NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION STS-42

PRESS KIT JANUARY 1992

International Microgravity Laboratory-1 (IML-1)

STS-42 INSIGNIA

STS042-S-001 -- *Designed by the crewmembers, the STS-42 International Microgravity Lab-1 insignia depicts the orbiter with the Spacelab module aboard. The spacecraft is oriented in a quiescent, tail-to-Earth, gravity-gradient attitude to best support the various microgravity payloads and experiments. The international composition of the crew is depicted by symbols representing Canada and the European Space Agency. The number 42 is represented by six white stars, four on one side of the orbiter and two on the other. The single gold star above the Earth's horizon honors the memory of astronaut Manley Lanier (Sonny) Carter, Jr., who was killed in 1991 in a commuter plane crash. A crew spokesperson stated that Carter "...Was our crewmate, colleague and friend." Blue letters set against white give the surnames of the five astronauts and two payloads specialists 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.

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PUBLIC AFFAIRS CONTACTS

Mark Hess/Ed Campion
Office of Space Flight
NASA Headquarters, Washington, DC
(Phone: 202/453-8536)

Mike Braukus/Paula Cleggett-Haleim/Brian Dunbar
Office of Space Science and Applications
NASA Headquarters, Washington, DC
(Phone: 407/453-1547)

Lisa Malone
Kennedy Space Center, FL
(Phone: 407/867-2468)

Mike Simmons
Marshall Space Flight Center, Huntsville, AL
(Phone: 205/544-6537)

James Hartsfield
Johnson Space Center, Houston, TX
(Phone: 713/483-5111)

Jane Hutchison
Ames Research Center, Moffett Field, CA
(Phone: 415/604-9000)

Dolores Beasley
Goddard Space Flight Center, Greenbelt, MD
(Phone: 301/286-7277)

Myron Webb
Stennis Space Center, MS
(Phone: 601/688-3341)

Nancy Lovato
Ames-Dryden Flight Research Facility, Edwards, CA
(Phone: 805/258-3448)

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WORLD-WIDE MATERIALS, LIFE SCIENCE STUDIES HIGHLIGHT

Space Shuttle mission STS-42, the 45th Shuttle flight, will be a world-wide research effort in the behavior of materials and life in weightlessness.

Scientists from NASA, the European Space Agency, the Canadian Space Agency, the French National Center for Space Studies, the German Space Agency and the National Space Development Agency of Japan have cooperated in planning experiments aboard the International Microgravity Laboratory-1 (IML-1) in Discovery's cargo bay. More than 200 scientists from 16 countries will participate in the investigations.

STS-42 will be the 15th flight of Discovery. Commanding the mission will Ron Grabe, Col., USAF. Steve Oswald will serve as pilot. Mission specialists will include Dr. Norm Thagard, MD; Dave Hilmers, Lt. Col., USMC; and Bill Readdy. In addition, Dr. Roberta Bondar, MD and Ph.D., of the Canadian Space Agency and Ulf Merbold of the European Space Agency will serve as payload specialists.

Discovery is currently planned for a 8:54 a.m. EST, Jan. 22, 1992, launch. With an as-planned launch, landing will be at 10:06 a.m. EST, Jan. 29, 1992, at Edwards Air Force Base, Calif.

Along with the IML-1 module, 12 Get Away Special containers will be mounted in Discovery's cargo bay containing experiments ranging from materials processing work to investigations into the development of animal life in weightlessness.

Also aboard Discovery will be the IMAX camera, a large format camera flown on several Shuttle missions as a joint project by NASA, the National Air and Space Museum and the IMAX Film Corporation. On Discovery's lower deck, the Investigations into Polymer Membrane Processing will investigate possible advances in filtering technologies in microgravity, and the Radiation Monitoring Equipment-III will record radiation levels in the crew cabin.

Two experiments developed by students and submitted to NASA under the Space Shuttle Student Involvement Program will fly on Discovery as well. Convection in Zero Gravity, conceived by Scott Thomas while attending Richland High School in Johnstown, Pa., will make a second Shuttle flight to investigate the effects of heat on fluid surface tension in weightlessness. The Zero-G Capillary Rise of Liquid Through Granular Porous Media, conceived by Constantine Costes while he attended the Randolph School in Huntsville, Ala., will investigate how a fluid flows through granular substances in weightlessness.

STS-42 will be the first of eight Space Shuttle flights planned during 1992, five of which will feature international participation.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

STS-42 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 Space Shuttle orbiter and for 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, D.C. The television schedule will be updated to reflect changes dictated by mission operations.

Television schedules also may be obtained by calling the Johnson TV schedule bulletin board, 713/483-5817. The bulletin board 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 ET.

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 briefing schedule will be issued prior to launch. During the mission, change-of-shift briefings by the off-going flight director will occur at least once a day. The updated NASA Select television schedule will indicate when mission briefings are planned to occur.

STS-42 QUICK LOOK FACTS

Launch Date:	Jan. 22, 1991
Launch Site:	Kennedy Space Center, FL, Pad 39A
Launch Window:	8:54 a.m. - 11:24 a.m. EST
Orbiter:	Discovery (OV-103)
Orbit:	163 x 163 nautical miles
Inclination:	57 degrees
Landing Date:	January 29, 1991
Landing Time:	10:06 a.m. EST
Primary Landing Site:	Edwards AFB, CA
Abort Landing Sites:	Return to Launch Site - Kennedy Space Center, FL Transoceanic Abort Landing - Zaragoza, Spain Alternates - Moron, Spain; Ben Guerir, Morocco Abort Once Around - Edwards Air Force Base, CA
Crew:	Ronald J. Grabe, Commander (Blue Team) Stephen S. Oswald, Pilot (Blue Team) Norman E. Thagard, Mission Specialist 1 (Blue Team) William F. Readdy, Mission Specialist 2 (Red Team) David C. Hilmers, Mission Specialist 3 (Red Team) Roberta L. Bondar, Payload Specialist 1 (Blue Team) Ulf D. Merbold, Payload Specialist 2 (Red Team)
Cargo Bay:	IML-1 (International Microgravity Lab-1) GAS Bridge (Get-Away Special Bridge)
Middeck:	GOSAMR-1 (Gelation of Sols: Applied Microgravity Research) IPMP (Investigations into Polymer Membrane Processing) RME-III (Radiation Monitoring Equipment-III) SE-81-09 (Student Experiment., Convection in Zero Gravity) SE-82-03 (Student Experiment, Capillary Rise of Liquid Through Granular Porous Media)

STS-42 TRAJECTORY 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	182	0.16	771
End Roll Maneuver	00/00:00:18	389	0.35	3,164
SSME Throttle to 70%	00/00:00:30	699	0.63	8,963
SSME Throttle to 104%	00/00:01:00	1,408	1.38	36,655
Max. Dyn. Pressure (Max Q)	00/00:01:03	1,471	1.46	38,862
SRB Staging	00/00:02:06	4,195	3.80	155,520
Main Engine Cutoff (MECO)	00/00:08:34	25,000	21.62	376,591
Zero Thrust	00/00:08:40	25,000	N/A	376,909
ET Separation	00/00:08:52			
OMS-2 Burn	00/00:36:12			
Landing	07/01:12:00			

Apogee, Perigee at MECO: 160 x 17 nautical miles
Apogee, Perigee post-OMS 2: 163 x 163 nautical miles

STS-42 SUMMARY OF MAJOR ACTIVITIES

Day One	Ascent Post-insertion Unstow cabin Spacelab activation Transfer science specimens to Spacelab Begin IML-1 experiment operations
Days Two-Six	IML-1 experiment operations
Day Seven	Conclude experiment operations Spacelab deactivation Cabin stow Deorbit burn Landing at Edwards AFB

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, FL; 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 Zaragoza, Spain; Moron, Spain; or Ben Guerir, Morocco.

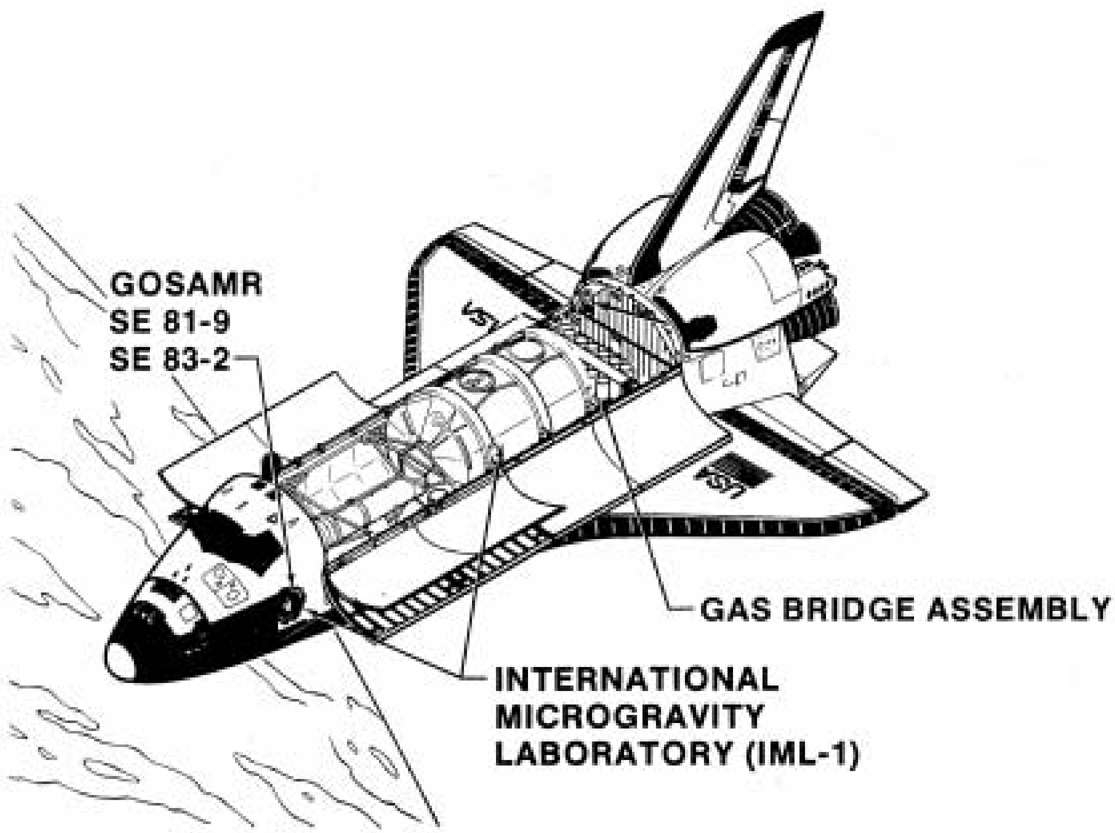
- Return-To-Launch-Site (RTLS) -- Early shutdown of one or more engines without enough energy to reach Zaragoza would result in a pitch around and thrust back toward KSC until within gliding distance of the SLF.

STS-42 contingency landing sites are Edwards AFB, Kennedy Space Center, White Sands, Zaragoza, Moron and Ben Guerir.

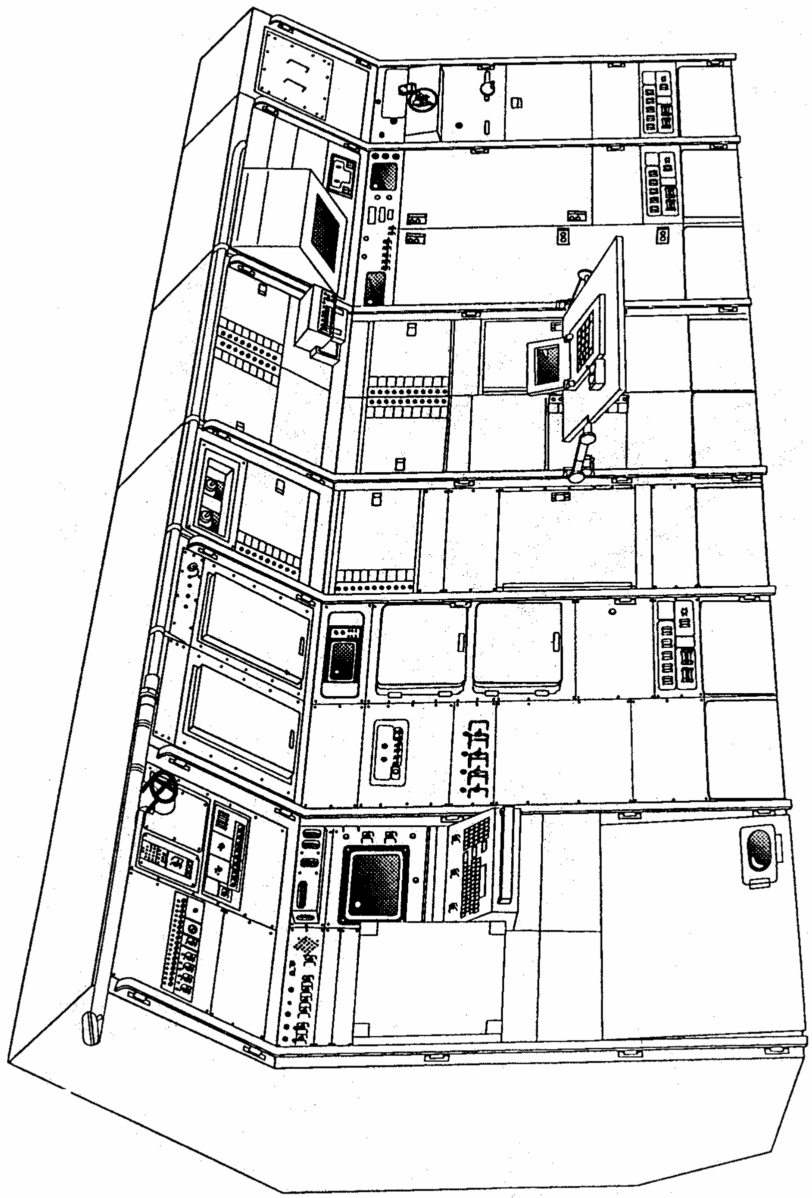
VEHICLE AND PAYLOAD WEIGHTS

	Pounds
Orbiter (Discovery) empty and 3 SSMEs	173,044
International Microgravity Lab-1/ Support Equipment	23,201
Get-Away Special Bridge Assembly	5,185
Gelation of Sols: Applied Microgravity Research-1	70
Investigations of Polymer Membrane Processing	17
Radiation Monitoring Experiment-III	7
Student Experiments	113
DSOs/DTOs	212
Total Vehicle at SRB Ignition	4,509,166
Orbiter Landing Weight	217,251

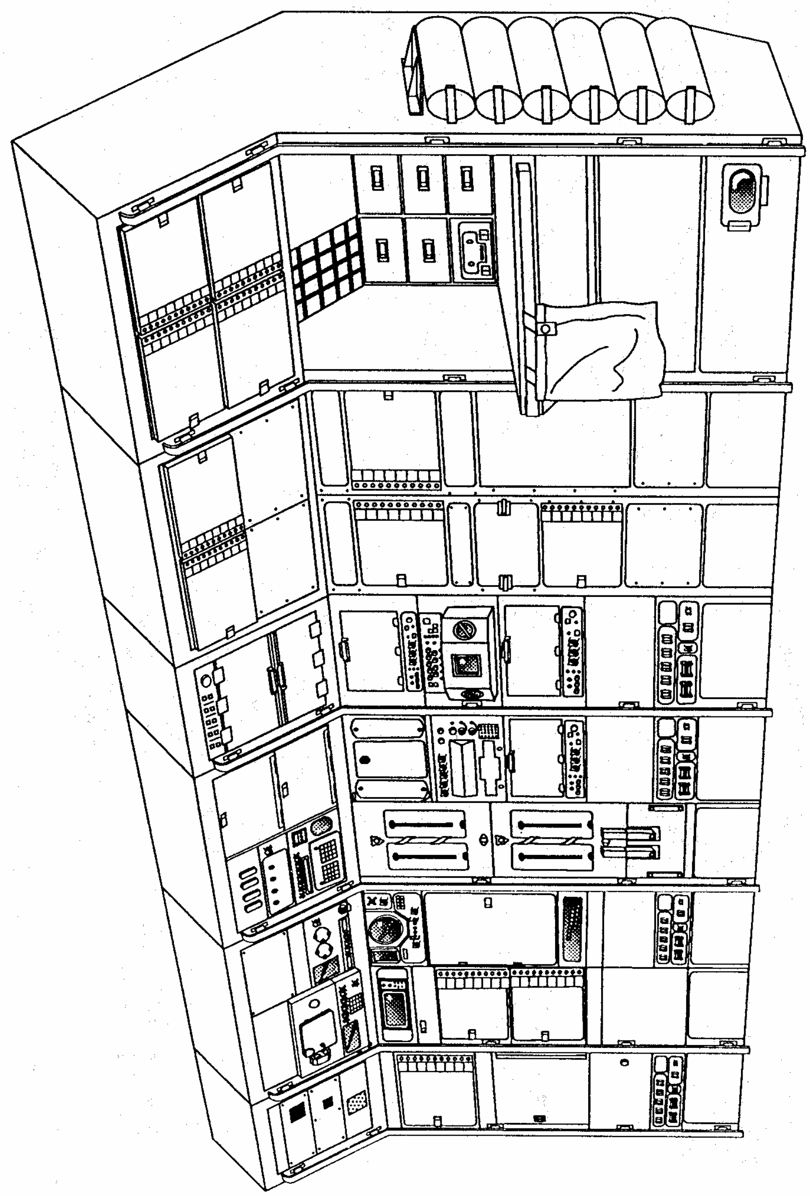
STS-42 CARGO CONFIGURATION



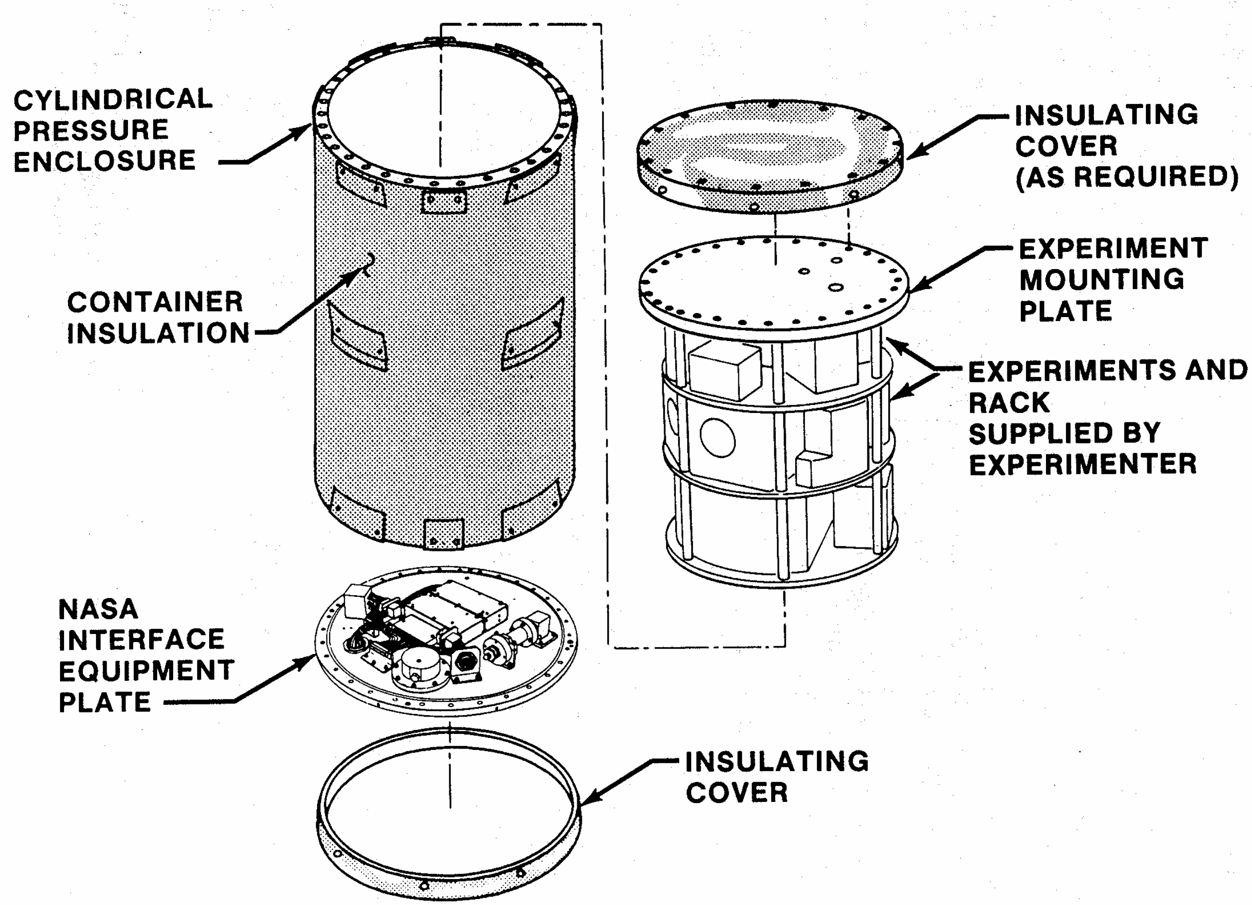
IML-1 STARBOARD SIDE CONFIGURATION



IML-1 PORT SIDE CONFIGURATION



GET AWAY SPECIAL (GAS)
CONTAINER CONCEPT



STS-42 PREFLIGHT PROCESSING

Flight preparations on Discovery for the STS-42 mission began Sept. 27 following its last mission, STS-48, which ended with a landing at Edwards Air Force Base, Calif.

The orbiter spent about 10 weeks in the Orbiter Processing Facility (OPF) bay 3 undergoing checkout and inspections to prepare it for its 14th flight, including the installation of the International Microgravity Laboratory which is the primary payload for mission STS-42.

Space Shuttle main engine locations for this flight are engine 2026 in the no. 1 position, engine 2022 in the no. 2 position, and engine 2027 in the no. 3 position. These engines were installed on October 24-25.

Technicians installed the International Microgravity Laboratory payload into Discovery's payload bay on Nov. 17, while the vehicle was in the OPF. The payload was closed out for flight in the OPF on Dec. 9.

The Crew Equipment Interface Test with the STS-42 flight crew was conducted in the OPF on Dec. 4. The crew became familiar with the configuration of the orbiter, the IML payload and unique equipment for mission STS-42.

Booster stacking operations on mobile launcher platform 3 began Oct. 1, and were completed by Oct. 21. The external tank was mated to the boosters on Nov. 4 and the orbiter Discovery was transferred to the Vehicle Assembly Building on Dec. 12, where it was mated to the external tank and solid rocket boosters.

The STS-42 vehicle was rolled out to Launch Pad 39-A on Dec. 19. A dress rehearsal launch countdown with the flight crew members was scheduled for Jan. 6-7 at KSC.

A standard 43-hour launch countdown was scheduled to begin 3 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 2 and one-half hours before liftoff, the flight crew will begin taking their assigned seats in the crew cabin.

Landing is planned at Edwards Air Force Base, Calif., because of the heavier weight of the vehicle returning with the IML tucked inside its payload bay. KSC's landing convoy teams will be on station to safe the vehicle on the runway and prepare it for the cross-country ferry flight back to Florida. Five days are planned at Dryden Flight Research Facility and a 2-day ferry flight is scheduled.

Once back in Florida, Discovery will be taken out of flight status for the next 8 and a half months while undergoing major modifications, upgrades and required inspections. The shuttle processing team will perform this work on Discovery in the OPF. Discovery's 15th space flight is planned in the fall on Mission STS-53, a Department of Defense flight.

IML-1 SCIENCE OPERATIONS

IML-1 science operations will be a cooperative effort between the Discovery's crew in orbit and mission management, scientists and engineers in a control facility at the Marshall Space Flight Center. Though the crew and the ground-based controllers and science teams will be separated by many miles, they will interact with one another in much the same way as they would if working side by side.

This degree of interaction is made possible by the ready availability of digital data, video and voice communications between the Shuttle and the Spacelab Mission Operations Control facility at Marshall. With these links, controllers and experiment scientists can talk to the orbiting Spacelab crew, visually monitor crew and experiment activities, receive data from the experiments and send commands directly to Spacelab to make adjustments to experiment hardware, parameters or protocols.

The result is a highly effective level of teamwork in sharing information about experiments, monitoring and evaluating data, solving problems which may arise during the mission and revising experiment plans to take advantage of unexpected research opportunities.

Many IML-1 experiments require a very smooth ride through space so that their delicate operations will not be disturbed. Therefore, when the Space Shuttle Discovery achieves its orbit of approximately 184 statute miles, it will be placed into a "gravity-gradient stabilized" attitude with its tail pointed toward Earth. This allows the orbiter's position to be maintained primarily by natural forces and reduces the need for frequent orbiter thruster firings which would disturb sensitive experiments.

To complete as many experiments as possible, the crew will work in 12-hour shifts around the clock. The first hours of the mission will be especially busy. The payload crew will begin the mission by setting up equipment and turning on equipment facilities. Because the Spacelab module is placed in the Shuttle's cargo bay weeks before launch, critical biological and materials samples, which degrade quickly, will be loaded into crew-cabin lockers a few hours before liftoff. Orbiter and payload crew members will transfer these samples to experiment facilities in the laboratory before science operations are begun.

During the first days of the mission, the payload crew will activate critical biological and material experiments and set up those involving plants, cells and crystals. Much of the crew time throughout the mission will be devoted to experiments which measure how their own bodies adapt to living in space. In the middle of the mission, processing research will be continued and experiments which require precisely timed activities will be carried out. Experiments also will continue with plants, cells and other biological specimens. The crew will check investigations periodically, make adjustments needed to enhance results and when necessary, replace specimens or preserve them for ground-based analysis. The payload crew aboard Spacelab will use both voice and video links to consult with scientists on the ground during critical operations and to modify experiments as required.

The last days will be spent completing investigations. The crew will repeat some experiments performed earlier in the mission to measure how their bodies have adapted to space over the course of the flight. On the final day, they will turn off the equipment, store samples and specimens and prepare the laboratory for landing.

Complete analysis of all the data acquired during the mission may take from a few months to several years. Results will be shared with the worldwide scientific community through normal publication channels.

IML-1 LIFE SCIENCES EXPERIMENTS

BIORACK

Biorack will advance our knowledge of the fundamental behavior of living organisms. Broadly speaking there are five areas of research to be addressed by Biorack: cell proliferation and differentiation, genetics, gravity sensing and membrane behavior. The cells to be examined will include those of frogs, fruit flies, humans and mice. Exposure to microgravity will alter the regulatory mechanisms at a cellular level. The facilities aboard Biorack allow manipulation and study of large numbers of cells. Over the 7-day mission in space, these cells can be observed at various stages of their development. Specimens can be preserved at those stages and returned to Earth for detailed analysis.

Leukemia Virus Transformed Cells to Microgravity in the Presence of DMSO

Provided by the European Space Agency (ESA)

Principal Investigator:
Augusto Cogoli
ETH Institute of Biotechnology Space Biology Group
Zurich, Switzerland

This is one of three Biorack experiments being flown on the IML-1 mission as part of an investigation to study cell proliferation and performance in space. The purpose of this particular experiment is to study the adaptation of living cells to microgravity.

Previous experiments have shown that blood cells -- both white blood cells that fight infection and red blood cells that transport oxygen throughout the body -- are sensitive to gravity. On Earth, cells that normally would differentiate to become blood cells are sometimes transformed by the leukemia virus and become cancerous Friend leukemia cells.

Such cells do not produce hemoglobin, which plays an essential role in oxygen transport. But when exposed to a drug called dimethylsufoxide (DMSO), Friend cells produce hemoglobin. By studying these cells in microgravity, scientists may determine how the gene responsible for hemoglobin synthesis is regulated.

Proliferation and Performance of Hybridoma Cells in Microgravity (HYBRID)

Provided by ESA

Principal Investigator:
Augusto Cogoli
ETH Institute of Biotechnology Space Biology Group
Zurich, Switzerland

This experiment is one of three Biorack experiments being flown in the IML-1 mission as part of an investigation to study cell proliferation and performance in space. The purpose of this experiment is to study how cell performance (biosynthesis and secretion) is altered by altered gravity conditions. If cells produce material more rapidly in space, it may be practical to manufacture some pharmaceutical products in space.

Hybridoma cells are obtained by fusion of activated white blood cells (B-lymphocytes) with cancerous tumor cells (melanoma cells). Activated B-lymphocytes, derived from a human or an animal, carry the information required to produce antibodies of a certain specificity and can survive only a few days in culture. Myeloma cells are tumor cells which can grow indefinitely in culture. Therefore, the product of the fusion is a continuing cell line capable of producing homogeneous antibodies (monoclonal antibodies) more rapidly than white blood cells alone. Growing these cell cultures in microgravity will allow scientists to compare the amount of their antibody secretions to those grown on Earth.

Dynamic Cell Culture System (CULTURE)
Provided by ESA

Principal Investigator:
Augusto Cogoli
ETH Institute of Biotechnology Space Biology Group
Zurich, Switzerland

This experiment is one of three IML-1 Biorack experiments as part of an investigation studying cell proliferation and performance in space. One of the objectives is to assess the potential benefits of bioprocessing in space with the ultimate goal of developing a bioreactor for continuous cell cultures in space. This experiment will test the operation of an automated culture chamber, the Dynamic Cell Culture System (DCCS), that was designed for use in a bioreactor in space.

The DCCS is a simple device for cell cultures in which media are reviewed or chemicals are injected automatically by means of osmotic pumps. As culture nutrients flow into the cell container, old medium is forced out. The system is designed to operate automatically for 2 weeks.

Chondrogenesis in Micromass Cultures of Mouse Limb Mesenchyme Exposed to Microgravity (CELLS)
Provided by NASA

Principal Investigator:
Dr. P. J. Duke
Dental Science Institute University of Texas
Houston, TX

This investigation studies the effect of microgravity on cartilage formation by embryonic mouse limb cells in culture. The susceptibility of cartilage cells to gravitational changes is well documented. Cartilage impairments found in rodents flown on previous space flights are similar to those observed in skeletal malformations in children. Among these are changes in the collagen molecules -- the major support fibers of cartilage and bone. By studying how gravity affects cartilage formation, scientists may learn subtle aspects of cartilage development on Earth.

This experiment also may help clarify how bones heal in space. Fracture healing involves a cartilage stage prior to formation of bone. Soviet experience indicates that a bone broken by an astronaut during a 3-year mission to Mars will not heal properly. Cartilage formation, which is the subject of this experiment, is part of the healing process.

Effects of Microgravity and Mechanical Stimulation on the In-Vitro Mineralization and Resorption of Fetal Mouse Bones (BONES)
Provided by ESA

Principal Investigator:
Dr. Jacobos-Paul Veldhuijzen
ACTA Free University
Amsterdam, The Netherlands

Astronauts experience a loss of minerals from their bones during exposure to the microgravity of space. If calcium loss continues indefinitely during space flight, the likelihood that crew members will break these weakened bones increases the longer a mission lasts. Significant calcium loss also affects a person's ability to function in Earth's gravity after a mission. Before long spaceflights can be planned, the effects of microgravity on bone growth, maintenance and repair must be understood.

In this experiment, scientists will study the response to microgravity of embryonic mouse leg bones. Scientists postulate that the uncompressed cultures grown outside the centrifuge (under microgravity conditions) should respond like bones that are unstressed in a weightless environment. To test this hypothesis, both the microscopic structure and the biochemical make-up of the cultures are analyzed to determine their mineralization and resorption rates.

Why Microgravity Might Interfere With Amphibian Egg Fertilization and the Role of Gravity in Determination of the Dorsal/Ventral Axis in Developing Amphibian Embryos (EGGS)
Provided by ESA

Principal Investigator:
Dr. Geertje A. Ubbels
Hubrecht Laboratory
Utrecht, The Netherlands

Scientists are not sure what role gravity plays in the earliest stages of embryonic development that determine the future front and back sides of the body. This experiment may help scientists clarify the role of gravity by studying fertilization of eggs and embryo formation of frogs in space.

Before fertilization, each frog egg is positioned inside a sticky membrane that holds the parts of the egg random with respect to gravity. After the egg is fertilized, gravity aligns the lightest part of the egg (the part with the least yolk) up and the heaviest part of the egg (with the most yolk) down.

In normal cases, the sperm's point of entry will become the front side of the embryo. However, if gravity disturbs the yolk distribution inside the fertilized egg, this may not happen. Scientists want to confirm that in space the sperm entrance point always becomes the front side of the embryo.

Eggs of the African clawed frog, Xenopus laevis, will be fertilized in space, incubated and preserved during various phases of embryonic development. A similar experiment will be performed on a centrifuge in the Spacelab that produces the force of normal Earth gravity. Post-flight, the samples will be compared to see if fertilization and development proceeded normally.

Effects of Space Environment on the Development of Drosophila Melanogaster (FLY)
Provided by ESA

Principal Investigator:
Roberto Marco
Department of Biochemistry, UAM Institute of Biomedical Investigations CSIC
Madrid, Spain

This experiment involves the study of the development of eggs of the fly Drosophila (fruit fly) exposed to microgravity. It is presumed that cogenesis, rather than further states of embryonic development, is sensitive to gravity. This hypothesis will be tested by collecting eggs laid at specific times in-flight and postflight from flies exposed to 0-g and 1-g. This portion of the experiment is a repetition of an earlier experiment flown in Biorack during the D1 Spacelab mission in November 1985. An added feature of the experiment for the IML-1 mission is to study the effect of microgravity on the life span of Drosophila male flies. In this way more information will be gathered on the processes affected by microgravity in complex organisms.

Genetic and Molecular Dosimetry of HZE Radiation (RADIAT)
Provided by NASA

Principal Investigator:
Dr. Gregory A. Nelson
NASA Jet Propulsion Laboratory
Pasadena, CA

One of the major features of the space environment is the presence of cosmic rays or HZE (high energy and charge) particles. Although they account for only about one percent of the radiation particles in space, they constitute about half of the total absorbed radiation dose. The experiment's purpose is to understand the biological effects of exposure to cosmic rays to protect space travelers on long missions. Exposure may place astronauts at risk for certain medical problems, such as cataracts, mutations and cancers.

A microscopic soil nematode (roundworm) will be used to "capture" mutations caused by cosmic rays, to evaluate whether certain genetic processes occur normally in space, and to test whether development and reproduction proceed normally in microgravity for up to three generations.

The nematode used in this experiment is a small (maximum size 1 mm), transparent, free-living soil organism. Although small, it possesses most of the major organ systems and tissues found in other animals, including mammals. The worms are placed in containers with detectors that record the number of HZE particles and the total radiation dose. After the mission, the worms are examined for genetic mutations and development progress.

Dosimetric Mapping Inside Biorack (DOSIMTR)
Provided by German Aerospace Research Establishment (DLR)

Principal Investigator:
G. Reitz
Institute for Flight Medicine
Cologne, Germany

The IML-1 experiments are done in an environment with electromagnetic radiation, charged particles and secondary radiation. This flux is not constant but changes with spacecraft inclination and altitude, solar activity and Earth's magnetic field.

The purpose of this experiment is to document the radiation environment inside the Biorack and to compare the experimental data with theoretical predictions. It will provide documentation of the actual nature and distribution of the radiation inside Biorack. Special emphasis is given to measuring the radiation environment in the neighborhood of those experiments which might be especially critical to radiation effects, and so have a way of determining if changes to samples are caused by radiation or microgravity.

Embryogenesis and Organogenesis of Carausius (MOROSUS)
Provided by DLR

Principal Investigator:
H. Buecker
Institute for Flight Medicine
DLR, Cologne, Germany

Before humans can live for extended periods of time in space, the effects of microgravity and long-term exposure to radiation on living organisms must be known.

This experiment will study the influence of cosmic radiation, background radiation and/or low gravity on stick insect eggs (Carausius morosus) at early stages of development. Sandwiched between detectors, the eggs hit by radiation can be determined precisely. Other detectors allow scientists to determine the nature, energy and direction of the incident particles.

Flown previously in Biorack during the D1 Spacelab mission (November 1985), this experiment has shown that the larvae from all eggs penetrated by heavy ions under microgravity had shorter life spans and an unusually high rate of deformities.

Gravity Related Behavior of the Acellular Slime Mold Physarum Polycephalum (SLIME)
Provided by DLR

Principal Investigator:
Ingrid Block
Institute for Flight Medicine, DLR
Cologne, Germany

Many living things, including people, perform various activities, such as sleeping, at regular periods. Scientists are not certain whether these activities are controlled by an internal biological clock or by external cues such as day and night cycles or gravity. In space, these cues are absent, and investigators can examine organisms to see if these functions occur in regular circadian time frames.

Physarum polycephalum, a slime mold that lives on decaying trees and in soil, has regular contractions and dilations that slowly move the cell. On Earth, gravity modifies the direction of cell movement. Any direct effects of microgravity should alter this movement and be evident as a change in circadian rhythm.

After the mission, IML-1 data will be compared with results from the Spacelab D1 mission. These results revealed that the frequency of the contractions was slightly shortened at first but returned to normal as the slime mold adapted to microgravity.

Microgravitational Effects on Chromosome Behavior (YEAST)
Provided by NASA

Principal Investigator:
Dr. Carlo V. Bruschi
Cell and Molecular Biology Division, Lawrence Berkeley Laboratory
Berkeley, CA

Scientists have measured the effects of microgravity and radiation on DNA and chromosomes in many different organisms. They have learned that microgravity alters chromosome structure during mitosis or normal cell division to produce new cells. Changes in DNA structure caused by radiation are then passed on during meiosis or cell division by reproductive cells that reduces the number of chromosomes.

In this experiment, the effects of microgravity and radiation are monitored separately in the same organism by measuring genetic damage during mitosis and meiosis of common brewer's yeast. By employing both normal and radiation- sensitive cells, scientists can monitor frequencies of chromosomal loss, structural deformities and DNA mutation rates with a resolution impossible in higher organisms. Because yeast chromosomes are small, sensitive measurements can be made that can be extrapolated to higher organisms, including humans.
Post-flight genetic studies of cells incubated in space will examine chromosome abnormalities, preference for sexual versus asexual reproduction and viability of gametes.

Growth and Sporulation in Bacillus Subtilis Under Microgravity (SPORES)
Provided by ESA

Principal Investigator:
Horst-Dieter Menningmann
Institute of Microbiology, University of Frankfurt
Frankfurt am Main, Germany

Cell differentiation -- the way that cells with different functions are produced -- normally does not occur in simple organisms like bacteria. However, some bacteria such as Bacillus subtilis, wrap up part of their cellular content into special structures called spores. Sporulation, resulting from the distribution of a particular enzyme, is considered to represent a very simple type of differentiation.

This experiment is aimed at measuring growth and sporulation of Bacillus subtilis bacteria under microgravity conditions. The influence of microgravity on enzyme distribution and the way the enzyme acts in the absence of gravity are studied by examining the structure and biochemistry of the spores after the mission.

Studies on Penetration of Antibiotics in Bacterial Cells in Space Conditions (ANTIBIO)
Provided by ESA

Principal Investigator:
Rene Tixador
National Institute of Health and Medical Research
Toulouse, France

In space, bacteria may be more resistant to antibiotics because the structure of their cell walls may be thicker in microgravity. This wall is a barrier between the drug and target molecules in the cell, and a thicker wall could be more effective in preventing antibiotics from destroying bacteria. The increased resistance of bacteria to antibiotics, together with their increased proliferation, is of prime importance for the future of very long duration space flight.

This experiment will study the effects of antibiotics in bacterial cells cultivated "in vitro" in space conditions. Proliferation rates of bacteria exposed to antibiotics will then be compared to those that were not exposed and to sets of bacteria grown on the ground.

Transmission of the Gravity Stimulus in Statocyte of the Lentil Root (ROOTS)
Provided by ESA

Principal Investigator:
Gerald Perbal
Laboratory of Cytology, Pierre et Marie Curie University
Paris, France

The purpose of this experiment is to study the growth of lentil seedlings to gain understanding of that organism's mechanism of gravity perception. On Earth, the roots of most plants can clearly perceive gravity since they grow downward. In space, under microgravity conditions, previous results from the D1 mission on Spacelab (November 1985) have shown that roots loose their ability to orient themselves. Exposed to 1 g, the roots reorient themselves in the direction of the simulated gravity.

The experiment flown on IML-1 is aimed at determining the minimum amount of simulated 1-g exposure required for the plants to regain gravity sensitivity and reorient roots.

Genotype Control of Graviresponse, Cell Polarity and Morphological Development of Arabidopsis Thaliana in Microgravity (SHOOTS)
Provided by ESA

Principal Investigators:
Edmund Maher
Open University of Scotland
Edinburgh, Scotland

Greg Briarty
University of Nottingham
Nottingham, England

It is of high interest to determine what might be the long-term effects of microgravity on the growth of plants. The aim of this two-part experiment will be to quantify the structural and behavioral changes taking place in germinating seeds of the small plant Arabidopsis thaliana. One strain of this species, the wild type, is gravitropic. Its roots grow down and its shoots grow up. Another strain, aux-1, is an agravitropic mutant. Its roots and shoots grow in any direction.

One experiment will examine the differences in root and shoot development and orientation between these two strains. The other experiment will investigate the effects of growth in microgravity on the polarity of the cells containing gravity sensors (statocytes). It also will investigate its influence on the structure, orientation and distribution of their amyloplasts.

Effects of Microgravity Environment on Cell Wall Regeneration, Cell Divisions, Growth and Differentiation of Plants From Protoplasts (PROTO)
Provided by ESA

Principal Investigator:
Ole Rasmussen
Institute of Molecular Biology and Plant Physiology, University of Aarhus
Aarhus, Denmark

An essential basis for prospective biological experiments in space and for man's stay in space is the existence of a profound and exact knowledge of how growth and development of living cells proceed under microgravity. Only in a few cases is the influence of gravity on living cells known.

It is the aim of this study to provide basic knowledge on the development of plant cells under microgravity conditions. This knowledge is essential if plants are to be cultured in space to produce food, enzymes, hormones and other products.

For this experiment, plant cells from carrots (Daucus carota) and a fodder plant, rape (Brassica napus) are prepared to make them into protoplasts, plant cells in which the cell walls have been removed. During the mission, a culture of protoplasts from each gravity environment is analyzed to determine whether the cell walls are reforming and whether the cells are dividing. They are later compared to plants grown from protoplasts that developed on the ground.

GRAVITATIONAL PLANT PHYSIOLOGY FACILITY EXPERIMENTS

Gravitational Plant Physiology Facility

NASA Ames Research Center Mountain View, CA

The Gravitational Plant Physiology Facility (GPPF), which houses the two IML-1 plant experiments, was designed and built in 1984 by the University of Pennsylvania. All hardware testing and payload implementation were provided by NASA Ames Research Center. The GPPF includes four centrifuges, lights, three videotape recorders and plant-holding compartments described below.

The control unit serves both experiments and contains a microprocessor that controls the operation of the rotors (centrifuges), cameras, recording and stimulus chamber (REST) and videotape recorders.

Two culture rotors operate independently at the force of gravity (1g) to simulate Earth's gravitational field. Two variable-speed test rotors provide accurately controlled centripetal forces from 0g to 1g. Seedlings in plant cubes are placed in the rotors.

The REST provides the capability for time-lapse infrared video recording of plant positions in four FOTRAN cubes, both before and after exposure to blue light.

The Mesocotyl Suppression Box (MSB) is located in the upper left of the GPPF double rack. It is used only for oat seedlings in the Gravity Threshold experiment. The MSB exposes the seedlings to red light, which suppresses the growth of the plant mesocotyl and makes them grow straight.

The Plant Carry-on Container will hold 36 cubes, cushioned in foam for launch, plus soil trays for in-flight plantings.

Gravity Threshold (GTHRES)

Principal Investigator:

Dr. Allan H. Brown
University of Pennsylvania
Philadelphia, PA

This experiment investigates the changes that occur when oat plants are exposed to different levels and durations of gravity. It studies how a growing plant responds to altered gravitational fields and how microgravity affects a plant's structure. Four centrifuges in the Gravitational Plant Physiology Facility are used to determine the sensitivity and threshold of the gravity-detecting mechanism of oat plants. Seedlings used early in the experiment germinate on the ground. For specimens used later in the mission, a crew member plants seeds in soil supplied with the right amount of water, and germination occurs in space.

Once in flight, some of the plants, in light-tight plant cubes, are transferred to one of two centrifuges that produce a force equivalent to the force of normal Earth gravity (1g). These plants continue to develop normally under the 1g force until they are ready to be used in the experiment. Others are maintained in microgravity until ready to be used in the experiment.

The plant cubes then are placed on either of two other centrifuges to expose them to various combinations of acceleration durations. This allows scientists to study gravitational forces from 0.1g to 1g without interference from the constant 1g force present on Earth.

Plant images are recorded by two time-lapse video cameras using infrared radiation. The video, plant samples and other data are stored for post-flight analyses. Some plants will be fixed, or preserved, during the mission for comparison with seedlings grown on the ground.

Response to Light Stimulation: Phototropic Transients (FOTRAN)

Principal Investigator:

Dr. David G. Heathcote
University City Science Center
Philadelphia, PA

This experiment investigates how plants respond to light (phototropism) in microgravity and the impact of microgravity on two other types of plant behavior. The first, nutation, is the rhythmic curving movement of plants caused by irregular growth rates of plant parts. The second, autotropism, is the straightening often observed in plants that were curved during tropic or nutational movements. These growth patterns occur naturally on Earth. Scientists want to learn details of how the movements change in microgravity.

The experiment uses wheat seedlings planted both before and during the mission. When they have reached the appropriate size, the seedlings are exposed to a pulse of blue light. Ground studies have shown blue light to be an effective way to evoke a phototropic response. Different groups of seedlings receive different durations of exposure to light.

The seedlings' responses are monitored by an infrared-sensitive, time-lapse video camera and recorded for later analysis. Some samples are preserved chemically for study after the mission ends. Gas samples are taken from the plant cubes for post-flight analysis of the environmental conditions during the plants' growth.

MICROGRAVITY VESTIBULAR INVESTIGATIONS

Twenty investigators representing major universities and research facilities from five countries have joined forces to better examine the effects of spaceflight on the human orientation system with the Microgravity Vestibular Investigations (MVI).

The vestibular system, using the stimulus of gravity and motion-detecting organs in the inner ear, provides input to the brain for orientation. When environmental conditions change so the body receives new stimuli, the nervous system responds by interpreting the sensory information. In the absence of gravity, however, input from the sensors is changed, prompting the nervous system to develop a new interpretation of the stimuli.

MVI, led by Dr. Millard F. Reschke, senior scientist at the Johnson Space Center, examines the effects of microgravity on the vestibular system. By provoking interactions among the vestibular, visual and proprioceptive systems and measuring the perceptual and sensorimotor reactions, scientists can study the changes that are integral for the adaptive process.

For the investigations, STS-42 crew members will be placed in a rotating chair with a helmet assembly outfitted with accelerometers to measure head movements and visors that fit over each eye independently to provide visual stimuli. The chair can be configured so that the subject can be sitting upright, lying on his side or lying on his back. The chair system has three movement patterns: "sinusoidal" or traveling predictably back and forth over the same distance at a constant speed, "pseudorandom" or moving back and forth over the varying distances and "stepped" or varying speeds and beginning and stopping suddenly. The test sequences will study the effect of microgravity on six physiological responses, including the eye's ability to track an object, the perception of rotation during and after spinning, function of the motion and gravity sensing organs in the inner ear, the interaction between visual cues and vestibular responses and sensory perception. Crew members will be tested both pre- and post-flight to establish a comparison for the in-flight measurements.

Results from the MVI experiments will aid in designing appropriate measures to counteract neurosensory and motion sickness problems on future spaceflights.

MENTAL WORKLOAD AND PERFORMANCE EXPERIMENT

The Mental Workload and Performance Experiment will study the influences of microgravity on crew members performing tasks with a computer workstation.

The STS-42 crew will use a redesigned workstation with an adjustable surface for their daily planning sessions and record keeping. Cameras will record the crew's range of motion and variety of positions while at the workstation. During tests of mental function, reaction times and physiological responses, crew members will evaluate a portable microcomputer. The microcomputer with its display monitor and keyboard is attached to a Spacelab handrail and positioned in the most convenient location. The crew member will memorize a sequence of characters, then move the cursor to the target with keyboard cursor keys, a two-axis joystick and a track ball. The crew will perform the activities several times before and after the mission to provide a comparison for the in-flight experiments.

CANADA'S PARTICIPATION IN IML-1

Canadian astronauts Drs. Roberta Bondar and Ken Money are the Canadian prime and alternate payload specialists, respectively, for the first International Microgravity Laboratory (IML-1) mission.

The Canadian Space Physiology Experiments (SPE) on IML-1 will investigate human adaptation to weightlessness and other phenomena. The human vestibular and proprioceptive (sense of body position) systems, energy expenditure, cardiovascular adaptation, nystagmus (oscillating eye movement) and back pain in astronauts will be studied.

SPACE PHYSIOLOGY EXPERIMENTS

Space Adaptation Syndrome Experiments (SASE)

Principal Investigator:

Douglas G. D. Watt, Ph.D.
McGill University
Montreal, Quebec

Many astronauts experience space adaptation syndrome, which may include illusions, loss of knowledge of limb position, nausea and vomiting. These symptoms may occur because of conflicting messages about body position and movement which the brain receives from the eyes, the balance organs of the inner ear and gravity sensing receptors in the muscles, tendons, and joints. Seven investigations to study the nervous system's adaptation to microgravity have been developed.

Sled Experiment

This investigation measures changes in the gravity sensing part of the inner ear, the otolith organ. Normally, this organ provides a sense of up and down and helps us stand upright by means of reflexes leading to muscles in the body. In microgravity, the otolith organ produces modified signals and the nervous system must either learn to reinterpret this information or ignore it entirely.

Subjects are strapped into a seat on a device known as the mini-sled. The seat glides gently back and forth, providing a stimulus to the otolith organ. Audio and visual stimuli are eliminated, and small electric impulses are applied to the subject's leg with an electrode. Responses to these impulses are measured.

The stimulus to the inner ear affects the response to the electric impulses. Measurements of the modulations of the responses are gathered to determine whether the nervous system learns to reinterpret the different signals or learns to ignore them.

Rotation Experiment

The semicircular canals are the rotation-sensing part of the inner ear and provide the nervous system with information used to stabilize gaze and vision despite rapid or random head movements. In microgravity, this vestibulo-ocular reflex may be less effective due to the interaction between the semicircular canals and the otolith organ.

Head and eye movements are recorded as the subject sits strapped onto the stationary mini-sled. Two tests are conducted involving the subject's ability to keep closed eyes fixed on a predetermined target while either rotating the head or moving it up and down. A third test requires subjects to shift their gaze to a series of targets projected onto a screen. This studies coordination between eye and head movements.

Visual Stimulator Experiment

This investigation measures the relative importance of visual and balance organ information in determining body orientation. In space, exposure to a rotating visual field results in a sensation of self-rotation known as "circularvection." On Earth, the otolith organ acts to limit this sensation.

The subject stares into an umbrella-shaped device with a pattern of colored dots while strapped onto a stationary mini-sled. The visual stimulator turns in either direction at three different speeds. The subject's self-perceived body motion is tracked. The greater the false sense of circularvection, the more the subject is relying on visual information instead of otolith information.

Proprioceptive Experiments

These four experiments will investigate the effect of microgravity on the proprioceptive system which provides the sense of position and movement of the body and the limbs. A variety of receptors located in the muscles, tendons and joints contribute information.

Previous spaceflights suggest that crew members experience a decreased knowledge of limb position and while performing certain movements, experience illusions such as the floor moving up and down. It also has been shown that the vertebrae in the spine spread apart, possibly leading to partial nerve block. Closer investigations of these phenomena form the basis of these experiments.

Two of the proprioceptive experiments involve measuring knowledge of limb position and determining the ability to point at a target in weightlessness. Subjects are blindfolded in both experiments. A third experiment investigates how visual and tactile stimuli may affect illusions, while the fourth experiment measures tactile sensitivity in a finger and a toe to determine if any sensory nerve block develops during spaceflight.

Energy Expenditure in Spaceflight (EES)

Principal Investigator:

Dr. Howard G. Parsons
University of Calgary
Calgary, Alberta, Canada

It is necessary to have accurate information on the amount of energy expended in spaceflight to design proper fitness and nutrition programs for astronauts. A new technique has been developed which requires analysis of urine samples taken during the test period and measurement of the amount of carbon dioxide produced by the body. Energy expenditure then can be calculated and changes in body composition such as fat content and muscle mass can be estimated.

Subjects drink water enriched with stable, non-radioactive isotopes of oxygen and hydrogen both at the start of the mission and immediately post-flight. The isotopes can be traced in the urine and then measured to determine energy expenditure. Amount of body water and therefore body composition is calculated by dilution of the stable oxygen isotope.

Position and Spontaneous Nystagmus (PSN)

Principal Investigator:

Dr. Joseph A. McClure
London Ear Clinic
London, Ontario, Canada

Nystagmus is the normal oscillatory scanning motion of the eye. The vestibular system of the inner ear is closely related to nystagmus. When the inner ear is dysfunctional, it no longer gives the right signals to the eye, resulting in a different type of eye movement which could be accompanied by dizziness and blurred vision. Analysis of the nystagmus is a powerful tool in diagnosing problems of the inner ear.

Two types of nystagmus will be investigated: spontaneous, where the eye oscillates at the same rate regardless of head position, and positional, where the oscillation varies according to head position. The goal is to determine whether it is possible for both types to occur simultaneously in the same individual. The ultimate aim is to improve detection and treatment of inner ear disorders.

Gravity is the determining factor in positional nystagmus. Eye movement is measured in microgravity. If a subject who has positional nystagmus on Earth shows no sign of it in space, it proves the two types of nystagmus are superimposed on one another. This information will improve diagnosis of inner ear disorders on Earth.

Measurement of Venous Compliance & Evaluation of an Experimental Anti-Gravity Suit (MVC)

Principal Investigator:

Dr. Robert B. Thirsk
Canadian Space Agency
Ottawa, Ontario, Canada

A loss of blood volume and other body fluids during spaceflight has been suggested as the primary cause of the lowering of the cardiovascular system's ability to withstand Earth's gravitational force field. Unprotected astronauts may feel tired and dizzy, lose peripheral vision or faint upon returning to Earth. Drinking salt solutions and wearing anti-gravity suits which are inflated during re-entry through the atmosphere have been shown to combat this after-effect of spaceflight.

One feature of this experiment will measure the venous compliance (tone of the veins) before, during and after the mission. Being able to determine how veins adapt to microgravity will be useful to engineers who design anti-gravity suits. Veins in the lower leg are measured using an electronic monitor and two large blood pressure cuffs that encircle the thigh and calf, altering the pressure by inflating the cuffs. Ensuing changes in blood volume in the veins are determined.

The evaluation of an experimental anti-gravity suit is another goal of this experiment. The suit employs 11 pressurized sections and is able to apply pressure to the legs and lower abdomen in may different ways. Effectiveness of the suit will be determined and compared to a conventional anti-gravity suit and to wearing no suit at all. Blood pressure and blood flow readings, and subjective impressions of the astronauts, will contribute to the results.

Assessment of Back Pain in Astronauts (BPA)

Principal Investigator:

Dr. Peter C. Wing
University of British Columbia, University Hospital
Vancouver, British Columbia, Canada

In microgravity, the spine elongates by as much as 2.76 inches due to the vertebrae in the back spreading slightly apart. This elongation causes painful tension and possibly affects tactile acuity. More than two thirds of astronauts and cosmonauts have experienced back pain during space flight. The aim of this experiment is to develop techniques to alleviate this condition by studying its causes.

Subjects will daily record the precise location and intensity of any back pain. Stereo photographs of the astronauts' backs will be taken to record physical changes in shape and mobility during spaceflight. Immediately after the mission, back examinations and more stereo photographs will be used to obtain precise knowledge of changes in spinal dimension and shape. Earthbound spin-offs are expected as a result of the increased understanding of back pain.

Phase Partitioning Experiment (PPE)

Principal Investigator:

Dr. Donald E. Brooks
University of British Columbia
Vancouver, British Columbia, Canada
Phase partitioning is a process used to separate different kinds of molecules and cells out of complex mixtures of substances. It involves using two polymer solutions dissolved in water. These solutions separate from each other (like oil separates from water) and particles in the mixture will attach to one or the other of the solutions and separate with them. The solution then is poured off to gather the attached particles. The objective is to increase the purity of the separated cells. On Earth, gravity induces fluid flow and inhibits effective separation and purification.

The experiment involves shaking a container including a number of chambers with different solutions. The container will be observed and photographed as phase partitioning occurs. The effects of applying an electric field on the process are observable in microgravity and also will be studied.

Phase partitioning is used to separate biological materials such as bone marrow cells for cancer treatment. It is of interest to medical researchers as it applies to separation and purification of cells for use in transplants and treatment of disease.

Biostack
Provided by DLR

Principal Investigator:

Dr. H. Buecker
Institute for Flight Medicine, DLR
Cologne, Germany

Four Biostack packages, located in a Spacelab rack under the module floor, will gather data to be used in calculating potential effects of exposure to cosmic radiation in space. The packages contain single layers of bacteria and fungus spores, thale cress seeds and shrimp eggs sandwiched between sheets of nuclear emulsion and plastic radiation detectors. Scientists will analyze the resulting data to track the path an energized particle takes through Biostack and then determine the level of radiation damage to the organisms. Findings from this investigation also will be studied to see if better radiation protection is needed in certain areas of Spacelab

Radiation Monitoring Container Device (RMCD)
Development Agency of Japan (NASDA)

Principal Investigator:

Dr. S. Nagaoka
National Space Development Agency of Japan
Tokyo, Japan

In the Radiation Monitoring Container Device, mounted in the aft end of the Spacelab, layers of cosmic ray detectors and bacteria spores, maize seeds and shrimp eggs are sandwiched together and enclosed on all sides by gauges that measure radiation doses. After being exposed to cosmic radiation for the duration of the mission, the plastic detectors will be chemically treated to reveal the three-dimensional radiation tracks showing the path the radiation traveled after entering the container. The specimens will be examined by biological and biochemical methods to determine the effects of radiation on the enclosed organisms. The results of this investigation will be used in developing a sensitive solid-state nuclear detector for future spaceflights and to improve basic understanding of radiation biology.

IML-1 MATERIALS SCIENCE EXPERIMENTS

Protein Crystal Growth (PCG)
Provided by NASA

Principal Investigator:

Dr. Charles E. Bugg
University of Alabama at Birmingham
Birmingham, AL

The Protein Crystal Growth investigation is made up of 120 individual experiments designed for the low-gravity environment of space. Located in two refrigerator/incubator modules carried in the orbiter mid-deck, these experiments operate by the vapor diffusion method of crystal growth. For each experiment, liquids from a double-barreled syringe are released and suspended as droplets on the ends of the syringes. Water vapor then moves out of the droplets in each growth chamber and into a reservoir, stimulating growth of the protein crystal. After the mission, the crystals are returned to the laboratory where scientists hope to find larger, less-flawed crystals then those produced on Earth.

CRYOSTAT
Provided by German Space Agency (DARA)

The Cryostate provides a temperature-controlled environment for growing protein crystals by liquid diffusion under two different thermal conditions. The facility can operate in either the stabilizer mode with a constant temperature between 59 and 77 degrees Fahrenheit or the freezer mode where temperatures can be varied from 17.6 to 77 degrees Fahrenheit. Temperatures are controlled by preprogrammed commands, but crew members can reprogram the computer if necessary. When the experiments are started, solutions of a protein, a salt and buffer mix via diffusion to initiate crystal growth.

Single Crystal Growth of Beta-Galactosidase and Beta-Galactosidase/Inhibitor Complex
Provided by DARA

Principal Investigator:

Dr. W. Littke
University of Freiburg
Freiburg, Germany

Beta-galactosidase, an enzyme found in the intestines of human and animal babies, as well as in E. coli bacteria, aids in the digestion of milk and milk products. It is a key enzyme in modern genetics, and scientists want to determine its three-dimensional molecular makeup to find out how the structure affects its function. Beta-galactosidase was the first protein crystallized in space using the Cryostat in Spacelab 1 in 1983. For IML-1, scientists will attempt to grow higher quality crystals. Cryostat will be used in the freezer mode, at temperatures ranging from 24.8 to 68 degrees Fahrenheit, for this investigation.

Crystal Growth of the Electrogenic Membrane Protein Bacteriorhodopsin
Provided by DARA

Principal Investigator:

Dr. G. Wagner
University of Giessen Plant Biology Institute 1
Giessen, Germany

This experiment uses the Cryostat in the stabilizer mode, with the temperature being maintained at 68 degrees Fahrenheit. The protein to be crystallized is bacteriorhodopsin, a well-known membrane protein that converts light energy to voltages in the membranes of certain primitive microorganisms. Resolution of the three-dimensional structure, which will help biologists understand how bacteriorhodopsin works, depends on the availability of large, high quality crystals.

Crystallization of Proteins and Viruses in Microgravity by Liquid-Liquid Diffusion
Provided by NASA

Principal Investigator:

Dr. Alexander McPherson
University of California at Riverside
Riverside, CA

One protein, canavalin, and one virus, satellite tobacco mosaic virus, will be crystallized in this investigation. Three samples of each substance will be crystallized during the mission. One sample of each will be placed in the freezer mode with the temperature being varied from 28.4 to 68 degrees Fahrenheit and the other sample will be grown in the stabilizer mode with a temperature of 68 degrees Fahrenheit. The crystals will be analyzed to determine the potential benefits of microgravity along with the effects of diverse temperature conditions. Another objective of this experiment is to compare crystals grown in the Cryostat using the liquid diffusion method with those grown in the Protein Crystal Growth hardware using the vapor diffusion method.

FLUIDS EXPERIMENT SYSTEM (FES)

The Fluids Experiment System is a facility with a sophisticated optical system for showing how fluids flow during crystal growth. The optical system includes a laser for producing three-dimensional holograms of samples and a video camera for recording images of fluid flows in and around the samples.

Study of Solution Crystal Growth in Low-Gravity (TGS)
Provided by NASA

Principal Investigator:

Dr. Ravindra B. Lal
Alabama A & M University
Normal, AL

This experiment uses the Fluids Experiment System to grow crystals from a seed immersed in a solution of triglycine sulfate. The original seed is a slice from the face of a larger crystal grown on Earth. In space, it is immersed in a solution of triglycine sulfate, which is initially heated slightly to remove any surface imperfections from the seed. As the seed is cooled, dissolved triglycine sulfate incorporates around the seed, forming new layers of growth. Video is returned to Earth during the experiment, allowing scientists to monitor the growth of the crystal and if necessary, instruct the crew to adjust the temperature. Triglycine sulfate crystals have potential for use as room-temperature infrared detectors with applications for military systems, astronomical telescopes, Earth observation cameras and environmental analysis monitors.

An Optical Study of Grain Formation: Casting and Solidification Technology (CAST)
Provided by NASA

Principal Investigator:

Dr. Mary H. McCay
University of Tennessee Space Institute
Tullahoma, TN

Advanced alloys, which are made by combining two or more metals or a metal and a nonmetal, are essential for such products as jet engines, nuclear power plant turbines and future spacecraft. As alloys solidify, the components redistribute themselves through the liquid and in the solid. To study this solidification process, scientists will use three experiment samples of a salt (ammonium chloride) which, in water solution, models the freezing of alloys. The salt solution is transparent, which makes it ideal for observations of fluid flow and crystallization. Up to 11 experiments may be run, using the samples repetitively. Using the sophisticated FES optical equipment, scientists are able to monitor the experiment from the ground and if necessary, request that the crew make changes to experiment procedures during the present or future runs.

MERCURIC IODIDE

Mercuric iodide crystals have practical uses as sensitive X-ray and gamma-ray detectors. In addition to their exceptional electronic properties, these crystals can operate at room temperature. This makes them potentially useful in portable detector devices for nuclear power plant monitoring, natural resource prospecting, biomedical applications and astronomical observing. Although mercury iodide has greater potential than existing detectors, problems in the growth process cause crystal defects. For instance, the crystal is fragile and can be deformed by its own weight. Scientists believe the growth process can be controlled better in a microgravity environment and that such problems can be reduced or eliminated. Two facilities will be used to grow mercury iodide crystals during IML-1.

Vapor Crystal Growth System (VCGS)
Provided by NASA

Vapor Crystal Growth Studies of Single Mercury Iodide Crystals

Principal Investigator:

Dr. Lodewijk van den Berg
EG&G, Inc.
Goleta, CA

Before the mission, the principal investigator grows a tiny seed crystal inside a sealed glass container called an ampoule. The ampoule is installed in a bell-jar shaped container which will be placed in the Vapor Crystal Growth System.

In space, heaters are started and the ampoule is warmed to around 212 degrees Fahrenheit. Once the ideal growth temperature is established, mercury iodide source material evaporates and then condenses on the seed, which is maintained at a temperature around 104 degrees F. The vapor molecules deposit on the seed for approximately 100 hours to produce a larger crystal.

At the end of the experiment, the ampoule is cooled, and the module is removed and stowed for later analysis. This experiment builds on results from the Spacelab 3 mission, where the principal investigator was the payload specialist who operated it in orbit.

Mercury Iodide Crystal Growth (MICG)
Provided by French National Center for Space Studies (CNES)

Mercury Iodide Nucleations and Crystal Growth in Vapor Phase

Principal Investigator:

Dr. Robert Cadoret
University of Clermont-Ferrand
Aubiere, France

Efforts to grow high-quality mercury iodide crystals on Earth are hampered by gravity-related convection. This causes an uneven concentration of mercury iodide on the seed crystal because material settles only on certain parts of the seed. There are usually defects where the seed and the new growth meet. In space, investigators hope to produce larger, nearly flawless crystals.

This IML-1 investigation uses six single-seed crystals placed in separate containers to grow large crystals under controlled conditions. The furnace for this experiment will hold three ampoules simultaneously. One end of each ampoule is heated, while the other end is kept cooler. The higher temperature at the source-end of each ampoule will cause mercury iodide to evaporate, then condense on the seed crystal at the ampoule's cooler end. Any excess source material will be deposited in a "sink" area behind the growing crystal. The crystals are cooled for 4 hours before being removed by the payload specialist. A second experiment run will be performed with the other three seed crystals if time permits.

ORGANIC CRYSTAL GROWTH FACILITY (OCGF)
Provided by NASDA

Principal Investigator:

Dr. A. Kanbayashi
National Space Development Agency of Japan
Tokyo, Japan

The Organic Crystal Growth Facility is designed to grow high-quality superconductor crystals from a complex organic compound. Researchers are interested in this compound because it can P- at certain temperatures P- transfer electric current with no resistance, just like a metal superconductor. Because of the potential technological value, scientists want to grow a single crystal 10 times larger than ground-based ones to study its natural physical properties. Superconductors are key components of computers, communication satellites and many other electrical devices.

The facility has one chamber for growing a large crystal and a small chamber with a window for observing the growth of a smaller crystal. A seed crystal is mounted on a gold wire in the center section of each chamber. When the experiment is started, valves are opened, allowing donor and acceptor solutions to diffuse into the crystal-growth chamber in which a seed crystal is suspended in an acetone solvent solution. Near the end of the mission, a crew member raises the crystal into a protective chamber for later analysis.

CRITICAL POINT FACILITY (CPF)

ESA's Critical Point Facility is designed for the optical study of fluids at their "critical point," where a precise combination of temperature and pressure makes the vapor and liquid states indistinguishable. Scientists are interested in what happens to materials at their critical points because critical point phenomena are universally common to many different materials. Physically different systems act very similarly near their critical points. Observations such as these are hampered on Earth, since as soon as vapor begins to liquefy and form droplets, gravity pulls the drops down. IML-1 will be the first Space Shuttle flight for the Critical Point Facility, so results gained during this mission are expected to provide new insights on fundamental questions about the basic physics of substances undergoing phase changes.

Study of Density Distribution in a Near-Critical Simple Fluid

Provided by ESA

Principal Investigator:

Dr. Antonius C. Michels
Van der Waals Laboratory
Amsterdam, The Netherlands

Planned for a duration of 60 hours, this experiment will use visual observation, an ultra-sensitive optical measurement technique known as interferometry and light-scattering techniques to reveal the density profile distribution in sulfur hexafluoride (SF6) above and below the critical point. This fluid is used because its critical temperature is near room temperature, avoiding the need for large amounts of power to heat or cool the fluid.

Heat and Mass Transport in a Pure Fluid in the Vicinity of a Critical Point

Provided by ESA

Principal Investigator:

Dr. Daniel Beysens
C.E.N.
Saclay, France

This experiment will focus on mechanisms of heat and mass transport in sulfur hexafluoride (SF6), a gas of technological interest that can be obtained in a very pure form. Here scientists will examine heat and mass transport when temperature is increased from the two-phase region to the one-phase region, when it is varied in the one-phase region and when it is lowered from the one-phase region to the two-phase region.

Phase Separation of an Off-Critical Binary Mixture Provided by ESA

Principal Investigator:

Dr. Daniel Beysens
C.E.N.
Saclay, France

During this experiment, scientists will investigate how a fluid at the critical point separates from a single phase to form two phases. They are interested in how changes in temperature affect formation of the two phases. Small-angle light scattering and direct observation will be used to study phase separation at various temperatures.

Critical Fluid Thermal Equilibration Experiment Provided by NASA

Principal Investigator:

Dr. Allen Wilkinson
NASA Lewis Research Center
Cleveland, OH

In this experiment the temperature and density changes of sulfur hexafluoride, a fluid with a critical point just above room temperature will be measured with a resolution not possible on Earth (at the critical point gas and liquid become indistinguishable). The cells are integrated into the ESA Critical Point Facility and will be observed via interferometry, visualization and transmission under various conditions.

During the full experiment, accelerometry time correlated with the video records will identify the compressible fluid dynamics associated with Space Shuttle acceleration events and provide the investigators with insight concerning gravity effects on fluids in a non-vibration isolated Shuttle experiment.

SPACE ACCELERATION MEASUREMENT SYSTEM

NASA Lewis Research Center
Cleveland, Ohio

The Space Acceleration Measurement System (SAMS) is designed to measure and record low-level acceleration that the Spacelab experiences during typical on-orbit activities. The three SAMS sensor heads are mounted on or near experiments to measure the acceleration environment experienced by the research package. The signals from these sensors are amplified, filtered and converted to digital data before being stored on optical disks.

On STS-42, the SAMS main unit is mounted in the Spacelab's center aisle. The unit contains the data processing electronics, two optical disk drives and the control panel for crew interaction. A sensor head is mounted under the floor at the Microgravity Vestibular Investigation rotating chair which also is located in the Spacelab center aisle.

SAMS primary support on STS-42 will be for experiments conducted in the Fluid Experiment Systems rack and the Vapor Crystal Growth System rack. Typically, crystal growth experiments conducted in these racks take several days to grow and are sensitive to low-frequency acceleration. Therefore, it is important to understand how movement affects the development of the crystal during the growth period. Two sensor heads are mounted in the Fluid Experiment Systems rack.

Data obtained from SAMS will enable engineers and scientists to study how vibrations or movements caused by crew members, equipment or other activities are transferred through the vehicle to the experiment racks.

The first two SAMS units were flown on the first Spacelab Life Sciences mission on STS-40 in June 1991 and on the middeck in STS-43 in August 1991. The flight hardware was designed and developed in-house by the NASA Lewis Research Center.

GELATION OF SOLS: APPLIED MICROGRAVITY RESEARCH

The Gelation of Sols: Applied Microgravity Research (GOSAMR) is a middeck materials processing experiment flown under the sponsorship of a Joint Endeavor Agreement between NASA's Office of Commercial Programs and 3M's Science Research Laboratories, St. Paul, Minn.

The objective of GOSAMR-1 is to investigate the influence of microgravity on the processing of gelled sols -- or dispersions of solid particles in a liquid often referred to as colloids. Stoke's law predicts that there will be more settling of the denser and larger-sized particulates in Earth's unit gravity as compared to the differentiation that should occur in a microgravity environment. In particular, GOSAMR will attempt to determine whether composite ceramic precursors composed of large particulates and small colloidal sols can be produced in space with more structural uniformity and to show that this improved uniformity will result in finer matrix grain sizes and superior physical properties.

Researchers believe that microgravity-produced ceramic composite precursors will have more uniform structures than their ground-based counterparts. The degree to which this is realized will indicate the value of developing enhanced processing techniques for ground-based production of associated products.

The potential commercial impact of GOSAMR applied research on enhanced ceramic composite materials will be in the areas of abrasives and fracture-resistant materials. 3M currently sells film coated with diamond-loaded silica beads for polishing computer disk drive heads and VCR heads. Zirconia-toughened alumina is a premium performance abrasive grit and functions extremely well as a cutting tool for the machining of metals. The performance of these materials may be enhanced by improving their structural uniformity through processing in space.

The GOSAMR experiment will attempt to form precursors for advanced ceramic materials by using chemical gelation. Chemical gelation involves disrupting the stability of a sol and forming a gel (semi-solid material). These precursor gels will be returned to 3M, dried and fired to temperatures ranging from 900 to 2,900 degrees F. to complete the fabrication of the ceramic composites. These composites then will be evaluated to determine if processing in space has indeed resulted in better structural uniformity and superior physical properties.

On STS-42, 80 samples (5 cc each) will be generated by varying the particle sizes and loadings, the length of gelation times and the sol sizes. The chemical components will consist of either colloidal silica sols doped with diamond particles or colloidal alumina sols doped with zirconia particulates. Both sols also will be mixed with a gelling agent of aqueous ammonium acetate.

About a month before launch, the GOSAMR payload is pre-packed into a middeck stowage locker and surrounded with half an inch of isolator material. The experiment contains an internal battery source and uses no power from the Shuttle orbiter. Designed to operate at ambient cabin temperature and pressure to insure scientific success of the experiment, the payload must maintain temperatures above 40 degrees F. and below 120 degrees F. at all times prior to, during or after the mission.

The GOSAMR container consists of a back cover, five identical and independent apparatus modules holding 10 mixing systems and a front cover. The modules and covers comprise a common sealed apparatus container which provides an outermost level of chemical containment. The front cover contains two ambient temperature-logging devices, two purge ports for venting and backfilling the container with inert gas and the electrical feedthrough between the sealed apparatus and the control housing. The control housing at the front of the payload contains power switches for payload activation, indicator lights for payload status and a test connector used during ground-based checkout. Once the payload is installed in the locker, the control housing will be the only portion of the payload accessible to the flight crew.

Each of GOSAMR-1's five modules has two mixing systems with eight double syringes (5 cc each) containing one of two chemical components. Prior to on-orbit activation, the two components (either colloidal silica sols doped with diamond particles or colloidal alumina sols doped with zirconia particulates) will be kept isolated from each other by a seal between the syringe couplers. The coupled syringes in each assembly will contain a gelling agent (either aqueous ammonium acetate or nitric acid) in one syringe and one of the two chemical components in the other.

Once on orbit, a crewmember will sequentially activate the five power switches on the control housing. When the payload is activated, a pilot light for each module will illuminate, indicating that mixing has begun and that the syringe-to-syringe seal has been broken. The sample mixing process for each system will last about 10 to 20 seconds and once the mixing cycle is complete, an internal limit switch will automatically stop each mixing system.

The flight crew will monitor the experiment status by observing the control-housing indicator lights, which will be illuminated during the motor- driven mixing of each system. The pilot lights will extinguish once the mixing is complete, and a crewmember will deactivate each module. The payload will require no further crew interaction. However, physical changes in the samples will continue passively and unattended for a minimum of 24 hours in the microgravity environment. Total crew interaction will be less than 1 hour, and only during this period will the locker door be open.

After landing the payload will be removed from the orbiter during normal destowage operations and returned to 3M within 24 hours where post-flight processing and analyses will be conducted on space- and ground-processed samples to ascertain the differences in physical structure and properties.

The 3M GOSAMR management team includes Dr. Theodore F. Bolles, Technical Director; Dr. Earl L. Cook, Program Manager; and Dr. Bruce A. Nerad, Principal Scientist.

GETAWAY SPECIAL EXPERIMENTS

Since its inception in 1982, hundreds of nonprofessional and professional experimenters have gained access to space through NASA's Get Away Special (GAS) program. The GAS program, managed by Goddard Space Flight Center, Greenbelt, MD, provides individuals and organizations of all countries the opportunity to send scientific research and development experiments on board a Space Shuttle for a nominal fee on a space-available basis. Clarke Prouty is the GAS Mission Manager and Larry Thomas is Technical Liaison Officer.

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 economical way of flying several canisters simultaneously. Twelve GAS payloads were originally scheduled to fly on this mission. However, two GAS payloads dropped out because of technical difficulties. In their place, two GAS ballast payloads were adjusted to match the weight of the payload it replaced.

On STS-42 will be GAS payloads from six countries: Australia, China, Federal Republic of Germany, Japan, Sweden and the United States. This is the first time a payload from China will be carried aboard a Space Shuttle. GAS payloads most recently flew on STS-40 in June 1991. To date, 67 GAS cans have flown on 16 missions. The 10 GAS payloads on STS-42 are:

(G-086) Brine Shrimp/Air Bubbles in Microgravity

Sponsor: Booker T. Washington Senior High School, Houston, Texas

This payload involves two experiments: the artemia (brine shrimp) experiment that will attempt to hatch and grow shrimp in microgravity, and the air/water chamber of the fluid physics experiment, in which measured amounts of air are injected into a chamber filled with distilled water resulting in air bubbles of different sizes. Research indicates the direction and speed of bubble movements should depend on both bubble size and temperature. The NASA Technical Manager (NTM) is Tom Dixon.

(G-140) Marangoni Convection in a Floating Zone and (G-143) Glass Fining

Sponsor: German Space Agency (DARA), Bonn, Germany

G-140 and G-143 are Material Science Autonomous Experiments (MAUS) developed by scientists of the German Aerospace Research Establishment (DLR)/Gottingen and the Technical University Clausthal. The MAUS project is managed by the German Space Agency (DARA) representing Germany for space activities.

In the G-140 experiment, the influence of rotation on the steady and the oscillatory Marangoni convection induced through surface tension gradients will be investigated.

Glass fining is the removal of all visible gaseous inhomogeneities from a glass melt. In G-143, a glass sample with an artificial helium bubble at its center will be heated to 1300 degrees Celsius and kept at this temperature for about 2 hours. The glass melts and the helium dissolves in the melt, causing the bubble to shrink. The NTM is Tom Dixon.

(G-329) The Effect of Gravity on the Solidification Process of Alloys

Sponsor: Swedish Space Corporation (SSC), Solna, Sweden

The purpose of this experiment is to improve understanding of the effect of gravity on the solidification process of alloys. The payload includes three experimental furnaces and an energy buffer, which protects the payload from excessive temperatures. The NTM is Tom Dixon.

(G-336) Visual Photometric Experiment (VIPER)

Sponsor: U.S. Air Force, Phillips Laboratory, Hanscom Air Force Base, Mass.

VIPER is designed to measure the visible light reflected by intergalactic dust. The data from these measurements will be used to validate and update existing data collected in earlier experiments and will help provide background measurements of visible light for use in space surveillance. The NTM is Tom Dixon.

(G-337) Space Thermoacoustic Refrigerator (STAR)

Sponsor: Naval Postgraduate School, Monterey, Calif.

This experiment is the first autonomous application of an entirely new refrigeration cycle which uses sound to pump heat and does so with only one moving part. Unlike conventional refrigerators which use compressors and ozone-depleting chlorofluorocarbons (CFCs), the thermoacoustic refrigerator uses standing sound waves and inert gas to produce refrigeration.

The experiment is a joint effort of the Physics Department and Space Systems Academic Group at the U.S. Naval Postgraduate School. Financial and material support was supplied by the Naval Research Laboratory. The NTM is Tom Dixon.

(G-457) Separation of Gas Bubbles From Liquid

Sponsor: The Society of Japanese Aerospace Companies, Inc. (SJAC)

In this experiment, modes of bubble movement in liquid under microgravity conditions will be examined. Gas bubbles will be separated out of a liquid by artificial gravity. After separation, the gas is circulated by a pump and injected into liquid again in a mixing box. The NTM is Herb Foster.

(G-609 & G-610) Endeavor, the Australian Space Telescope

Sponsor: Australian Space Office, Canberra, Australia

The Endeavor payload is an Australian ultraviolet light telescope designed and built by Auspace Limited for the Australian Space Office. It will obtain ultraviolet images of violent events in nearby galaxies of interest to science.

Two interconnected GAS cans will house the components of the payload. One canister contains the optical elements, a large format photon counting array detector and a control computer. The other GAS can contains a flight battery and two tape recorders for recording data produced by the detector.

(G-614) A Study of Motion of Debris in Microgravity and Investigation of Mixing of Low Melting Point Materials in Microgravity

Sponsor: American Association for Promotion of Science in China and the Chinese Society of Astronautics

This payload consists of two experiments. For the first experiment, small lumps of different materials will be stored in a container which has a side wall covered with a sheet of adhesive paper. A movie camera is mounted in the container to photograph the motion of debris upon their release in the microgravity environment. In the second experiment, two low melt-point materials will be premixed in various ratios in solid form on Earth and remelted in space, then left to cool and resolidify.

The experiments were designed by students selected in 1986 from more than 7,000 proposals. The experiments represent the first time a payload from China will be carried aboard a space shuttle.

INVESTIGATIONS INTO POLYMER MEMBRANE PROCESSING

The Investigations into Polymer Membrane Processing (IPMP), a middeck payload, will make its fifth Space Shuttle flight for the Columbus, Ohio-based Battelle Advanced Materials Center, a NASA Center for the Commercial Development of Space (CCDS), sponsored in part by the Office of Commercial Programs.

The objective of the IPMP is to investigate the physical and chemical processes that occur during the formation of polymer membranes in microgravity such that the improved knowledge base can be applied to commercial membrane processing techniques. Supporting the overall program objective, the STS-42 mission will provide additional data on the polymer precipitation process.

Polymer membranes have been used by industry in separations processes for many years. Typical applications include enriching the oxygen content of air, desalination of water and kidney dialysis.

Polymer membranes frequently are made using a two-step process. A sample mixture of polymer and solvents is applied to a casting surface. The first step involves the evaporation of solvents from the mixture. In the second step, the remaining sample is immersed in a fluid bath (typically water) to precipitate the membrane from the solution and complete the process.

On the STS-42 mission, Commander Ron Grabe and Mission Specialist Bill Readdy, will operate the IPMP experiment. They will begin by accessing the units in their stowage location in a middeck locker. By turning the unit's valve to the first stop, the evaporation process is initiated. On this flight, the effects of varying the time between initiation of solvent evaporation and quenching will be studied -- 1 unit at 5 minutes, the other at approximately 8 hours. Then, a quench procedure will be initiated. The quench consists of introducing a humid atmosphere which will allow the polymer membrane to precipitate out. Ground-based research indicates that the precipitation process should be complete after approximately 10 minutes, and the entire procedure is at that point effectively quenched.

Following the flight, the samples will be retrieved and returned to Battelle for testing. Portions of the samples will be sent to the CCDS's industry partners for quantitative evaluation consisting of comparisons of the membranes' permeability and selectivity characteristics with those of laboratory-produced membranes.

Lisa A. McCauley, Associate Director of the Battelle CCDS, is the Program Manager for IPMP. Dr. Vince McGinness of Battelle is Principal Investigator.

IMAX

The IMAX project is a collaboration between NASA and the Smithsonian Institution's National Air and Space Museum to document significant space activities using the IMAX film medium. This system, developed by IMAX systems Corp., Toronto, Canada, uses specially designed 70 mm film cameras and projectors to record and display very high definition large-screen pictures.

During STS-42, the crew will use the camera to film activities in the Spacelab module and the crew compartment, with particular emphasis on the space physiology experiments that have a bearing on future long duration human presence in space. It also will take advantage of the high inclination of the STS-42 orbit to film Earth features at latitudes not overflown by most Shuttle flights. These scenes will be used in an IMAX film now in production which will deal with mankind's future in space.

IMAX cameras previously have flown on Space Shuttle missions 41-C, 41-D and 41-G to document crew operations in the payload bay and the orbiter's mid deck and flight deck along with spectacular views of Earth. Film from those missions formed the basis for the IMAX production, The Dream is Alive. The IMAX camera also flew on Shuttle missions STS-29, STS-34 and STS-32. During those missions, the camera was used to gather material for the IMAX film, The Blue Planet.

STUDENT EXPERIMENTS

(SE81-09) Convection in Zero Gravity

Scott Thomas, formerly of Richland High School, Johnstown, Penn., created an experiment to study surface tension convection in microgravity. The experiment, selected in 1981, will study the effects of boundary layer conditions and geometries on the onset and character of the convection. The experiment consists of a frame holding six pans with hinged lids and heaters imbedded in the bottom and sides.

A crew member removes and secures the experiment from the mid-deck locker, sets up a television camera, injects a pan with oil and activates the heater and camera. The heater will run for 10 minutes, ample time for convection to occur. The camera will observe the flow patterns produced by aluminum powder in Krytox oil. After six cycles, the experiment is concluded and returned to the locker.

Thomas' experiment, which flew on STS-5, is being reflown because a safety shield interfered with the initial operation of the experiment.

Thomas is a doctoral candidate of physics at University of Texas, Austin. After high school, he attended Utah State University, majoring in physics. His teacher advisor is Wayne E. Lehman, (formerly with Richland High School). The experiment is sponsored by Thiokol Corp. Dr. Lee Davis, Thiokol Corp., and R. Gilbert Moore, Utah State University, are the science advisors of the experiment.

(SE83-02) Zero-G Capillary Rise of Liquid Through Granular Media

Constantine N. Costes, formerly of Randolph High School, Huntsville, Ala., created an experiment to study and measure capillary flow of liquids through densely-packed course granular media in microgravity.

Knowledge of the mechanisms of capillary liquid transport through porous media is of primary importance to many disciplines, including soil physics, agriculture, ground hydrology, petroleum engineering and water purification techniques.

The experiment consists of hardware containing three glass tubes 2 inches in diameter and 15 inches long. The tubes will be filled with one of the three diameter-sized glass beads -- 1/4 mm, 1 mm, and 3 mm. The fluid is blue-colored water. Astronauts will videotape the timed progression of the liquid through beads.

Costes is a doctoral candidate of mathematics at Harvard. He received his undergraduate degree from Oxford. The experiment is sponsored by USBI, Inc., Huntsville. Jeff Fisher, a design engineer at USBI, is the science advisor for the experiment.

RADIATION MONITORING EQUIPMENT-III

The Radiation Monitoring Equipment-III measures ionizing radiation exposure to the crew within the orbiter cabin. RME-III measures gamma ray, electron, neutron and proton radiation and calculates in real time the exposure in RADS-tissue equivalent. The information is stored in memory modules for post-flight analysis.
The hand-held instrument will be stored in a middeck locker during flight except for activation and memory module replacement every two days. RME-III will be activated by the crew as soon as possible after reaching orbit and operated throughout the mission. A crew member will enter the correct mission elapsed time upon activation.

RME-III is the current configuration, replacing the earlier RME-I and RME-II units. RME-III last flew on STS-31. The experiment has four zinc-air batteries and five AA batteries in each replaceable memory module. RME-III is sponsored by the Department of Defense in cooperation with NASA.

STS-42 CREWMEMBERS

STS042-S-002 -- *STS-42 Discovery, Orbiter Vehicle (OV) 103, International Microgravity Laboratory 1 (IML-1) official crew portrait shows crewmembers, wearing launch and entry suits, backdropped against a space shuttle orbiter launch scene. From left to right are pilot Stephen S. Oswald, payload specialist Roberta L. Bondar, mission specialist Norman E. Thagard, missions commander Ronald J. Grabe, mission specialist David C. Hilmers, payload specialist Ulf D. Merbold, and mission specialist William F. Readdy. The two payload specialists represent Canada (Bondar) and the European Space Agency (ESA) (Merbold). Portrait was created using a double exposure.*

PHOTO CREDIT: NASA or National Aeronautics and Space Administration.

BIOGRAPHICAL DATA

RONALD J. GRABE, 46, Col., USAF, will serve as Commander. Selected as an astronaut in August 1981, Grabe was born in New York, NY. Grabe was pilot for STS 51-J, the second Space Shuttle Department of Defense-dedicated mission in 1985. He next flew as pilot for STS-30 in 1989.

Grabe graduated from Stuyvesant High School in 1962, received a bachelor's degree in engineering science from the Air Force Academy in 1966 and studied aeronautics as a Fulbright Scholar at the Technische Hochschule, Darmstadt, West Germany, in 1967.

As an Air Force F-100 pilot, he flew 200 combat missions in Vietnam. Grabe later was a test pilot for the A-7 and F-111 at the Air Force Flight Test Center and from 1976 to 1979, an exchange test pilot for the Harrier with the Royal Air Force at Boscombe Down, United Kingdom. Grabe has logged more than 4,500 hours flying time in various aircraft.

STEPHEN S. OSWALD, 40, will serve as Pilot. Selected as an astronaut in June 1985, he was born in Seattle, WA, but considers Bellingham, WA, his hometown. He will be making his first space flight.

Oswald graduated from Bellingham High School in 1969 and received a bachelor's degree in aerospace engineering from the Naval Academy in 1973. He was designated a naval aviator in September 1974 and flew the Corsair II aboard the USS Midway in the Western Pacific and Indian Oceans from 1975 through 1977. In 1978, Oswald attended the Naval Test Pilot School.

After leaving the Navy, he joined Westinghouse Electric Corp. as a test pilot in developmental flight testing of various airborne weapons systems for Westinghouse, including the F-16C and B-1B radars. Oswald remains active in the U.S. Naval Reserve, currently assigned as Commanding Officer of the Naval Space Command Reserve Unit, Dahlgren, VA. Oswald has logged more than 4,700 flying hours in 38 different aircraft.

NORMAN E. THAGARD, MD, 48, will serve as payload commander and mission specialist 1, making his third space flight. Although born in Marianna, FL, Thagard considers Jacksonville, FL, his hometown and was selected as an astronaut in 1978.

Thagard first flew as a mission specialist on STS-7 in 1983. He next flew on STS-51B, the Spacelab-3 science mission in 1985. Thagard's third flight was on STS-30 in 1989.

Thagard received a bachelor's degree and a master's degree in engineering science from Florida State University in 1965 and 1966, respectively, and a doctor of medicine degree from Texas Southwestern Medical School in 1977.

WILLIAM F. READDY, 39, will serve as Mission Specialist 2. Selected as an astronaut in June 1987, Readdy was born in Quonset Point, RI, but considers McLean, VA, his hometown and will be making his first space flight.

Readdy graduated from McLean High School in 1970 and received a bachelor's degree in aeronautical engineering from the Naval Academy in 1974. Readdy joined NASA in 1986 as an aerospace engineer and instructor pilot at Ellington Field, Houston. When he was selected as an astronaut, he was serving as Program Manager for the Shuttle Carrier Aircraft.

BIOGRAPHICAL DATA

DAVID C. HILMERS, 41, Lt. Col., USMC, will serve as Mission Specialist 3. Selected as an astronaut in 1980, Hilmers was born in Clinton, IA, but considers DeWitt, IA, his hometown.

Hilmers first flew as a mission specialist on STS-51J in 1985. His next flight was on STS-26 in 1988, the first flight to be flown after the Challenger accident. His third flight was on STS-36 in 1990.

Hilmers received a bachelor's degree in mathematics from Cornell College in 1972; a master's degree in electrical engineering from Cornell in 1977; and a degree in electrical engineering from the Naval Postgraduate School in 1978.

ROBERTA L. BONDAR, 46, Ph.D., MD, will serve as Payload Specialist 1. Bondar was born in Sault Ste. Marie, Ontario, Canada, and joined the Canadian Space Agency in 1984.

Bondar received a bachelor's degree in zoology and agriculture from the University of Guelph in 1968; a master's degree in experimental pathology from the University of Western Ontario in 1971; a doctorate in neurobiology from the University of Toronto in 1974; and a doctor of medicine degree from McMaster University in 1977. She was admitted as a Fellow of the Royal College of Physicians and Surgeons of Canada in neurology in 1981.

Bondar is a neurologist and clinical and basic science researcher in the nervous system and was appointed Assistant Professor of Medicine and Director of the Multiple Sclerosis Clinic for the Hamilton-Wentworth Region at McMaster University in 1982.

She was named chairperson of the Canadian Lifesciences Subcommittee for Space Station Freedom in 1985. She is a civil aviation medical examiner and member of the scientific staff at Sunnybrook Hospital where she is conducting research into blood flow in the brain in stroke patients and in subjects in microgravity on board NASA's KC-135.

ULF MERBOLD, 50, will serve as Payload Specialist 2. Merbold was born in Greiz, Germany, and will be making his second space flight for the European Space Agency. Merbold first flew on STS-9, the Spacelab-1 flight, in 1983.

Merbold attended various schools in Greiz, Germany. From 1961-1968, he was a student of physics at Stuttgart University and received a bachelor's degree in 1968. In 1976, he received a doctorate in science from Stuttgart. Following graduation, Merbold joined the Max-Planck Institute for Metals Research in Stuttgart. In 1987, Merbold was appointed as Head of the DLR Astronaut Office.

STS-42 MISSION MANAGEMENT

NASA HEADQUARTERS, WASHINGTON, DC

Richard H. Truly	NASA Administrator

Office of Space Flight

Dr. William Lenoir	Associate Administrator, Office of Space Flight

Office of Space Science

Dr. Lennard A. Fisk	Associate Administrator, Space Science and Applications
Alphonso V. Diaz	Deputy Associate Administrator, Space Science and Applications
Dr. Arnauld Nicogossian	Director, Life Sciences Division
Dr. Ronald J. White	Program Scientist
Robert C. Rhome	Director, Microgravity Science and Applications Division
Dr. Robert Sokolowski	Program Scientist (Microgravity)
Robert H. Benson	Director, Flight Systems Division
Wayne R. Richie	Program Manager

Office of Commercial Programs

John G. Mannix	Assistant Administrator for Commercial Programs
Richard H. Ott	Director, Commercial Development Division
Garland C. Misener	Chief, Flight Requirements and Accommodations
Ana M. Villamil	Program Manager, Centers for the Commercial Development of Space

Office of Safety and Mission Quality

George A. Rodney	Associate Administrator for the Office of Safety and Mission Quality
Richard U. Perry	Director Quality Assurance Division

KENNEDY SPACE CENTER, FL

Robert L. Crippen	Director
Leonard S. Nicholson	Director, Space Shuttle
Brewster H. Shaw	Deputy Director, Space Shuttle (Operations)
Jay Honeycutt	Director, Shuttle Management and Operations
Robert B. Sieck	Launch Director
John C. "Chris" Fairey	Discovery Flow Manager
John T. Conway	Director, Payload Management and Operations
P. Thomas Breakfield	Director, STS Payload Operations
Joanne H. Morgan	Director, Payload Project Management
Glenn E. Snyder	STS-42 Payload Manager

MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, AL

Thomas J. Lee	Director
Dr. J. Wayne Littles	Deputy Director
Harry G. Craft, Jr.	Manager, Payload Projects Office
Robert O. McBrayer	International Microgravity Laboratory-1 Mission Manager
Dr. Robert S. Snyder	Mission Scientist
Alexander A. McCool	Manager, Shuttle Projects Office
Dr. George McDonough	Director, Science and Engineering
James H. Ehl	Director, Safety and Mission Assurance
James N. Strickland	Acting Manager, Space Shuttle Main Engine Project
Victor Keith Henson	Manager, Solid Rocket Motor Project
Cary H. Rutland	Manager, Solid Rocket Booster Project
Gerald C. Ladner	Manager, External Tank Project

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

STENNIS SPACE CENTER, BAY ST. LOUIS, MS

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

AMES-DRYDEN FLIGHT RESEARCH FACILITY, EDWARDS, CA

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

AMES RESEARCH CENTER, MOFFETT FIELD, CA

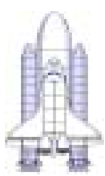
Dr. Dale L. Compton	Director
Victor L. Peterson	Deputy Director
Dr. Steven A. Hawley	Associate Director
Dr. Joseph C. Sharp	Director, Space Research

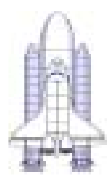
GODDARD SPACE FLIGHT CENTER, GREENBELT, MD

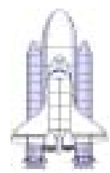
Dr. John M. Klineberg	Director
Clarke Prouty	GAS Mission Manager
Larry Thomas	Technical Liaison Officer

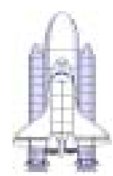
SHUTTLE FLIGHTS AS OF JANUARY 1992

44 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 19 SINCE RETURN TO FLIGHT









		STS-48 09/12/91 - 09/18/91	
		STS-39 04/28/91 - 05/06/91	
STS-40 06/05/91 - 06/14/91		STS-41 10/06/90 - 10/10/90	
STS-35 12/02/90 - 12/10/90	STS-51L 01/28/86	STS-31 04/24/90 - 04/29/90	STS-44 11/24/91 - 12/01/91
STS-32 01/09/90 - 01/20/90	STS-61A 10/30/85 - 11/06/85	STS-33 11/22/89 - 11/27/89	STS-43 08/02/91 - 08/11/91
STS-28 08/08/89 - 08/13/89	STS-51F 07/29/85 - 08/06/85	STS-29 03/13/89 - 03/18/89	STS-37 04/05/91 - 04/11/91
STS-61C 01/12/86 - 01/18/86	STS-51B 04/29/85 - 05/06/85	STS-26 09/29/88 - 10/03/88	STS-38 11/15/90 - 11/20/90
STS-9 11/28/83 - 12/08/83	STS-41G 10/05/84 - 10/13/84	STS-51-I 08/27/85 - 09/03/85	STS-36 02/28/90 - 03/04/90
STS-5 11/11/82 - 11/16/82	STS-41C 04/06/84 - 04/13/84	STS-51G 06/17/85 - 06/24/85	STS-34 10/18/89 - 10/23/89
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-30 05/04/89 - 05/08/89
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-27 12/02/88 - 12/06/88
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-61B 11/26/85 - 12/03/85
STS-1 04/12/81 - 04/14/81	STS-6 04/04/83 - 04/09/83	STS-41D 08/30/84 - 09/05/84	STS-51J 10/03/85 - 10/07/85
OV-102 Columbia (11 flights)	**OV-099 Challenger (10 flights)**	**OV-103 Discovery (13 flights)**	**OV-104 Atlantis (10 flights)**