ben Guerir would result in a pitch around and thrust back toward Kennedy Space Center, Fla., until within gliding distance of the SLF.

STS-40 contingency landing sites are Edwards AFB, Kennedy Space Center, White Sands, Ben Guerir, Moron and Zaragoza.

VEHICLE AND PAYLOAD WEIGHTS

	<u>Pounds</u>
Orbiter (Columbia), empty and 3 SSMEs	172,482
Spacelab Life Sciences-1 Module	21,271
GAS Bridge Assembly	4,885
Spacelab Support Equipment	750
Space Acceleration Measurement System	250
Detailed Test Objectives	88
Detailed Supplementary Objectives	35
Total Vehicle at SRB Ignition	4,519,081
Orbiter Landing Weight	225,492

FLIGHT SEQUENCE OF EVENTS

Event	MET (d/h:m:s)	Relative Velocity (fps)	Mach	Altitude (ft)
Launch	00/00:00:00			
Begin Roll Maneuver	00/00:00:10	189	0.17	799
End Roll Maneuver	00/00:00:18	403	0.36	3,286
SSME Throttle Down to 67%	00/00:00:33	784	0.71	11,283
Max. Dyn. Pressure (Max Q)	00/00:00:52	1,183	1.14	27,829
SSME Throttle Up to 104%	00/00:01:04	1,504	1.54	41,579
SRB Staging	00/00:02:05	4,136	3.85	155,954
Main Engine Cutoff (MECO)	00/00:08:33	24,644	22.27	367,999
Zero Thrust	00/00:08:40	24,673	22.3	370,235
ET Separation	00/00:08:50			
OMS 2 Burn	00/00:42:20			
Deorbit Burn (orbit 146)	09/02:31:00			
Landing (orbit 147)	09/03:30:00			
Apogee, Perigee at MECO:		155 x 40 nautical miles		
Apogee, Perigee post-OMS 2:		160 x 150 nautical miles		

STS-40 PRELAUNCH PROCESSING

Processing the orbiter Columbia for the STS-40 mission at Kennedy Space Center began Feb. 9, following its last mission - STS-35/Astro I.

About 40 modifications were made to Columbia during its 10 and a half-week stay in the OPF. These modifications enhance the performance and efficiency of the orbiter's complex systems. While in the OPF, four modified external tank door bellcrank housings were installed. Small cracks previously were found in three of the housings.

Space Shuttle main engine locations for this flight are as follows: engine 2015 in the No. 1 position, engine 2022 in the No. 2 position and engine 2027 in the No. 3 position. These engines were installed in March.

The Crew Equipment Interface Test with the STS-40 flight crew was conducted on April 7 in the OPF. This test provided an opportunity for the crew to become familiar with the configuration of the orbiter and anything that is unique to the STS-40 mission.

Technicians installed the Spacelab module on March 24 and successfully conducted the required tests. The Spacelab tunnel, leading from the orbiter's airlock to the module, was installed April 3.

Booster stacking operations on mobile launcher platform 3 began March 16 with the left and right aft boosters. These segments later were destacked to allow a realignment of the launch platform holddown posts. Restacking began on March 23 with the left aft booster. Stacking of all booster segments was completed by April 11. The external tank was mated to the boosters on April 17 and Columbia was transferred to the Vehicle Assembly Building on April 26 where it was mated to the external tank and solid rocket boosters.

The STS-40 vehicle was rolled out to Launch Pad 39-B on May 2. A launch countdown dress rehearsal was scheduled for May 6-7 at Kennedy Space Center.

A standard 43-hour launch countdown is scheduled to begin three days prior to launch. During the countdown, the orbiter's onboard fuel and oxidizer storage tanks will be loaded and all orbiter systems will be prepared for flight.

About 9 hours before launch, the external tank will be filled with its flight load of a half a million gallons of liquid oxygen and liquid hydrogen propellants. About two and one-half hours before liftoff, the flight crew will begin taking their assigned seats in the crew cabin.

KSC's recovery teams will prepare the orbiter Columbia for the return trip to Florida following the end-of-mission landing at Edwards AFB, Calif. Orbiter turnaround operations at Dryden Flight Research Facility typically take about five days. A 2-day ferry flight is planned because of the additional weight of the orbiter returning with the Spacelab. The extra weight will require several refueling stops during the ferry flight.

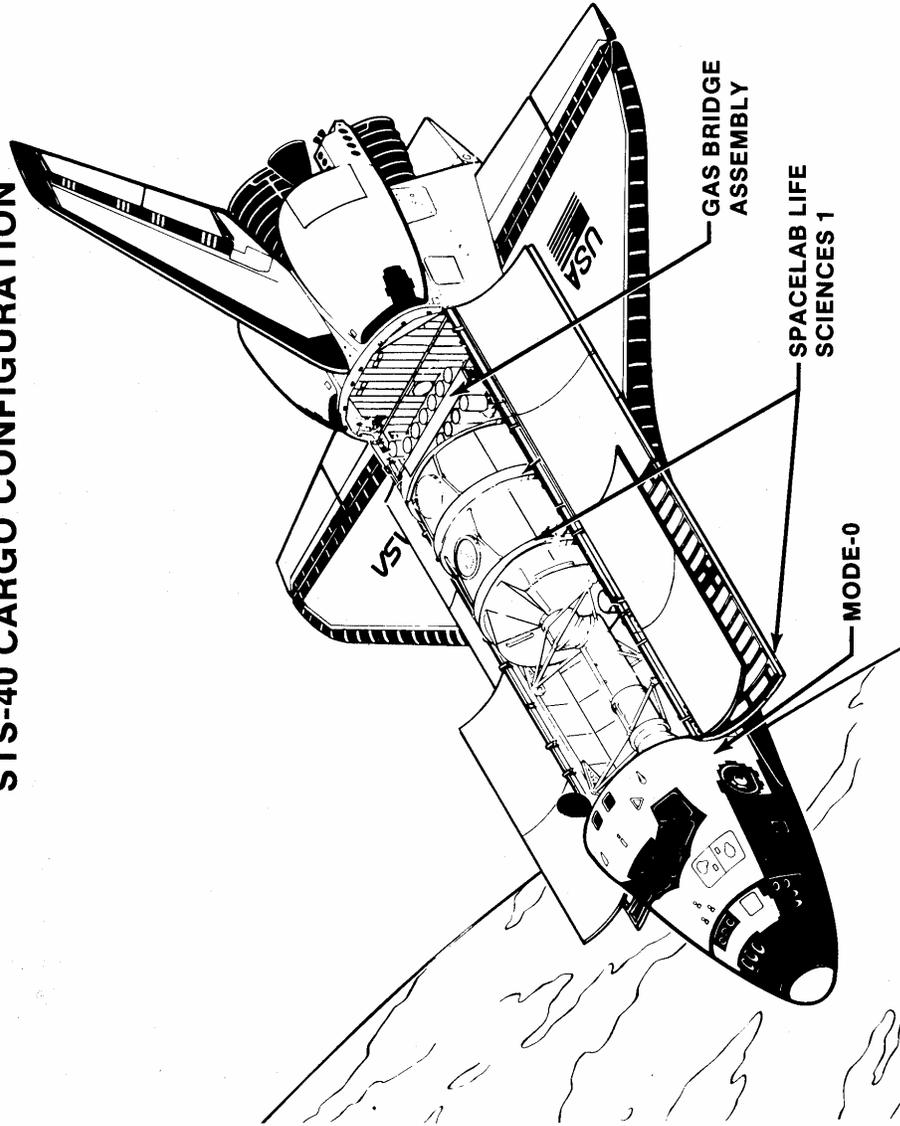
Following post-flight deservicing and removal of the Spacelab payload and major orbiter components at Kennedy Space Center, Columbia will be readied for ferry flight to Palmdale, Calif. The orbiter is scheduled to undergo extensive modifications, including changes to accommodate an extended duration mission, at the Rockwell manufacturing plant during a 6-month period from August 1991 to January 1992. Columbia's next scheduled flight is STS-50, a planned extended duration mission with the U.S. Microgravity Laboratory payload targeted for launch in June 1992.



SSP INTEGRATION
AND OPERATIONS

STS-40 PAYLOAD INFORMATION DOCUMENT

STS-40 CARGO CONFIGURATION



SPACELAB LIFE SCIENCES (SLS-1)

Many volumes of research remain to be recorded and studied regarding adaptation of humans to the weightless environment of space flight. The blanks, however, will begin to be filled following the broad range of experiments to be conducted on the Spacelab Life Sciences-1 (SLS-1).

With the help of the STS-40 crew, investigators from across the nation will conduct tests on the cardiovascular, cardiopulmonary, metabolic, musculoskeletal and neurovestibular systems.

There are 18 primary experiments chosen for SLS-1. Those using human subjects are managed by the Lyndon B. Johnson Space Center, Houston, Texas, and those using animals are managed by the Ames Research Center, Moffett Field, Calif. Organized by the managing NASA center, this section of the press kit will summarize the 18 experiments, identify the principal investigators and list flight hardware used to support the experiments.

Johnson Space Center Spacelab Life Sciences-1 Experiments

Activities involved with the human experiments on-board Columbia are managed by the Lyndon B. Johnson Space Center, Houston, Texas. Preflight baseline data collection will be performed primarily at Johnson Space Center with several tests scheduled at the Kennedy Space Center just prior to launch. Investigators will perform post-flight tests at the Ames-Dryden Flight Research Facility, Edwards, Calif.

A broad range of instruments -- some, unique hardware and others, standard equipment -- will be used by the human subjects throughout the mission. Equipment will include a neck chamber, cardiopulmonary rebreathing unit, gas analyzer mass spectrometer, rotating dome, inflight blood collection system, urine monitoring system, bag-in-box assembly, strip chart recorders, physiological monitoring system, incubators, low-gravity centrifuge, echocardiograph and venous occlusion cuff controller.

In total, the 10 experiments will explore the capabilities of the human body in space. A brief description of these experiments follows:

Influence Of Weightlessness Upon Human Autonomic Cardiovascular Controls

Principal investigator:
Dwain L. Eckberg, MD
Medical College of Virginia Richmond, VA

This experiment will investigate the theory that lightheadedness and a reduction in blood pressures in astronauts upon standing after landing may arise because the normal reflex system regulating blood pressure behaves differently after having adapted to a microgravity environment.

For this experiment, some SLS-1 crewmembers will wear neck chambers that resemble whip-lash collars to detect blood pressure in the neck. Investigators will take blood pressure measurements both before and after the flight for comparison. Astronauts will take the same measurements themselves on orbit to map changes that occur during spaceflight.

Inflight Study Of Cardiovascular Deconditioning

Principal investigator:

Leon E. Farhi, MD
State University of New York at Buffalo
Buffalo, NY

Just how rapidly astronauts become accustomed to microgravity and then readjust to the normal gravitational forces on Earth is the focus of this study. By analyzing the gas composition of a mixture which the STS-40 astronauts "rebreathe," investigators will calculate how much blood is being delivered by the heart to the body during space flight.

This experiment uses a non-invasive technique of prolonged expiration and rebreathing -- inhaling in previously exhaled gases -- to measure the cardiovascular and respiratory changes. The technique furnishes information on functions including the amount of blood pumped out of the heart, oxygen usage and carbon dioxide released by the body, heart contractions, blood pressure and lung functioning.

Astronauts will perform the rebreathing technique while resting and while pedaling on an exercise bike to provide a look at the heart's ability to cope with added physical stress. On the first and last days of the STS-40 mission, only resting measurements will be taken. Rest and graded exercise measurements are made on most other days.

VESTIBULAR EXPERIMENTS IN SPACELAB

Principal investigator:

Laurence R. Young, Sc. D. Massachusetts Institute of Technology
Cambridge, MA

A joint U.S./Canadian research program has been developed to perform a set of closely related experiments to investigate space motion sickness, any associated changes in inner ear vestibular function during weightlessness and the impact of those changes postflight. Parts of this experiment will be carried out in flight, other parts on the ground both pre- and post-flight.

As part of the in flight activities, the team will study the interaction between conflicting visual, vestibular and tactile information. Investigators expect crew members to become increasingly dependent on visual and tactile cues for spatial orientation. The test calls for a crew member to place his/her head in a rotating dome hemispherical display to induce a sensation of self-rotation in the direction opposite to the dome rotation. The astronaut will then move a joy stick to indicate his/her perception of self-motion.

Awareness of position by astronauts is important for reaching tasks especially during landing operations. The objective of several tests during the flight will document the loss of sense of orientation and limb position in the absence of visual cues and will determine what mechanisms underlie the phenomenon.

During the presleep period, crewmembers will view several targets placed about the interior of Spacelab. They then will be blindfolded and asked to describe the position of their limbs in reference to their torso and to point to the targets. In post sleep, crew members upon waking and while blindfolded perceive their posture, position of their limbs and location of familiar orbiter structures, recording the accuracy of their perceptions.

The next two parts of this experiment will be performed as time permits on the SLS-1 mission or continued on a later Spacelab mission. Both experiments have been previously performed by crewmembers in space.

The next part looks at the causes and treatment of space motion sickness (SMS) and evaluates the success of Earth-based tests to predict SMS susceptibility. Two crew members will wear an acceleration recording unit (ARU) to measure all head movement and to provide detailed commentary regarding the time, course and signs of SMS.

Subjects wearing the ARU will wear the collar for several hours during the mission and if desired, when symptoms occur. The influence of the collar on the resulting head movement pattern and SMS symptoms will be monitored.

Another battery of tests performed preflight will attempt to determine which test or combination of tests could aid in predicting SMS.

Protein Metabolism During Space Flight

Principal investigator:

T. Peter Stein, Ph.D. University of Medicine and Dentistry of New Jersey
Camden, NJ

This study involves several tests looking at the mechanisms involved in protein metabolism including changes in protein synthesis rates, muscle breakdown rates and use of dietary nitrogen in a weightless environment.

This experiment will examine whole body protein metabolism by measuring the concentration of ¹⁵N- glycine, an amino acid in protein, in saliva and urine samples from crew members and ground control subjects preflight, in flight and postflight.

Crew members will collect urine samples throughout the flight. On the second and eighth flight days, astronauts also will take oral doses of ¹⁵N-glycine. Crew members will collect and freeze a urine sample 10 hours after the

ingestion of the glycine for postflight analyses. Urinary 3-methyl histidine, a marker for muscle protein breakdown also will be monitored.

Fluid-Electrolyte Regulation During Spaceflight

Principal investigator:

Carolyn Leach-Huntoon, Ph.D. Lyndon B. Johnson Space Center
Houston, TX

Adaptation to the weightless environment is known to change fluid, electrolyte, renal and circulatory processes in humans. A shift of body fluids from the lower limbs to the upper body occurs to all astronauts while in space.

This experiment makes detailed measurements before, during and after flight to determine immediate and long-term changes in kidney function; changes in water, salt and mineral balance; shifts in body fluids from cells and tissues; and immediate and long-term changes in levels of hormones which affect kidney function and circulation.

Test protocol requires that crew members collect urine samples throughout the flight. Body mass is measured daily and a log is kept of all food, fluids and medication taken in flight. Fasting blood samples are collected from the crew members as soon as possible inflight and at specified intervals on selected flight days thereafter. Tests will determine the amount of certain tracers that can be released from a given volume of blood or plasma into urine in a specified amount of time, measuring the rate and loss of body water and determining changes in blood plasma volume and extracellular fluid. Measurements will be made two times inflight by collecting blood samples at timed intervals after each subject has received a precalculated dose of a tracer, a chemical which allows the compound to be tracked as it moves through the body. Total body water is measured during flight using water labeled with a heavy isotope of oxygen.

Each subject drinks a premeasured dose of the tracer and subsequently collects urine samples at timed intervals. Plasma volume and extracellular fluid volume are measured by collecting blood samples at timed intervals after tracer injections. Hormonal changes are investigated by sensitive assays of both plasma and urine.

Pulmonary Function During Weightlessness

Principal investigator:

John B. West, MD/Ph.D. University of California
San Diego, CA

This experiment provides an opportunity for study of the properties of the human lung without the influence of gravity. In the microgravity Spacelab, a model of lung function will be developed to serve as a basis for comparison for the normal and diseased lung. Also, investigators will glean information about the lung for planning longer space missions.

There will be a series of eight breath tests conducted with measurements taken at rest and after breathing various test bag mixtures. The test assembly allows the subject to switch from breathing cabin air to inhaling premixed gases in separate breathing bags. Breathing exercises involve the inhalation of specially prepared gas mixtures.

The tests are designed to examine the distribution and movement of blood and gas within the pulmonary system and how these measurements compare to normal respiration. By measuring gas concentrations, the flow of gas through the lungs into the blood stream and rate of blood flow into the lungs, investigators hope to better understand the human pulmonary function here on Earth and learn how gravity plays a part in influencing lung function.

Lymphocyte Proliferation In Weightlessness

Principal investigator:

Augusto Cogoli, Ph.D. Swiss Federal Institute of Technology
Zurich, Switzerland

Following investigations carried out during Spacelab 1 and the German D-1 shuttle missions, this experiment will investigate the effect of weightlessness on the activation of lymphocyte reproduction. The study also will test whether there is a possible alteration of the cells responsible for part of the immune defense system during space flight.

STS-40 will repeat the basic Spacelab-1 experiment. Lymphocytes will be purified from human blood collected 12 hours before launch. The cells will be resuspended in a culture medium, sealed in culture blocks and stowed on Columbia's middeck. Inflight, the samples will be exposed to a mitogen (a substance that promotes cell division) and allowed to grow in the weightless environment. Some of the samples also will be exposed to varying gravity levels on the low-gravity centrifuge. These samples will serve as a control group as they will experience the same environmental conditions with the exception of micro-gravity.

The stimulation of the lymphocytes to reproduce is determined by monitoring the incorporation of a chemical isotope tracer into the cells' DNA. Investigators will gather further information on lymphocytes from blood samples taken from the crew inflight.

Influence Of Space Flight On Erythrokinetics In Man

Principal investigator:

Clarence Alfrey, MD Baylor College of Medicine
Houston, TX

The most consistent finding from space flight is the decrease in circulating red blood cells or erythrocytes and subsequent reduction in the oxygen carrying capacity of the blood. This experiment studies the mechanisms which may be responsible for this decrease, including the effect of space flight on red blood cell production rate and the role of changes in body weight and plasma volume on red blood cell production.

Blood samples taken pre-, post- and inflight will trace the life of astronauts' red blood cells. By measuring the volume of red blood cells and plasma, researchers will check the rate of production and destruction of blood in both normal and microgravity conditions.

On flight day two, crew members will receive an injection of a tracer that will measure the amount of new red blood cells. Tracers (chemicals that will attach to the red blood cell to allowing them to be tracked) injected before launch will measure the destruction rate of red blood cells. Crew members will draw blood samples on the second, third, fourth, eighth and ninth days of flight.

Cardiovascular Adaptation To Microgravity

Principal investigator:

C. Gunnar Blomqvist, MD University of Texas Southwestern Medical Center
Dallas, TX

This experiment will focus on the acute changes in cardiovascular function, heart dimensions and function at rest, response to maximal exercise and control mechanisms.

The experiment seeks to increase the understanding of microgravity-induced changes in the cardiovascular structure and function responsible for a common problem during return to normal gravity of orthostatic hypotension or the inability to maintain normal blood pressure and flow while in an upright position.

Central venous pressure -- measurements of changes in the blood pressure in the great veins near the heart -- will be observed in one crew member. A cardiologist will insert a catheter into a vein in the arm and position it near the heart prior to flight. Measurements then will be recorded for 24 hours beginning prior to launch and extending for at least 4 hours into space flight, at which time the catheter is removed. The catheter data will indicate the degree of body fluid redistribution and the speed at which the redistribution occurs.

Echocardiograph measurements, a method of sending high frequency sound into the body to provide a view of the heart, will be performed on crew members each day.

Leg flow and compliance measurements will gather information on leg blood flow and leg vein pressure- volume relationships. During flow measurements, blood in the veins of the leg will be stopped for a short period of time by inflating a cuff above the knee. Compliance measurements, the amount of blood that pools for a given increased pressure in the veins will be obtained by inflating and incrementally deflating the cuff over different pressures and holding that pressure until the volume of the leg reaches an equilibrium.

Pathophysiology Of Mineral Loss During Space Flight

Principal investigator:

Claude D. Arnaud, MD University of California
San Francisco, CA

Changes in calcium balance during space flight is an area of concern for researchers since the changes appear to be similar to those observed in humans with osteoporosis, a condition in which bone mass decreases and the bones become porous and brittle and are prone to fracturing or breaking. Because of potential health problems for astronauts returning to Earth after long space flights, the mechanisms which cause these changes are of great interest in space medicine.

This experiment will measure the changes which occur during space flight in circulating levels of calcium metabolizing hormones and to directly measure the uptake and release of calcium in the body. Investigators believe there may be significant changes in the amount of these hormones produced due to an increase in the breakdown and reassimilation of bone tissue and that these changes begin to occur within hours after entering the weightless environment.

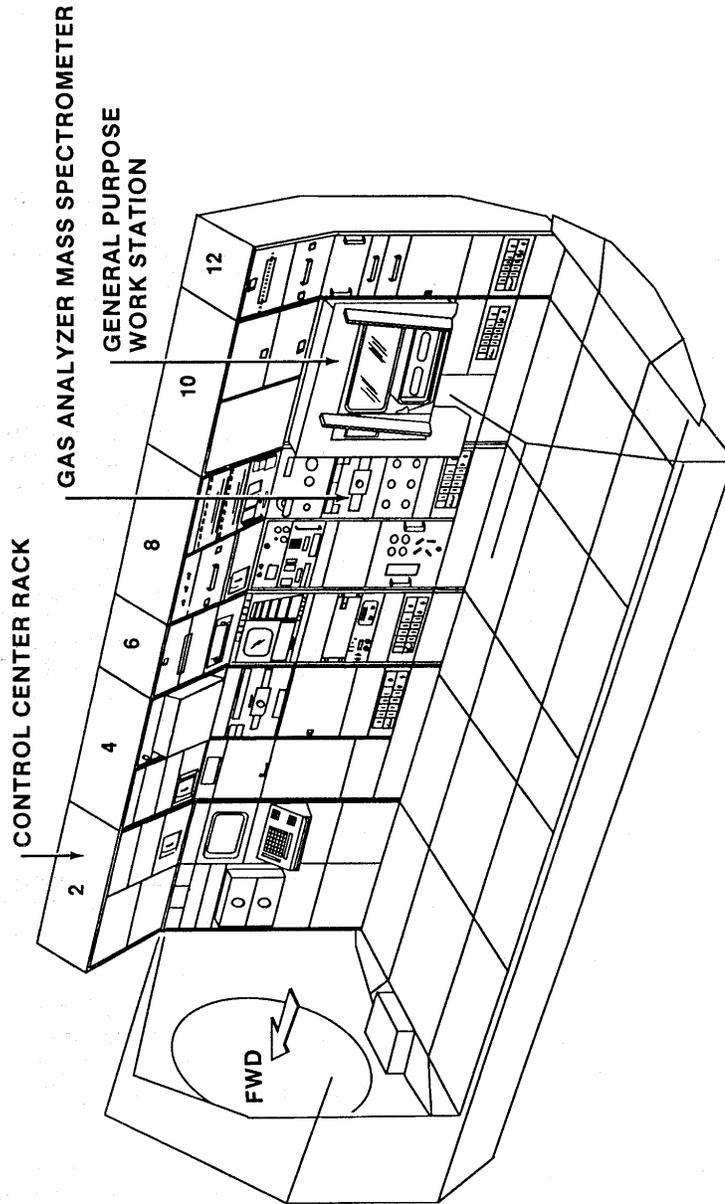
Each crew member will be weighed daily and will keep a log of all food, fluids and medications ingested. They also will draw blood samples on selected days to determine the role of calcium regulating hormones on the observed changes in calcium balance. The experiment is repeated on selected days preflight and postflight. A simultaneous ground experiment is performed using non-crew member subjects.



SSP INTEGRATION
AND OPERATIONS

STS-40 PAYLOAD INFORMATION DOCUMENT

SPACELAB STARBOARD SIDE CONFIGURATION

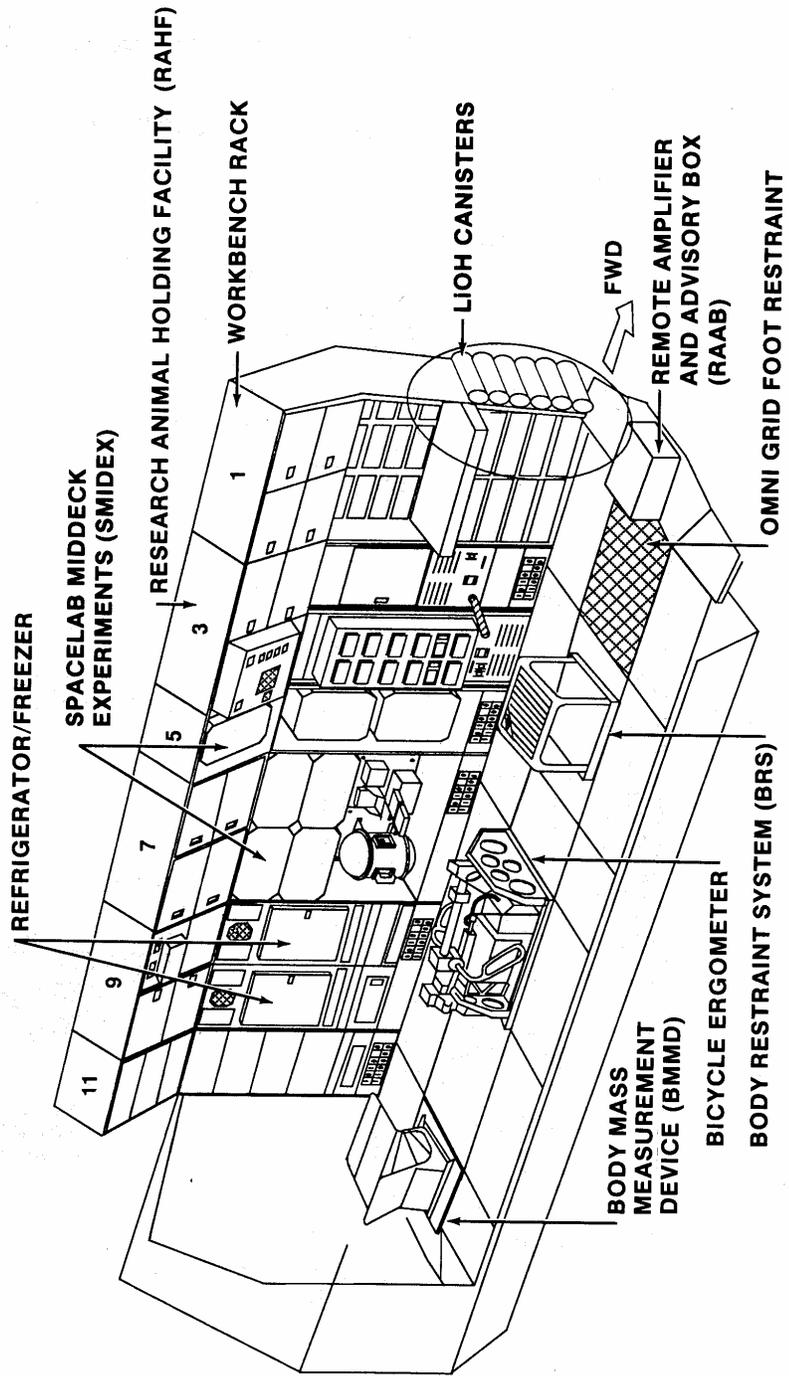




SSP INTEGRATION
AND OPERATIONS

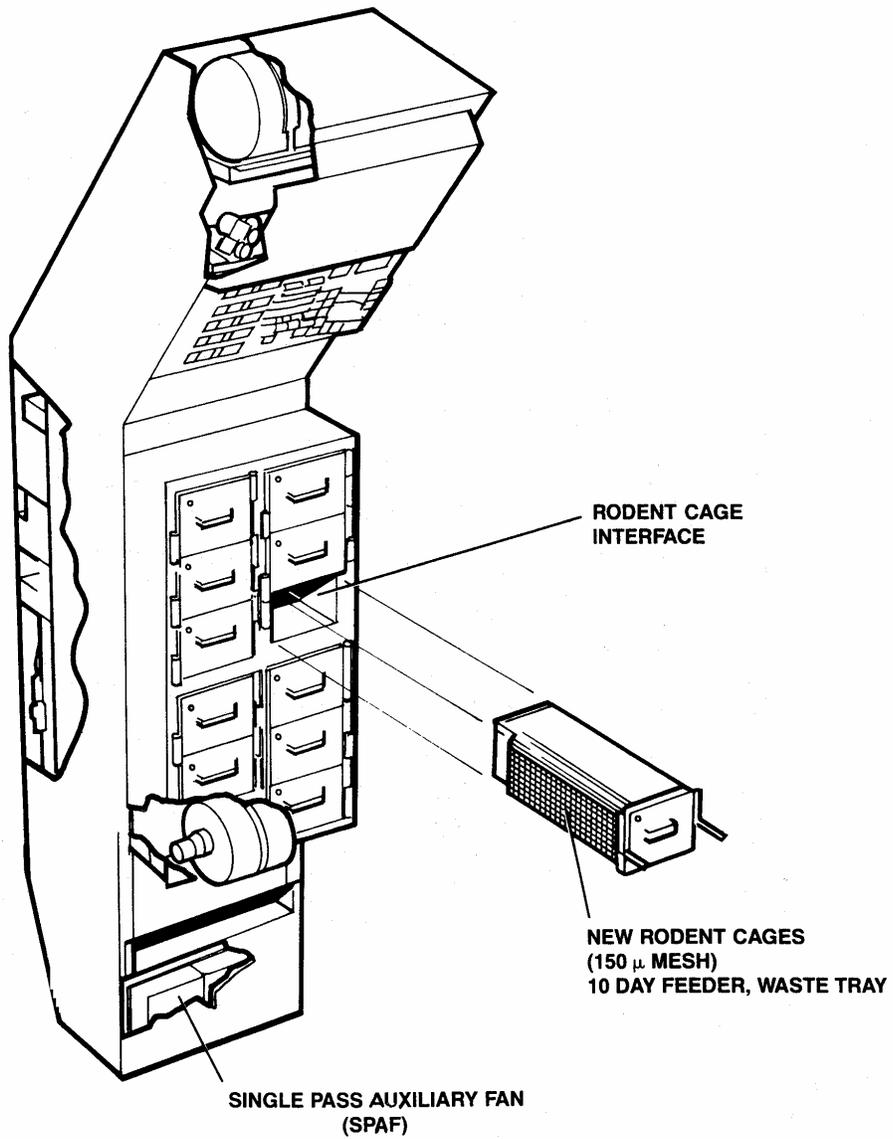
STS-40 PAYLOAD INFORMATION DOCUMENT

SPACELAB PORT SIDE CONFIGURATION

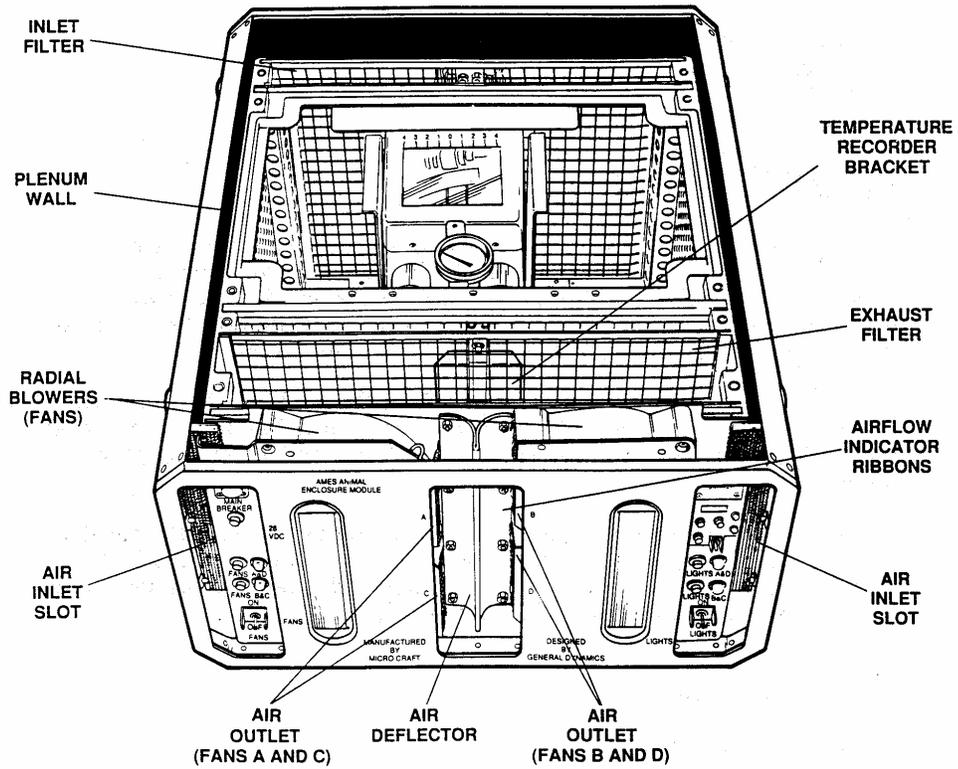


RESEARCH ANIMAL HOLDING FACILITY (RAHF)

RODENT CONFIGURATION



ANIMAL ENCLOSURE MODULE



AMES RESEARCH CENTER SPACELAB LIFE SCIENCES-1 EXPERIMENTS

The Ames Research Center, Moffett Field, Calif., as the developer of nonhuman life sciences experiments, will supply eight investigations to the SLS-1 mission. They are designed to increase our knowledge about the functioning of basic life processes during exposure to microgravity.

These experiments will examine three systems: musculoskeletal, neurovestibular and hematopoietic. Seven of the investigations will use laboratory rats as subjects. A gravitational biology experiment will study jellyfish development and behavior. Ames Research Center also has developed several pieces of flight hardware to support these experiments.

The Ames payload consists of a research animal holding facility (RAHF), two animal enclosure modules (AEMs), a general purpose work station and associated general purpose transfer unit, a refrigerator/incubator module, a small mass measuring instrument and eight animal experiments. A brief description of each of those experiments follows.

Regulation Of Erythropoiesis During Space Flight

Principal investigator:

Robert D. Lange, MD University of Tennessee Medical Center
Knoxville, TN

Regulation Of Blood Volume During Space Flight

Principal investigator:

Clarence Alfrey, MD Baylor College of Medicine
Houston, TX

This combined investigation will explore the mechanisms for changes seen in red blood cell mass and blood volume in crews on previous space flights. Several factors known to affect erythropoiesis will be examined. It also will determine whether comparable changes occur in the rat and if the rat is a satisfactory model for studying microgravity-induced changes in human blood.

Previous space flight crews have consistently exhibited decreased red blood cell mass and plasma volume. The mechanisms responsible for these changes are not known, although a decrease in red blood cell production may play a role in altered red cell mass.

The SLS-1 hematology experiments will study two parts of the blood system: the liquid portion (plasma), which contains water, proteins, nutrients, electrolytes, hormones and metabolic wastes and a cellular portion, which contains red and white blood cells and platelets.

Bone, Calcium And Space Flight

Principal investigator:

Emily Morey-Holton, Ph.D. NASA Ames Research Center
Moffett Field, CA

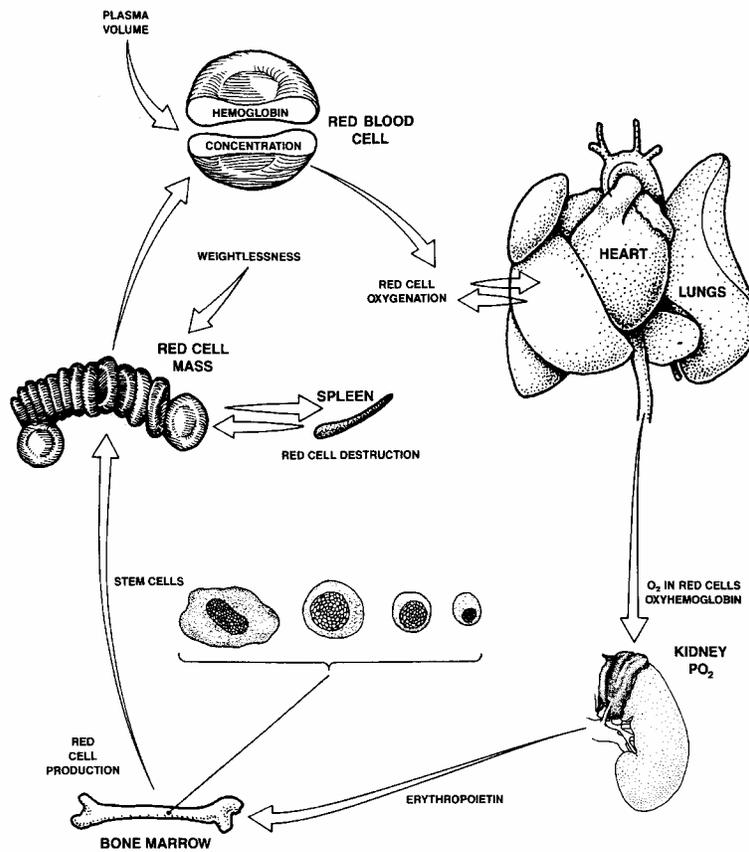
Weightlessness causes a slow loss of calcium and phosphorus from the bones during and immediately following space flight. Negative calcium balance, decreased bone density and inhibition of bone formation have been reported. Most of the loss is thought to occur in the leg bones and the spine, which are responsible for movement and erect posture.

Previous studies of rodents exposed to microgravity have shown decreased skeletal growth early in the mission; reduced concentrations of a protein secreted by bone-forming cells, suggesting a reduction in the activity of these cells; and reduced leg bone breaking strength and reduced bone mass in the spine.

Formation of bone probably does not cease abruptly, but more likely decreases gradually as the number and/or activity of bone-forming cells decreases. This experiment will allow more precise calculation of the length of flight time required to significantly inhibit bone formation in rats.

Dr. Morey-Holton's experiment focuses on growth that occurs in a number of specific bones such as the leg, spine and jaw. The study also will document alterations in bone growth patterns and bone-breaking strength in rodents exposed to weightlessness and it will determine whether bone formation returns to normal levels after space flight.

REGULATION OF RED BLOOD CELL PRODUCTION (ERYTHROPOIESIS)



A Study Of The Effects Of Space Travel On Mammalian Gravity Receptors

Principal investigator:

Muriel Ross, Ph.D. NASA Ames Research Center
Moffett Field, CA

The neurovestibular system, which helps animals orient their bodies, is very sensitive to gravity. In space, gravity no longer influences the tiny otolith crystals, which are small, calcified gravity receptors in the inner ear. In microgravity, information sent to the brain from the inner ear and other sensory organs may conflict with cues anticipated from past experiences in Earth's normal gravity field. This conflict results in disorientation.

Previous flight experience has shown that vestibular symptoms, including nausea, vomiting and dizziness and instability when standing, occur in more than half of the astronauts during the first few days of flight, with some symptoms lasting for up to 10 days post-flight.

This study investigates structural changes that may occur within the inner ear in response to the microgravity of space. It seeks to define the effects of prolonged weightlessness on the otoliths. Scientists suspect that otolith degeneration may occur as a result of changes in the body's calcium levels, carbohydrate and protein metabolism, body fluid distribution and hormone secretions.

The study also will examine the degree to which any changes noted remain static, progress or recover during a 7-day period post-flight.

Effects Of Microgravity-Induced Weightlessness On Aurelia Ephyra Differentiation And Statolith Synthesis

Principal investigator:

Dorothy B. Spangenberg, Ph.D. Eastern Virginia Medical School
Norfolk, VA

Jellyfish are among the simplest organisms possessing a nervous system. They use structures called rhopalia to maintain their correct orientation in water. Rhopalia have statoliths that are analogous to mammalian otoliths, the gravity-sensing organs of the inner ear that help mammals maintain balance.

The purpose of this investigation is to determine the role microgravity plays in the development and function of gravity-receptor structures of Aurelia (a type of jellyfish). Ephyrae are a tiny form of the jellyfish. This experiment will study the gravity receptors of ephyrae to determine how microgravity influences their development and function, as well as the animals' swimming behavior.

Skeletal Myosin Isoenzymes In Rats Exposed To Microgravity

Principal investigator:

Joseph Foon Yoong Hoh, Ph.D. University of Sydney
Sydney, Australia

Skeletal muscle fibers exist in two forms, classified as slow-twitch or fast-twitch, depending on how fast they contract. The two forms develop similar forces when contracting but they contract at different speeds. The speed of contraction is directly related to the amount of the protein myosin in muscle fibers. Myosin is made up of five isoenzymes, which differ in structure and in enzyme activity.

In Earth's gravity, a low-firing frequency stimulates the slow-twitch fibers, which support a body against gravity. The fast-twitch fibers, which are related to body movement, contract in response to high-frequency nerve impulses.

This study will examine how microgravity affects the speed of muscle contractions. Because stimuli to the slow-twitch anti-gravity muscles should be greatly reduced in microgravity, the concentration of myosin isoenzymes in these fibers should be lower. This experiment should provide additional data to help explain how microgravity affects the speed of muscle contractions and the growth and proliferation of slow-twitch and fast-twitch muscle fibers.

Effects Of Microgravity On Biochemical And Metabolic Properties Of Skeletal Muscle In Rats

Principal investigator:

Kenneth M. Baldwin, Ph.D. University of California
Irvine, CA

It has been proposed that a loss of muscle mass in astronauts during weightlessness produces the observed loss of strength and endurance, particularly in the anti-gravity muscles. One explanation is that exposure to microgravity results in the removal of sufficient stress or tension on the muscles to maintain adequate levels of certain proteins and enzymes.

These proteins and enzymes enable cells to use oxygen to convert nutrients into energy. When gravitational stress is reduced, protein activity also decreases and muscles become more dependent on glycogen stored in the liver and muscles for energy. As the body metabolizes glycogen, muscle endurance decreases.

Radioactive carbon compounds will be used to evaluate energy metabolism in the hind leg muscles of the rats exposed to microgravity. The concentration of the enzymes reflects the kind of metabolic activity occurring in muscles during periods of reduced gravitational stress. In addition, skeletal muscle cells of flight and ground-control animals will be compared to assess any changes in the concentration of enzymes that break down glycogen.

The Effects Of Microgravity On The Electron Microscopy, Histochemistry And Protease Activities Of Rat Hindlimb Muscles

Principal investigator:

Danny A. Riley, Ph.D. Medical College of Wisconsin
Milwaukee, WI

The anti-gravity skeletal muscles of astronauts exposed to microgravity for extended periods exhibit progressive weakness. Studies of rodents flown in space for 7 days on a previous mission have shown a 40 percent loss of mass in the anti-gravity leg muscles. Other studies indicate the loss of strength may result from simple muscle fiber shrinkage, death of muscle cells and/or degeneration of motor innervation. In addition, the biochemical process that generates energy in muscle cells was almost totally absent. The progressive atrophy of certain muscles in microgravity is the focus of this study, which compares the atrophy rates of muscles used primarily to oppose gravity with those muscles used for movement.

Investigators will examine muscle tissues of flight and ground-control rodents to look for the shrinkage or death of muscle cells, breakdown of muscle fibers or degeneration of motor nerves. Scientists also hope to discover the chemical basis for atrophy by analyzing the concentration of enzymes that facilitate the breakdown of proteins within cells.

GET AWAY SPECIAL EXPERIMENTS

NASA's Get Away Special (GAS) program's goal is to provide access to space to everyone by offering an inexpensive way for individuals and organizations, both private and public of all countries, to send scientific research and development experiments on board a Space Shuttle for a modest fee on a space- available basis.

The GAS bridge, capable of holding a maximum of 12 canisters (or cans), fits across the payload bay of the orbiter and offers a convenient and economic way of flying several canisters simultaneously.

To date, 55 GAS cans have flown on 15 missions. The GAS program began in 1982 and is managed by Goddard Space Flight Center, Greenbelt, MD. Clarke Prouty is GAS project manager and Larry Thomas is Technical liaison officer. The 12 GAS experiments on STS-40 are:

(G-021) Solid State Microaccelerometer Experiment

This experiment, sponsored by the European Space Agency (ESA), is part of ESA's In-Orbit Technology Demonstration Program, which makes use of flight opportunities available on European and American carriers to fly technology experiments.

The objective of the experiment is to test a new kind of very sensitive, highly miniaturized accelerometers, intended for applications on a number of ESA space missions. Using a block of silicon material etched to create a frame with a mass suspended on two beams, the experiment was devised to subject accelerometers to known vibration stimuli while in the microgravity environment of the Shuttle orbit.

As a result of the extreme sensitivity of the accelerometers, noise created by the crew or Shuttle systems could reduced the quality of the measurements. Because of this, the crew will switch on the experiment prior to a sleep period. The experiment will work autonomously and will last about 3 hours. After the sleep period, the crew will switch it off again.

The payload was designed and built by two Swiss companies, Compagnie Industrielle Radioelectrique S.A. and Centre Suisse D'Electronique et de Microtechnique S.A. The NASA technical manager (NTM) is Richard Hoffman.

(G-052) Experiment In Crystal Growth

This experiment was designed to grow crystals of gallium arsenide (GaAs). GaAs is a versatile electronic material used in high speed electronics and opto-electronics.

The payload will grow two selenium-doped GaAs crystals. The crystals will be 1 inch in diameter by 3.5 inches long and will be grown using a gradient freeze growth technique. Growth of the two crystals in space is part of a comprehensive research program to systematically investigate the effect of gravity-driven fluid flow on GaAs crystal growth.

The payload was designed and constructed at GTE Laboratories in Waltham, Mass., and is jointly sponsored by GTE, NASA's Lewis Research Center, Cleveland, Ohio, and the U.S. Air Force Wright Research and Development Center Materials Laboratory, Dayton, Ohio. Scientists from each research institution will contribute to characterization of the space-grown crystals. The NTM is Dave Peters.

(G-091) Orbital Ball Bearing Experiment

A team of researchers from California State University, Northridge (CSUN) have built an experiment apparatus called the Orbital Ball Bearing Experiment (OBBEX) to test the effects of melting cylindrical metal pellets in microgravity. If successful, this experiment may produce a type of ball bearing which has never before been built.

One of the goals of the OBBEX experiment is to create the world's first seamless, hollow ball bearing. The hollow characteristic of the ball can improve the service life rating of a ball bearing. This permits higher speeds and higher load applications and may reduce the friction encountered in normal operation.

With faculty support, the OBBEX was designed and built as part of a senior year design project at California State University, Northridge. Funding for the experiment was provided by two Southern California companies: Moore Industries Inc., a manufacturer of industrial control systems, and Industrial Tektonics, Inc., a specialty bearing manufacturer. Additional funding was supplied by the Aerospace Corporation, The CSUN Foundation and several individuals. The NTM is Don Carson.

(G-105) In-Space Commercial Processing

Scientists at the University of Alabama in Huntsville (UAH) will use five experiments to study possible commercial in-space processing opportunities. Those experiments and another in cosmic ray research are co-sponsored by UAH's Consortium for Materials Development in Space and the U.S. Space and Rocket Center in Huntsville.

While Columbia is in orbit, two experiment packages in the canister will process organic films and crystals that might be used in optical communications and computers. Another will electroplate metals to study special catalytic or reactory properties, or resistance to corrosion. A fourth experiment will study technology used to refine and process organic materials, such as medical samples.

The fifth UAH experiment will collect cosmic ray interactions on film emulsion while also helping scientists assess materials that may be used in future massive cosmic ray detectors to be flown aboard the Shuttle or Space Station Freedom or to determine exposure to energetic particles on Earth.

The sixth experiment is provided by the U.S. Space and Rocket Center, a state-owned, space science museum. It will study the effects of cosmic radiation on the chromosomes and genes of a common yeast. The NTM is Larry Thomas.

(G-286) Foamed Ultralight Metals

The scientific aim of this payload is to demonstrate the feasibility of producing, in orbit, foams of ultralight metals for possible application as shock-absorbing panel-backing to improve the shielding of both manned and unmanned vehicles and satellites, including Space Station Freedom, against hypervelocity impacts either from micrometeoroids or orbiting debris.

The concept of using ultralight, reactive alloys in the space environment, where their reactivity is not an issue, offers many advantages in the engineering of large-scale space structures. Similarly, the idea of using metal foams made from such alloys as shock-absorbing backing to improve the effectiveness of satellite armor may offer substantial benefits in the design of Space Station Freedom.

The payload was built at Duke University in the Department of Mechanical Engineering and Materials Science. The project was supported by Omni Magazine, which offered the canister as part of a national contest in 1983, and by the School of Engineering in subsequent years. The NTM is Don Carson.

(G-405) Chemical Precipitate Formation

This payload will return data concerning the formation of six insoluble inorganic chemical precipitates. The experiment will investigate the rate of formation and terminal size of precipitate particles when the growth is not impaired by settling due to gravity.

The experiment is sponsored by the Frontiers of Science Foundation of Oklahoma, a private, non-profit organization established to promote science education within Oklahoma, in conjunction with Louisiana Tech University. In 1983, the foundation sponsored a contest among high school students to conceptualize an experiment which would fly

aboard the Shuttle. The revisions for the payload were performed at the Louisiana Tech University, where the payload manager currently serves on the faculty in mechanical engineering.

After flight and analysis of data the payload will be donated and displayed at the Oklahoma Air and Space Museum in Oklahoma City. The NTM is Larry Thomas.

(G-408) Five Microgravity Experiments

Five student experiments from the Worcester Polytechnic Institute are included in one GAS can. One will attempt to grow large zeolite crystals. Another will study the behavior of fluids in microgravity. A third, the Environmental Data Acquisition System, will record information about sound, light, temperature and pressure within the GAS can. The fourth will measure the acceleration of the Shuttle along three axes with a high degree of precision. A fifth experiment will study the fogging of film in space.

The experimental packages are sponsored by the MITRE Corp. Bedford, Mass. The NTM is Don Carson.

(G-451) Flower And Vegetable Seeds Exposure To Space

Sakana Seeds Corporation in Yokohama, Japan, and the Nissho Iwai American Corporation in New York, NY, will jointly send 19 varieties of flower and vegetable seeds into space to determine how the unknown variables of microgravity will affect seed growth. After the Shuttle lands and the seeds are recovered, the companies plan to distribute the seeds widely to amateur growers. The NTM is Herbert Foster.

(G-455) Semiconductor Crystal Growth Experiment

This payload was developed to investigate the potential advantages of crystal growth under microgravity. There are two experiments -- PbSnTe crystal growth from vapor and GaAs crystal growth from metallic solution. The payload is sponsored by Fujitsu Limited in Kawasaki, Japan, and Nissho Iwai Corporation in Tokyo. The NTM is David Shrewsbury.

(G-507) Orbiter Stability Experiment

This experiment, developed at Goddard Space Flight Center, will measure the Space Shuttle's spectrum of small angular motions (or "jitter") produced by the operation of mechanical systems, thruster firings and human motions during normal crew activity.

In addition to the vibration measurements that will be made, Goddard's GAS can also carries a passive experiment to test the effects of radiation on photographic film. The experiment was developed and provided by Dr. Ernest Hammond of Morgan State University, Baltimore, MD. The NTM is Neal Barthleme.

(G-616) The Effect Of Cosmic Radiation On Floppy Disks & Plant Seeds Exposure To Microgravity

This payload consists of two experiments. The first will investigate static computer memory (floppy disks) to determine if cosmically charged particles will produce changes in data integrity or structure. The second will look for changes in the physiology or growth of 38 different types of plant seeds. Each cultivator will be examined post-flight in comparison with samples from the same seed lot, that remained on the Earth, for a wide variety of possible effects or changes.

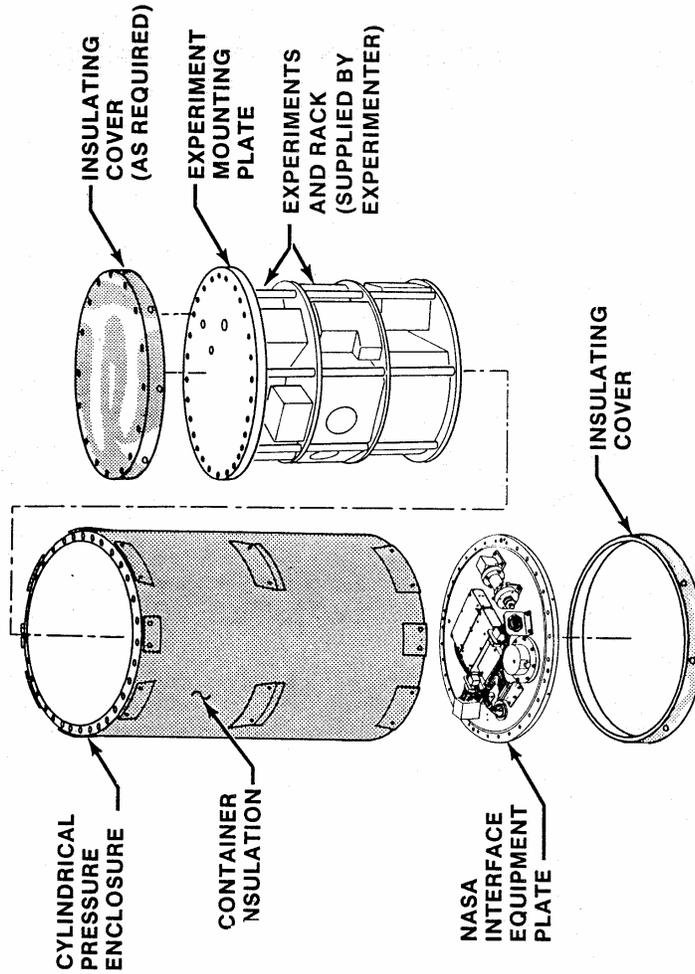
Several of the floppy disks contain programs developed by elementary school students. In addition, a large number of plant seeds will be distributed to every elementary and junior high school student in the Redlands, Calif., Unified School District, the sponsor of the experiment. The NTM is Charles Kim.



SSP INTEGRATION
AND OPERATIONS

STS-40 PAYLOAD INFORMATION DOCUMENT

GET AWAY SPECIAL (GAS) CONTAINER CONCEPT



(G-486) Six Active Soldering Experiments

No information on this payload was provided by the sponsor, EDSYN, Inc. of Van Nuys, Calif. The NTM is Bernard Karmilowicz.

ORBITER EXPERIMENTS PROGRAM

The advent of operations of the Space Shuttle orbiter provided an opportunity for researchers to perform flight experiments on a full-scale, lifting vehicle during atmospheric entry. To take advantage of this opportunity, NASA's Office of Aeronautics, Exploration and Technology instituted the orbiter experiments (OEX) program in 1976.

The OEX program provides a mechanism for flight research experiments to be developed and flown aboard a Space Shuttle orbiter. Since the program's inception, 13 experiments have been developed for flight. Principal investigators for these experiments represent NASA's Langley and Ames Research Centers, Johnson Space Center and Goddard Space Flight Center.

Seven OEX experiments will be flown on STS-40. Included among this group will be six experiments conceived by Langley researchers and one experiment developed by Johnson.

Shuttle Entry Air Data System (SEADS)

The SEADS nosecone on the orbiter Columbia contains 14 penetration assemblies, each containing a small hole through which the nosecone surface air pressure is sensed. Measurement of the pressure levels and distribution allows post-flight determination of vehicle attitude and atmospheric density during entry. SEADS, which has flown on four previous flights of Columbia, operates in an altitude range of 300,000 feet to landing. Paul M. Siemers III, Langley Research Center, Hampton, Va., is the principal investigator.

Shuttle Upper Atmosphere Mass Spectrometer (SUMS)

The SUMS experiment complements SEADS by enabling measurement of atmospheric density above 300,000 feet. SUMS samples air through a small hole on the lower surface of the vehicle just aft of the nosecone. It uses a mass spectrometer operating as a pressure sensing device to measure atmospheric density in the high altitude, rarefied flow regime where the pressure is too low for the use of ordinary pressure sensors. The mass spectrometer, incorporated in the SUMS experiment, was spare equipment originally developed for the Viking Mars Lander. SUMS was previously flown on STS-61C and STS-35. Robert C. Blanchard and Roy J. Duckett of Langley Research Center are co-principal investigators.

Both SEADS and SUMS provide entry atmospheric environmental (density) information. These data, when combined with vehicle motion data, are used to determine in-flight aerodynamic performance characteristics of the orbiter.

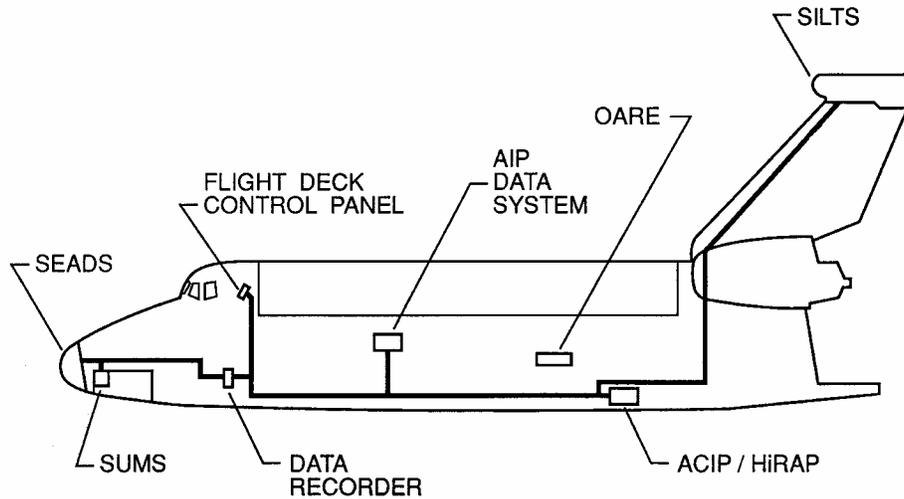
Aerodynamic Coefficient Identification Package (ACIP)

The ACIP instrumentation includes three-axis sets of linear accelerometers, angular accelerometers and angular rate gyros, which sense the orbiter's motions during flight. ACIP provides the vehicle motion data which is used in conjunction with the SEADS environmental information for determination of aerodynamic characteristics below about 300,000 feet altitude. The ACIP has flown on all flights of orbiters Columbia and Challenger. David B. Kanipe, Johnson Space Center, Houston, is the ACIP principal investigator.

High Resolution Accelerometer Package (HiRAP)

This instrument is a three-axis set of highly sensitive accelerometers which measure vehicle motions during the high altitude portion (above 300,000 feet) of entry. This instrument provides the companion vehicle motion data to be used with the SUMS results. HiRAP has been flown on 12 previous missions of the orbiters Columbia and Challenger. Robert C. Blanchard, Langley Research Center, is the HiRAP principal investigator.

ORBITER EXPERIMENTS PROGRAM CONFIGURATION FOR STS-40



Orbital Acceleration Research Experiment (OARE)

The Orbital Acceleration Research Experiment (OARE) complements the ACIP and HiRAP instruments by extending the altitude range over which vehicle acceleration data can be obtained to orbital altitudes. Like the HiRAP, the OARE instrument comprises a three-axis set of extremely sensitive linear accelerometers. The OARE sensors are substantially more sensitive than the HiRAP sensors.

Because of their extreme measurement sensitivity, the OARE sensors cannot be adequately calibrated on the ground (in a 1-g environment). Consequently, the sensors are mounted on a rotary calibration table which enables an accurate instrument calibration to be performed on orbit.

The OARE instrument is installed for flight on a special mounting plate within the orbiter's payload bay. OARE data are recorded on the mission payload recorder. This is the first flight for the OARE instrument. Principal investigator is Robert C. Blanchard of Langley Research Center.

Shuttle Infrared Leeside Temperature Sensing (SILTS)

This experiment uses a scanning infrared radiometer located atop the vertical tail to collect infrared images of the orbiter's leeside (upper) surfaces during entry, for the purpose of measuring the temperature distribution and the aerodynamic heating environment. On two previous missions, the experiment obtained images of the left wing. For STS-35 and STS-40, the experiment has been configured to obtain images of the upper fuselage. SILTS has flown on four Columbia flights. David A. Throckmorton and E. Vincent Zoby of Langley Research Center are co-principal investigators.

Aerothermal Instrumentation Package (AIP)

The AIP comprises some 125 measurements of aerodynamic surface temperature and pressure at discrete locations on the upper surface of the orbiter's left wing and fuselage and the vertical tail. These sensors were originally part of the development flight instrumentation system that flew aboard Columbia during its Orbital Flight Test missions (STS-1 through 5). They have been reactivated through the use of an AIP- unique data handling system. Among other applications, the AIP data provide "ground-truth" information for the SILTS experiment. The AIP has flown on three previous Columbia flights. David A. Throckmorton, Langley Research Center, is principal investigator.

STS-40 CREWMEMBERS



STS040-S-002 -- Five NASA astronauts and two scientists serving as payload specialists have been named to fly aboard Columbia, Orbiter Vehicle (OV) 102, for NASA's STS-40 mission. Astronaut Bryan D. O'Connor (rear left) is the mission commander, and Sidney M. Gutierrez (rear right) is the pilot. Others are (front, left to right) payload specialists F. Drew Gaffney and Millie Hughes-Fulford; mission specialists M. Rhea Seddon, James P. Bagian, and Tamara E. Jernigan (rear center). The primary payload for this flight is Spacelab Life Sciences 1 (SLS-1) (note the model of the shuttle with the Spacelab module and related hardware depicted). The crewmembers are wearing launch and entry suits (LESs). The crew insignia and the United States flag are displayed in the background.

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BIOGRAPHICAL DATA

MARINE CORPS COL. BRYAN D. O'CONNOR, 44, will serve as Commander of STS-40 and will be making his second space flight. O'Connor, from Twentynine Palms, Calif., was selected as an astronaut in May 1980.

He graduated from Twentynine Palms High School in 1964, received a bachelor of science degree in engineering from the U.S. Naval Academy in 1968 and received a master of science in aeronautical engineering from the University of West Florida in 1970.

He was commissioned in the Marine Corps in 1968 and following several overseas assignments, graduated from the Navy Test Pilot School and began duty as a test pilot at the Naval Air Test Center's Strike Test Directorate. He served as project pilot for various very short take off and landing (VSTOL) research aircraft, including preliminary evaluation of the YAV-88 advanced Harrier prototype.

After selection as an astronaut, he served as a T-38 chase pilot for STS-3 and as spacecraft communicator for STS-5 through STS-9. He then served as pilot of Atlantis on STS-61B from Nov. 26 through Dec. 3, 1985, during which the crew deployed three communications satellites and conducted two Space Station assembly test spacewalks. O'Connor has logged more than 165 hours in space and more than 4,100 hours flying time in jet aircraft.

AIR FORCE LT. COL. SIDNEY M. GUTIERREZ, 39, will serve as Pilot. Selected as an astronaut in 1984, Gutierrez, from Albuquerque, NM, will be making his first space flight.

Gutierrez graduated from Valley High School, Albuquerque, in 1969, received a bachelor of science in aeronautical engineering from the Air Force Academy in 1973 and received a master of arts in management from Webster College in 1977.

He was a member of the Air Force Academy collegiate parachute team while in college with a master parachutist rating and over 550 jumps. After graduating from the Air Force Academy, he was assigned as a T-38 instructor pilot from 1975-1977 at Laughlin Air Force Base, Del Rio, Texas. He attended the Air Force Test Pilot School in 1981 and was assigned to the F-16 Falcon Combined Test Force upon graduation, where he stayed until joining NASA.

At NASA, his duties have included work in the Shuttle Avionics Integration Laboratory and as the lead astronaut for Shuttle software development, verification and future requirements definition. He has logged more than 3,000 hours flying time in 30 different types of aircraft, sailplanes and balloons.

JAMES P. BAGIAN, MD, 39, will serve as Mission Specialist 1 (MS1). Selected as an astronaut in 1980, Bagian is from Philadelphia, Pa., and will be making his second space flight.

Bagian graduated from Central High School, Philadelphia, in 1969, received a bachelor of science in mechanical engineering from Drexel University in 1973 and received a doctorate of medicine from Thomas Jefferson University in 1977.

Bagian worked as a mechanical engineer at the Naval Air Test Center while pursuing his doctorate. Upon graduation, he served a 1-year residency with the Geisinger Medical Center, Danville, Pa. Subsequently, he joined NASA as a flight surgeon, concurrently completing studies at the Air Force Flight Surgeons School and School of Aerospace Medicine, San Antonio, Texas. Bagian is a Lt. Col. in the Air Force Reserve.

After selection as an astronaut, Bagian worked in planning and providing emergency medical and rescue support for the first six Shuttle flights. Bagian served as a mission specialist aboard Discovery on STS-29, March 13-18, 1989, on which the crew deployed a tracking and data relay satellite, conducted a Space Station heat pipe radiator experiment, two student experiments and a chromosome and plant cell division experiment.

BIOGRAPHICAL DATA

TAMARA E. JERNIGAN, Ph.D., 32, will serve as Mission Specialist 2 (MS2). Selected as an astronaut in 1985, Jernigan is from Santa Fe Springs, Calif., and will be making her first space flight.

Jernigan graduated from Santa Fe High School in 1977, received a bachelor of science in physics and a master of science in engineering science from Stanford University in 1981 and 1983, respectively, received a master of science in astronomy from the University of California-Berkley in 1985 and received a doctorate in space physics and astronomy from Rice University, Houston, Texas, in 1988. After selection as an astronaut, Jernigan worked as a spacecraft communicator in Mission Control for five Shuttle flights.

MARGARET RHEA SEDDON, MD, 43, will serve as Mission Specialist 3 (MS3). Selected as an astronaut in 1978, Seddon is from Murfreesboro, TN, and will be making her second space flight.

Seddon graduated from Central High School, Murfreesboro, in 1965, received a bachelor of arts in physiology from the University of California-Berkley in 1970 and received a doctorate of medicine from the University of Tennessee College of Medicine in 1973. She completed a surgical internship and 3 years of general surgery residency in Memphis following graduation.

Seddon served as a Mission Specialist aboard Discovery on STS-51D, April 12-19, 1985. During the flight, the crew deployed three communications satellites and conducted the first unscheduled Shuttle spacewalk to correct a malfunction of one satellite. Seddon has logged 168 hours of space flight.

FRANCIS ANDREW GAFFNEY, MD, 44, will serve as Payload Specialist 1 (PS1). Gaffney will be making his first space flight and his hometown is Carlsbad, NM.

Gaffney graduated from Carlsbad High School in 1964, received a bachelor of arts from the University of California-Berkley in 1968, received a doctor of medicine degree from the University of New Mexico in 1972 and received a fellowship in cardiology from the University of Texas in 1975.

He completed a 3-year medical internship and residency at Cleveland Metropolitan General Hospital, Cleveland, Ohio, in 1975, and went on to receive a fellowship in cardiology at the University of Texas' Southwestern Medical Center in Dallas, becoming a faculty associate and an assistant professor of medicine there in 1979. From 1979-1987, he served as assistant director of echocardiography at Parkland Memorial Hospital, Dallas.

Gaffney served as a visiting senior scientist with NASA from 1987-1989. He is a co-investigator on an experiment aboard STS-40 that studies human cardiovascular adaptation to space flight.

MILLIE HUGHES-FULFORD, Ph.D., 46, will serve as Payload Specialist 2 (PS2). Hughes-Fulford, from Mineral Wells, Texas, will be making her first space flight.

Hughes-Fulford graduated from Mineral Wells High School in 1972, received a bachelor of science in chemistry from Tarleton State University, Stephenville, Texas and received a doctorate in chemistry from Texas Woman's University, Denton, in 1972.

Since 1973, she has worked at the University of California and the Veterans Administration Medical Center, doing extensive research on cholesterol metabolism, cell differentiation, DNA synthesis and cell growth. After assignment by NASA, she has continued her research, concentrating on a study of cellular and molecular mechanisms for bone formation as it relates to space flight.

STS-40 MISSION MANAGEMENT

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Brewster Shaw	Deputy Director, Space Shuttle (Operations)
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Robert Benson	Director, Flight Systems Division
Gary McCollum	Program Manager, SLS Mission

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JoAnn H. Morgan	Director, Payload Project Management
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Dr. J. Wayne Littles	Deputy Director
G. Porter Bridwell	Manager, Shuttle Projects Office
Dr. George F. McDonough	Director, Science and Engineering
Alexander A. McCool	Director, Safety and Mission Assurance
Victor Keith Henson	Manager, Solid Rocket Motor Project
Cary H. Rutland	Manager, Solid Rocket Booster Project
Jerry W. Smelser	Manager, Space Shuttle Main Engine Project
Gerald C. Ladner	Manager, External Tank Project

STENNIS SPACE CENTER, BAY ST. LOUIS, MS

Roy S. Estess	Director
Gerald W. Smith	Deputy Director
J. Harry Guin	Director, Propulsion Test Operations

JOHNSON SPACE CENTER, HOUSTON, TX

Aaron Cohen	Director
Paul J. Weitz	Deputy Director
Daniel Germany	Manager, Orbiter and GFE Projects
Paul J. Weitz	Acting Director, Flight Crew Operations
Eugene F. Kranz	Director, Mission Operations
Henry O. Pohl	Director, Engineering
Charles S. Harlan	Director, Safety, Reliability and Quality Assurance

LANGLEY RESEARCH CENTER, HAMPTON, VA

Richard H. Petersen	Director
W. Ray Hook	Director for Space
William H. Piland	Chief, Space Systems Division
Delma C. Freeman Jr.	Assistant Chief, Space Systems Division

AMES RESEARCH CENTER, MOFFETT FIELD, CA

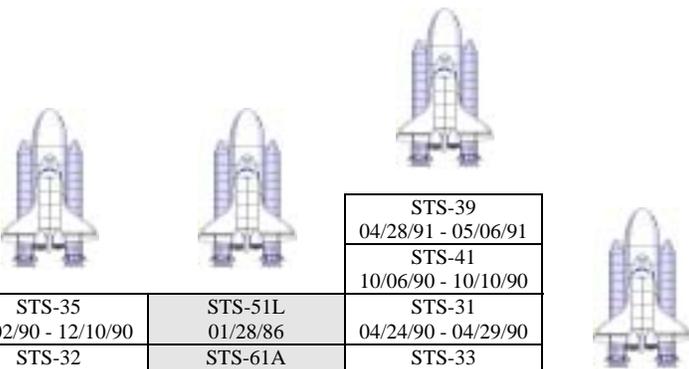
Dr. Dale L. Compton	Director
Victor L. Peterson	Deputy Director
Dr. Steven A. Hawley	Associate Director
Dr. Joseph C. Sharp	Director, Space Research

AMES DRYDEN FLIGHT RESEARCH FACILITY, EDWARDS, CA

Kenneth J. Szalai	Director
T. G. Ayers	Deputy Director
James R. Phelps	Chief, Shuttle Support Office

SHUTTLE FLIGHTS AS OF MAY 1991

40 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 15 SINCE RETURN TO FLIGHT



STS-35 12/02/90 - 12/10/90	STS-51L 01/28/86	STS-39 04/28/91 - 05/06/91	
STS-32 01/09/90 - 01/20/90	STS-61A 10/30/85 - 11/06/85	STS-41 10/06/90 - 10/10/90	
STS-28 08/08/89 - 08/13/89	STS-51F 07/29/85 - 08/06/85	STS-31 04/24/90 - 04/29/90	
STS-61C 01/12/86 - 01/18/86	STS-51B 04/29/85 - 05/06/85	STS-33 11/22/89 - 11/27/89	
STS-9 11/28/83 - 12/08/83	STS-41G 10/05/84 - 10/13/84	STS-29 03/13/89 - 03/18/89	STS-37 04/05/91 - 04/11/91
STS-5 11/11/82 - 11/16/82	STS-41C 04/06/84 - 04/13/84	STS-26 09/29/88 - 10/03/88	STS-38 11/15/90 - 11/20/90
STS-4 06/27/82 - 07/04/82	STS-41B 02/03/84 - 02/11/84	STS-51-I 08/27/85 - 09/03/85	STS-36 02/28/90 - 03/04/90
STS-3 03/22/82 - 03/30/82	STS-8 08/30/83 - 09/05/83	STS-51G 06/17/85 - 06/24/85	STS-34 10/18/89 - 10/23/89
STS-2 11/12/81 - 11/14/81	STS-7 06/18/83 - 06/24/83	STS-51D 04/12/85 - 04/19/85	STS-30 05/04/89 - 05/08/89
STS-1 04/12/81 - 04/14/81	STS-6 04/04/83 - 04/09/83	STS-51C 01/24/85 - 01/27/85	STS-27 12/02/88 - 12/06/88
		STS-51A 11/08/84 - 11/16/84	STS-61B 11/26/85 - 12/03/85
		STS-41D 08/30/84 - 09/05/84	STS-51J 10/03/85 - 10/07/85

**OV-102
Columbia
(10 flights)**

**OV-099
Challenger
(10 flights)**

**OV-103
Discovery
(12 flights)**

**OV-104
Atlantis
(8 flights)**