NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION
STS-58

PRESS KIT
SEPTEMBER 1993

SPACELAB LIFE SCIENCES-2

STS-58 INSIGNIA

STS058-S-001 -- Designed by members of the flight crew, the STS-58 insignia depicts the space shuttle Columbia with a Spacelab module in its payload bay in orbit around Earth. The Spacelab and the lettering "Spacelab Life Sciences II" highlight the primary mission of the second space shuttle flight dedicated to life sciences research. An Extended Duration Orbiter (EDO) support pallet is shown in the aft payload bay, stressing the scheduled two-week duration of the longest space shuttle mission to date. The hexagonal shape of the insignia depicts the carbon ring, a molecule common to all living organisms. Encircling the inner border of the insignia is the double helix of DNA, representing the genetic basis of life. Its yellow background represents the sun, energy source for all life on Earth. Both medical and veterinary caducei are shown to represent the STS-58 life sciences experiments. The position of the spacecraft in orbit about Earth with the United States in the background symbolizes the ongoing support of the American people for scientific research intended to benefit all mankind.

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

PHOTO CREDIT: NASA or National Aeronautics and Space Administration.

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RELEASE: 93-135

STS-58 SECOND SPACELAB MISSION DEDICATED TO LIFE SCIENCES

The Space Shuttle Columbia mission STS-58 will be the second Spacelab flight dedicated to life sciences research. Columbia's seven crewmembers will perform a series of experiments to gain more knowledge on how the human body adapts to the weightless environment of space.

While in Earth orbit, almost every human physiological system undergoes some form of adaptation. Understanding the causes of these changes will aid NASA in the effort to fly longer missions as well as give researchers insight into medical problems experienced by individuals on Earth.

The STS-58 crew will perform experiments focusing on the cardiovascular, regulatory, neurovestibular and musculoskeletal systems of the body. The experiments performed on Columbia's crew and on laboratory animals, along with data collected on the SLS-1 mission in June 1991, will provide the most detailed and interrelated physiological measurements acquired in the space environment since the Skylab program in 1973 and 1974.

The SLS-2 mission currently is scheduled for launch no earlier than Sept. 10, 1993. The mission will be flown at an altitude of 153 nautical miles and at an inclination of 39 degrees to the Equator.

The mission is planned to last 14 days concluding with a landing at Edwards Air Force Base, Calif. Commander for the flight is John Blaha, Col., USAF. Rick Searfoss, Lt. Col., USAF will serve as Pilot. Mission specialists are Rhea Seddon, M.D.; Bill MacArthur, Lt. Col., USA; David Wolf, M.D.; and Shannon Lucid, Ph.D. The payload specialist for STS-58 is Martin Fettman, D.V.M., Ph.D.

Following the STS-58 mission, Columbia will be returned to Kennedy Space Center, Fla., where the Spacelab payload will be removed. Work then will begin to prepare Columbia for its next flight, STS-62 -- the United States Microgravity Payload-2 mission scheduled to fly in February 1994.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

MEDIA SERVICES INFORMATION

NASA Select Television Transmission

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

The schedule for television transmissions from the orbiter and for mission briefings will be available during the mission at Kennedy Space Center, Fla.; Marshall Space Flight Center, Huntsville, Ala.; Ames-Dryden Flight Research Facility, Edwards, Calif.; Johnson Space Center, Houston 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 COMSTOR 713/483- 5817. COMSTOR is a computer data base service requiring the use of a telephone modem. A voice recording of the television schedule is updated daily at noon eastern time.

Status Reports

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

Briefings

A mission press briefing schedule will be issued prior to launch. During the mission, status briefings by a flight director or mission operations representative and when appropriate, representatives from the science team, will occur at least once per day. The updated NASA Select television schedule will indicate when mission briefings are planned.

STS-58 QUICK LOOK

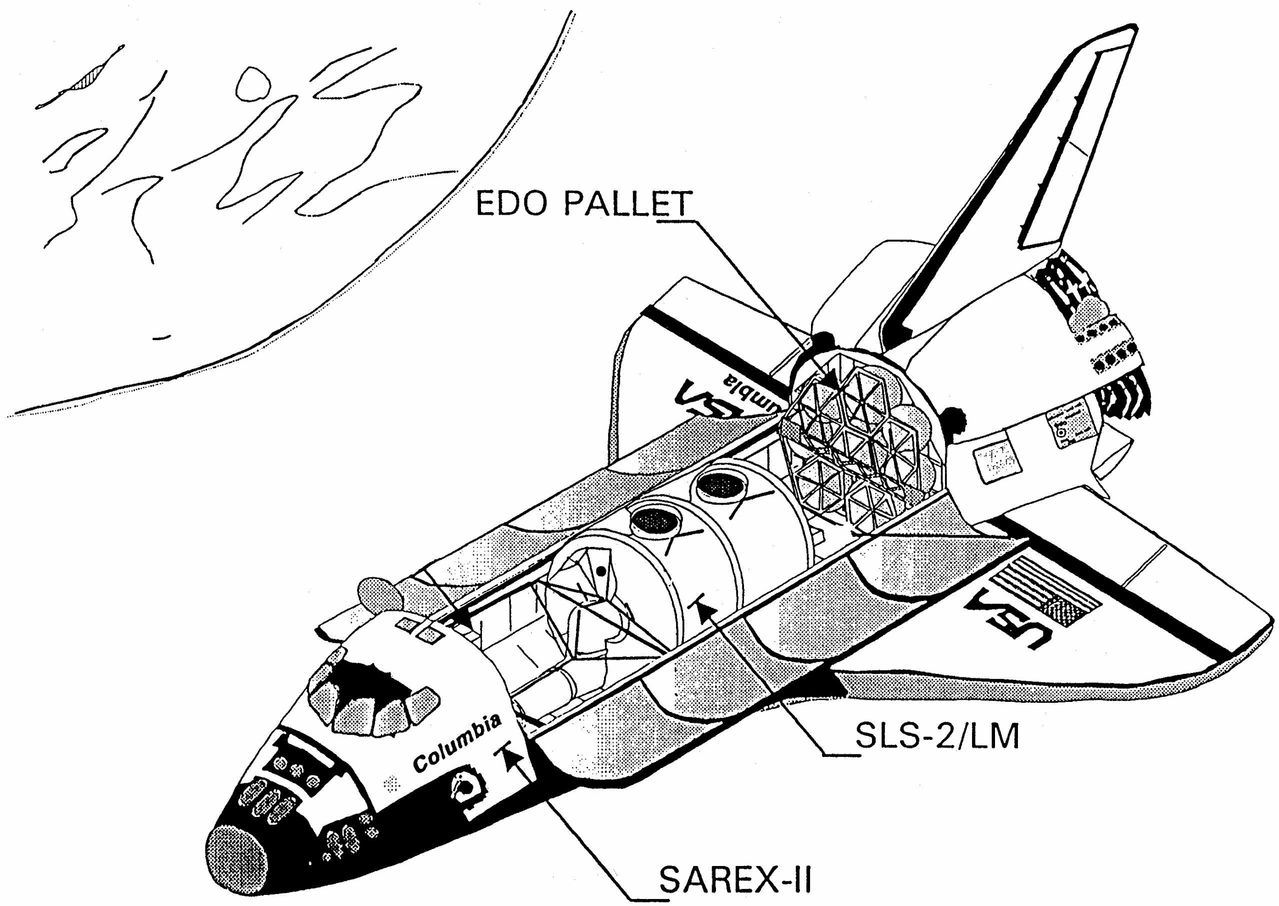
Launch Date/Site:	September 1993/Kennedy Space Center - Pad 39B
Launch Time:	TBD
Orbiter:	Columbia (OV-102) - 15th Flight
Orbit/Inclination:	153 nautical miles/39 degrees
Mission Duration:	14 days, 23 minutes
Landing Time/Date:	TBD
Primary Landing Site:	Edwards Air Force Base, Calif.
Abort Landing Sites:	Return to Launch Site - KSC, Fla. TransAtlantic Abort landing - Ben Guerir, Morocco Moron, Spain Zaragoza, Spain Abort Once Around - Edwards AFB, Calif.
Crew:	John Blaha, Commander (CDR) Rick Searfoss, Pilot (PLT) Rhea Seddon, Mission Specialist 1 (MS1) Bill MacArthur, Mission Specialist 2 (MS2) David Wolf, Mission Specialist 3 (MS3) Shannon Lucid, Mission Specialist 4 (MS4) Martin Fettman, Payload Specialist (PS)
Cargo Bay Payloads:	SLS-2 (Spacelab Life Sciences-2)
In-Cabin Payloads:	SAREX-II (Shuttle Amateur Radio Experiment-II)

DTOs/DSOs:

DTO 312:	ET TPS Performance
DTO 623:	Cabin Air Monitoring
DTO 663:	Acoustical Noise Dosimeter Data
DTO 665:	Acoustical Noise Sound Level Data
DTO 667:	Pilot In-Flight Landing Operations Trainer
DTO 910:	Orbital Acceleration Research Experiment
DSO 314:	Acceleration Data to Support Microgravity Disturbances
DSO 485:	InterMars Tissue Equivalent Proportional Counter
DSO 603B:	Orthostatic Function During Entry, Landing and Egress
DSO 611:	Air Monitoring Instrument Evaluation and Atmosphere Characterization
DSO 612:	Energy Utilization
DSO 617:	Evaluation of Functional Skeletal Muscle Performance Following Space Flight
DSO 620:	Physiological Evaluation of Astronaut Seat Egress Ability at Wheel Stop
DSO 623:	Lower Body Negative Pressure Countermeasures
DSO 624:	Cardiorespiratory Responses to Submaximal Exercise
DSO 802:	Education Activities
DSO 904:	Assessment of Human Factors
DSO 901:	Documentary Television
DSO 902:	Documentary Motion Picture Photography
DSO 903:	Documentary Still Photography

NASA

Space Shuttle Program
STS-58 Cargo Configuration



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 Edwards Air Force Base, Calif.

- TransAtlantic Abort Landing (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at either Ben Guerir, Morocco; Moron, Spain; or Zaragoza, Spain.

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

STS-58 contingency landing sites are the Kennedy Space Center, Edwards Air Force Base, Ben Guerir, Moron or Zaragoza.

STS-58 SUMMARY TIMELINE

Flight Day 1
Ascent
OMS-2 (153 n.m. x 153 n.m)
Spacelab activation
Spacelab Life Sciences-2 activities

Flight Day 2to 13
Spacelab Life Sciences-2 activities

Flight Day 14
Flight Control Systems checkout
Reaction Control System hot-fire
Spacelab stow
Cabin stow
Spacelab deactivation -- first half

Flight Day 15
Spacelab final deactivation
Deorbit Entry Landing

STS-58 ORBITAL EVENTS SUMMARY

Event	Start Time (dd/hh:mm:ss)	Velocity Change (feet per second)	Orbit (n.m.)
OMS-2	00/00:40:00	198	153 x 153
Deorbit	13/23:23:00	TBD	N/A
Landing	14/00:23:00	N/A	N/A

STS-58 VEHICLE AND PAYLOAD WEIGHTS

	Pounds
Orbiter (Columbia) empty and 3 SSMEs	168,713
Spacelab Life Sciences-2	21,840
Extended Duration Orbiter Pallet	3,588
SAREX-II	46
DSOs/DTOs	547
Total Vehicle at SRB Ignition	4,519,358
Orbiter Landing Weight	227,395

STS-51 CREW RESPONSIBILITIES

Task/Payload	Primary	Backup
SLS-	Seddon	Lucid, Wolf, Fettman
Spacelab activation	Seddon	Wolf
Spacelab deactivation	Wolf	Seddon
Spacelab systems	Blaha	Searfoss
<u>Experiments:</u>		
SLS-2	Seddon	Lucid, Wolf, Fettman
SAREX	McArthur	Searfoss
<u>DTOs/DSOs:</u>		
ET Photo	Searfoss	
Acoustic Noise	Searfoss	
Orbiter Acceleration	Searfoss	
Landing Trainer	Blaha	
Cabin Air	McArthur	
LBNP	Searfoss	
Seat Egress/Landing	Fettman	
Education Activities	Fettman	
Human Factors	Lucid, Fettman	
<u>Other Responsibilities:</u>		
Photography/TV	Searfoss	McArthur
Earth observations	Searfoss	McArthur
Maintenance-Orbiter	McArthur	Searfoss
Maintenance-Spacelab	Wolf	McArthur
Medic	Wolf	Seddon
EVA	Lucid (EV1)	Wolf (EV2), Searfoss (IV)

SPACELAB LIFE SCIENCES-2 (SLS-2)

In the past 32 years, Americans have been rocketed into space 87 times. Each time the astronauts' bodies adapted to the unique weightlessness environment of space and then readapted to Earth's gravity, but still the mechanisms responsible for that adaptation remain a mystery.

The Spacelab Life Sciences missions seek to solve the mystery. A series of comprehensive experiments will fly for the second time on STS-58 and will give researchers from across the nation access to the most unique laboratory available to science -- the microgravity environment of space.

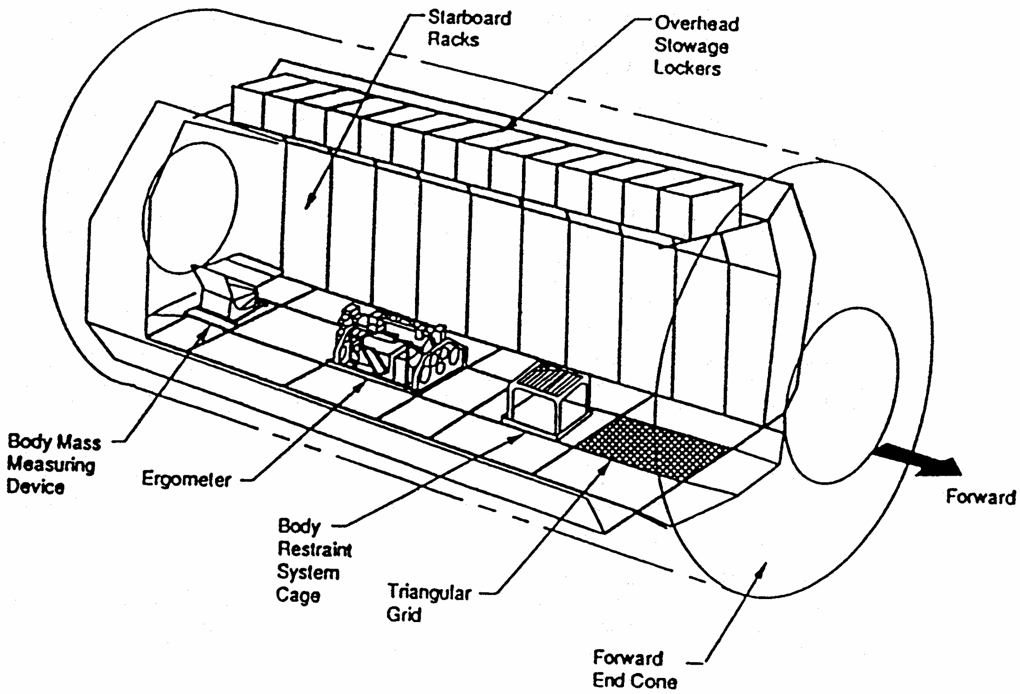
In weightlessness, virtually every human physiological system undergoes some form of adaptation. The capacity of the cardiovascular system is diminished. Muscle and bone density also begin to decrease. A shifting of the body's fluids affect the renal and endocrine systems as well as the way the blood system operates. And the balance and position sensing organs of the neurovestibular system must readapt to an environment where up and down no longer matter.

Spacelab Life Sciences 2 consists of 14 experiments focusing on the cardiovascular, regulatory, neurovestibular and musculoskeletal systems of the body. Eight of the experiments will use the astronaut crew as subjects and six will use rats. A broad range of instruments -- some, unique hardware and others, standard equipment -- will be used for the human subjects throughout the mission. Equipment items will include a Gas Analyzer Mass Spectrometer, rotating dome and a rotating chair, a Body Mass Measuring Device, Inflight Blood Collection System, Urine Monitoring System, strip chart recorders, incubators, refrigerator/freezers, a low-gravity centrifuge and an echocardiograph.

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

The rodent experiments are managed by the Ames Research Center, Moffett Field, Calif. In addition to inflight data and tissue collection, data will be collected preflight and post-flight for comparison with flight results. Both ground-control and flight animals will be part of post-flight studies.

The primary goal of the SLS-2 mission is to conduct experiments in a variety of disciplines to address important biomedical questions related to physiological responses to microgravity and subsequent re-adaptation to gravity. The science also is constructed to ensure crew health and safety on missions of up to 16 days in duration. A third goal of SLS-2 is to demonstrate the effectiveness of hardware standardization in experiment- to-rack interfaces for future applications on Space Station.



SLS-2 module isometric view

CARDIOVASCULAR

Throughout the space program, cardiovascular "deconditioning" has often been observed in spaceflight crews. This diminished capacity of the cardiovascular system is evidenced by decreased orthostatic tolerance, or lightheadedness, upon return to Earth's gravity and is usually accompanied by increases in resting heart rate and decreases in pulse pressure post- flight.

Measurements of body fluids in microgravity reveal a redistribution of circulating blood and body water toward the head and neck area. The fluid redistribution fools the body into thinking there is too much fluid and results in a reduction of fluid volume. This overall shift may influence cardiovascular parameters such as cardiac output, arterial and venous pressure and stroke volume. Upon return to Earth, the cardiovascular system must readapt rapidly. This challenges the space-adapted cardiovascular system, which contains less blood volume than normal and sometimes results in orthostatic intolerance.

Scientists also believe that microgravity may alter lung function in orbit and are investigating the effect that weightlessness has on the pulmonary system, particularly on respiration, blood flow and gas exchange.

The SLS-2 cardiovascular/cardiopulmonary experiments seek to understand and quantify these changes that occur on orbit and focus both on the acute fluid shift and the long-term adaptation of the heart and lungs.

Inflight Study of Cardiovascular Deconditioning

Principal Investigator: Leon E. Farhi, M.D.
State University of New York at Buffalo
Buffalo, NY

Quantifying and identifying the mechanisms and time course of how astronauts adapt to microgravity and then readjust to the normal gravitational forces on Earth is the focus of Experiment 066 -- "Inflight Study of Cardiovascular Deconditioning."

Data from SLS-1 suggest that the cardiovascular adjustment is seen in total peripheral resistance. In other words, the resistance of blood flow through the body and not cardiac output. Cardiac output stayed elevated throughout the SLS-1 mission, but total peripheral resistance adapted. Early inflight data was not collected on that flight and is needed to enhance the investigation's findings.

To do this, STS-58 crew members will be measuring cardiac output or the amount of blood pumped by the heart with each beat at rest and during exercise. Both activities begin with the subject performing a calibration with the Gas Analyzer Mass Spectrometer followed by the collection of heart rate, blood pressure and respiratory gas volumes and concentrations. Changes to these parameters will be measured during the exercise portion of the investigation. Many of the inflight procedures are being performed jointly with Experiment 294 to efficiently use mission resources and optimize science return.

Cardiovascular Adaptation to Zero Gravity

Principal Investigator: C. Gunnar Blomqvist, M.D.
University of Texas Southwestern Medical Center
Dallas, TX

Experiment 294, “Cardiovascular Adaptation to Zero Gravity,” will study the changes in the cardiovascular system to increase understanding of microgravity-induced changes in the heart’s structure and function in space.

According to Experiment 294 investigators, the experiment’s central venous pressure results from SLS-1 were surprising. Central venous pressure decreased in space, refuting the hypothesis that the pressure increases due to the microgravity-induced fluid shift. Despite that decrease, heart size increased as did stroke volume, the amount of blood pumped with each heart beat, and overall cardiac output when compared to preflight supine values. These changes were not predicted by ground-based models and could indicate that there is a general opening of blood vessels on orbit.

Many of the inflight procedures are being performed jointly with Experiment 066 to efficiently use mission resources and optimize science return. In addition to cardiovascular measurements -- heart rate, blood pressure and respiratory gas volumes taken during rest and exercise, the central venous pressure will be measured during the first few hours of flight by a venous catheter inserted into the arm of a crew member preflight. Echocardiograph data also will be taken, and leg blood flow and volume will be measured using a leg cuff device.

Pulmonary Function During Weightlessness

Principal Investigator: John B. West, M.D., Ph.D.
University of California
San Diego, CA

Investigating the effects of microgravity on the various aspects of pulmonary function is the goal of Experiment 198, “Cardiovascular Adaptation to Zero Gravity.”

Prior to SLS-1, scientists believed that lung ventilation would be much more even in space than on Earth. Data from the first mission, however, revealed that the lung function improved only by about half as much as was expected. The investigators hope to identify the mechanisms that are responsible for this unexpected trend on SLS-2.

The experiment protocol calls for astronauts to participate in a series of breathing tests designed to examine the distribution and movement of blood and gas within the pulmonary system and how these measurements compare to normal respiration in Earth’s gravity. By measuring gas concentrations, the flow of gas through the lungs into the blood stream and rate of blood flow into the lungs in space, investigators hope to isolate irregularities seen on Earth. Non-invasive breathing exercises involve the inhalation of gas mixtures including oxygen, nitrogen and other trace gases.

Experiment 198 is a reserve experiment and will be conducted in flight if crew time and resources become available.

REGULATORY SYSTEM

Investigations of regulatory physiology in space include studies of both the renal/endocrine and hematological systems.

The amount of fluids and the pressures inside veins and arteries is well- regulated by the kidneys and hormones of the renal/endocrine system. On Earth, gravity affects the distribution of fluids inside the body by pulling the various body fluids down toward the feet. But in space, fluids redistribute upwards toward the chest and the head. This perceived increase causes multiple physiological changes in the kidneys and associated fluid regulating hormones in the cardiovascular system and in the blood system.

The SLS-2 regulatory physiology experiments investigate the theory that the kidneys and endocrine glands adjust the body's fluid regulating hormones to stimulate an increase in fluid to be excreted. Over a longer period of time, the kidneys and hormones establish new levels of salts, minerals and hormones appropriate for the reduced fluid volume. The fluid shift also impacts the blood system initially by a decrease in the plasma volume.

Another effect of spaceflight is a decrease in red blood cells which are responsible for carrying oxygen to the tissues. Investigators hope to better understand the mechanisms behind these changes after SLS-2.

Fluid-Electrolyte Regulation During Spaceflight

Principal Investigator: Carolyn Leach, Ph.D.
Lyndon B. Johnson Space Center
Houston, TX

Experiment 192, "Fluid-Electrolyte Regulation During Spaceflight," makes detailed measurements before, during and after Shuttle missions to determine immediate and long-term changes in kidney function; changes in water, salt and mineral balance; shifts in body fluids from cells and tissues; and immediate and long-term changes in levels of hormones which effect kidney function and circulation.

Both the acute (short-term) and adaptive (long-term) phases of the body's adjustment to spaceflight will be studied for the experiment. Investigators will focus on the acute phase during the immediate inflight period by placing emphasis on the circulatory system, hormonal and kidney involvement in the initial loss of fluids. For the adaptive phase, the specific mechanisms related to the body developing a new stable level in response to these fluid shifts will be examined.

The test protocols require crew members to collect urine samples throughout the flight. Body weight is measured daily and a log is kept of all food, fluids and medication taken in flight. Chemical tracers will be used to measure the rate and loss of body water and to determine changes in blood plasma volume and extracellular fluid.

Regulation Of Blood Volume During Spaceflight

Principal Investigator: Clarence P. Alfrey, M.D.
Baylor College of Medicine
Houston, TX

Experiment 141, Regulation of Blood Volume During Spaceflights will study changes in the volume of blood in response to spaceflight. Blood in the body is contained in the heart, arteries, veins and capillaries. The amount of blood contained within specific spaces is determined in part by gravity. Since the force of gravity during spaceflight is greatly reduced, the space available to contain blood is decreased. In response, the body senses that the amount of blood is too great.

Previous spaceflight crews have consistently exhibited decreases in the volume of plasma, the liquid part of blood. An experiment on SLS-1 showed a similar decrease in rats.

Because less space is available to blood during spaceflight, the body slows down the rate at which it produces red blood cells. This flight experiment should provide important information about the role of growth factors and hormones in the maturation and release of red blood cells from the bone marrow.

Radioactive tracers will be injected into the rats to permit monitoring of changes in the blood when blood samples are taken preflight, inflight and post-flight. From these samples scientists can determine the volume of red blood cells and plasma, the length of survival of the red blood cells, the number of red blood cells being made during spaceflight and the number released into the blood.

Understanding how the hormone erythropoietin controls the formation and maturation of red blood cells has important implications on Earth. Erythropoietin is a very expensive treatment for anemia -- a common consequence of AIDS and kidney failure. With increased knowledge about how this hormone works, more cost-effective erythropoietin treatment schedules could be developed. Spaceflight affords an opportunity to study the altered rate of production and release of red blood cells from the bone marrow in non-disease states.

Regulation Of Erythropoiesis In Rats During Space Flight

Principal Investigator: Albert Ichiki, Ph.D.
University of Tennessee Medical Center
Knoxville, TN

Astronauts on previous Space Shuttle missions have exhibited anemia or decreased red blood cell mass. The causes of this change, which are not known, are the subject of Experiment 012. A decrease in red blood cell production may play a role.

A decrease in red blood cell mass so far has not been life-threatening during short duration flights. There are concerns, however, about what might happen on long-term flights and how this change may affect crew performance.

This experiment, along with the hematology experiments (rat and human) of Dr. Clarence Alfrey, will determine what processes are occurring in space anemia. They also will determine whether the changes in the blood system of the rat during spaceflight are the same as in humans.

For the first time, scientists will be able to study blood samples collected at various points during the flight. Other samples will be taken before and after flight. SLS-2 will provide the opportunity to investigate the consequences of the body's adaptation to microgravity and subsequent readjustment to normal Earth gravity.

By studying the mechanisms of space anemia, scientists can learn the basic regulatory physiology of red blood cell production in a controlled environment. The principal investigator will compare measurements of red blood cells, white cells, platelets and hemoglobin from flight rats with those from crew members and from ground-control rats. Post-flight analyses of the bone marrow, spleen and thymus from flight and ground-control rats will provide additional information about how microgravity affects the blood system.

The health care industry will be the largest benefactor of information from these experiments. Information may be useful in learning to control or prevent harm to people on Earth with anemia or other blood diseases.

Influence of Spaceflight on Erythrokinetics in Man

Principal Investigator: Clarence Alfrey, M.D.
Baylor College of Medicine
Houston, TX

One of the most consistent findings from spaceflight research is the decrease in circulating red blood cells, or erythrocytes, and the subsequent reduction in the blood's oxygen carrying capacity. Experiment 261, "Influence of Spaceflight on Erythrokinetics in Man," studies the mechanisms which may be responsible for this decrease, including the effect of spaceflight on red blood cell production rate and the role of changes in body weight and plasma volume on red blood cell production.

The experiment will measure specific factors of red blood cell function, particularly erythropoiesis or the production of red blood cells, which may be altered during weightlessness.

During the mission, crew members will measure iron uptake by injecting tracers followed by timed blood draws. The blood then will be centrifuged and stored in the Spacelab freezer for post-flight analysis.

During SLS-1, investigators saw a decrease in red blood cell mass, plasma volume and erythropoietin. The life span of the red blood cells did not change and hemolysis, or the disintegration of red blood cells, did not occur. This indicates that the decrease in red blood cell mass was do to a suppressed red blood cell production in flight. The SLS-2 subjects will help verify the preliminary findings of the study.

NEUROVESTIBULAR

Neurovestibular changes related to equilibrium and body orientation affect astronauts early in flight probably more than any other physiological changes. The awareness of body orientation on Earth is attributed, in part, to the detection of gravity by the otolith organs in the inner ear. Gravity sensors in the joints and touch sensors in the skin also are involved, and the eyes contribute by sensing the body's relationship to other objects. In space, however, the weightless environment no longer corresponds with the visual and sensual cues set to the brain, causing disorientation.

Space motion sickness may result from this disorientation, and although astronauts adapt within a few days, investigators are working to better understand and counter these negative effects. A similar disorientation of the balancing organs can occur when crew members readapt to Earth's gravity after landing.

The SLS-2 neuroscience investigations seek to document both physical vestibular changes and perception changes and to investigate the mechanisms involved. Investigators also hope to identify countermeasures to alleviate the effects of space motion sickness.

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

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

The neurovestibular system, which helps animals maintain balance, is very sensitive to gravity. Experiment 238 will continue research begun on SLS-1. This flight experiment showed that gravity sensors in adult rats adapt to a novel environment by changing the number, type and groups of synapses. Synapses are gaps between nerve cells. The SLS-2 flight experiment should uncover the precise nature of this adaptation and the structural changes that may occur within the inner ear in response to the microgravity of space.

This experiment will examine how gravity influences the development, organization and maintenance of the mammalian gravity receptors. It also will study how these gravity-sensing endorgans can adapt to an altered gravitational environment provided the change falls within a range that is non-lethal to the functioning system and how rapid is the speed of readaptation to Earth's gravitational field.

If we are to learn the effects of near-zero gravity on gravity receptors and the recovery from these effects, it is essential that sample collection and fixation of the inner ear tissue be completed during flight. Scientists will look at the implications of spaceflight on the structure of gravity receptors using the rat maculas (inner ear sensory hair cells) as the model for human sensors. Gravity receptors are sensitive to linear accelerations (movements) and gravitational force. Complete and accurate knowledge of the systems anatomy is essential to understanding the functional basis of vestibular involvement in disequilibrium, including space motion sickness.

The results of this study should have clinical applications for people suffering from motion sickness or from vestibular disorders, which may lead to falls and dizziness. This health-related spin-off is in addition to the study of adaptation to microgravity and the possibility of developing countermeasures based on anatomical, physiological and behavioral findings. These results also will help shape the future of physiological experimentation on gravity receptors in space.

Vestibular Experiments in Spacelab

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

A battery of closely-related tests will serve as the basis of a joint U.S./Canadian research program to study space motion sickness and changes in the vestibular system in space.

Experiment 072, "Vestibular Experiments in Spacelab," consists of six different tests to assess sensory-motor adaptation. A rotating chair will be used to test ocular deviation and vestibulo-ocular reflex, in other words the changes in reflexive eye motions. One chair protocol requires that the test subject be rotated about a vertical axis and stopped suddenly. A second procedure requires the subject to pitch his or her head forward after the chair is stopped.

A rotating dome is used in another test. When a crew member sees the dot-patterned dome rotating in one direction, he/she senses that he/she is moving in the opposite direction. The subject uses a joystick to indicate the perceived direction and velocity of rotation.

In the awareness of position task, crew members will view various targets on a visual screen and then, with their eyes closed, point to them with a light pointer. This will allow investigators to quantify differences in crew members' perceived relationships of their bodies to their environments in spaceflight versus on Earth.

The otolith-spinal reflex, or the reflex that causes one to catch oneself when sensing a fall, will be tested in the "drop" experiment. For the study, a crew member will don a harness with bungee cords attached to the floor and hang from a suspended T-handle. When the T-handle automatically releases and drops the crew member, electromyogram electrodes will measure the muscle activity to determine the relationship between the nervous system and muscle response in space.

Crew members also will wear an Acceleration Recording Unit to measure head movements, both natural and exaggerated, and record any space motion sickness symptoms on a pocket voice recorder.

A variety of pre- and post-flight tests will enhance the information collected on orbit.

Astronaut Science Advisor

The Astronaut Science Advisor (ASA) is a computer-based intelligent assistant designed to help astronauts work more efficiently and improve the quality of space science. The first flight prototype will be operational on SLS-2.
The ASA will support the Rotating Dome Experiment, which measures how the visual and vestibular (balance) systems interact and how this interaction is affected as humans adapt to microgravity.

Developed by NASA's Ames Research Center and the Massachusetts Institute of Technology, the ASA addresses many of the problems of conducting experiments in space. It uses a Macintosh PowerBook computer and a combination of commercial and NASA-developed software.

Two critical resources in flight experiments are crew time and the limited ability of an Earth-bound scientist to correct problems or follow new leads as the experiment unfolds in space.

The ASA can help with both of these problems. It helps astronauts increase their productivity and improve the scientific quality of the data they collect. The ASA uses detailed knowledge of the experiment to provide the astronaut with observations about the quality and importance of the data as it is collected inflight.

The ASA performs four major functions: diagnosis and trouble- shooting of experiment equipment, data collection, protocol management and detection of interesting data. It keeps track of the time spent on the experiment and can generate potential new protocols that could be used to optimize the course of the experiment. The system should significantly enhance the crews ability to perform science experiments. It also should reduce their reliance on air-to-ground communications.

MUSCULOSKELETAL

In microgravity, the body's bones and muscles are not used as extensively as they are on Earth. As a result, researchers have seen a decrease in the mass of both during spaceflight.

Human muscle atrophy has been noted frequently among returning astronauts and can be characterized by a loss of lean body mass, decreased muscle mass in the calves and decreased muscle strength. Despite an adequate protein intake, the effects of spaceflight appear analogous to those of the fasting state when muscle protein is broken down into its constituent amino acids.

Researchers also have identified a progressive loss of skeletal mass in microgravity. This is associated with changes of calcium homeostasis as is evidenced by increased urinary and fecal excretion of calcium. Efforts to avoid the loss of skeletal density through exercise have been only partially successful, and researchers have not been able to reverse calcium and nitrogen loss.

On return to Earth after short-duration missions, these responses are shown to be reversible, but the effects on muscles and bones during long- duration missions yet are not well known. The SLS-2 studies will provide more information about this complex system.

Protein Metabolism During Spaceflight

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

Experiment 120, "Protein Metabolism During Spaceflight," will investigate changes in protein metabolism which lead to a decrease in muscle mass on orbit.

Previous studies of nitrogen balance during spaceflight have reported a persistent negative nitrogen balance. Normal metabolic processes establish a balance between protein synthesis (build up) and protein catabolism (break down). To understand the protein metabolic changes, it is necessary to measure both the synthetic and catabolic rates to determine how each contributes to the decrease in muscle mass.
Data collected during SLS-1 suggests that the decrease of muscle mass is similar to a stress response which is characterized by an increase in both protein synthesis and protein breakdown, with a larger increase in the breakdown rate. SLS-2 tests will focus on measuring the levels of fibrinogen, a blood protein essential to coagulation.

Inflight procedures require crew members to ingest an amino acid labeled with a non-radioactive isotope of nitrogen which can be used to track protein metabolism in the body. Approximately 10 hours later, urine, saliva, and blood samples will be collected and frozen for post-flight analysis. These samples will be compared to baseline samples to determine the rates of protein synthesis and catabolism.

Effects of Zero Gravity on the Functional and Biochemical Properties of Antigravity Skeletal Muscle

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

Experiment 127 will examine how the function and biochemistry of skeletal muscles changes when exposed to the microgravity of space. Previous research has shown that exposure to microgravity causes a loss of muscle mass or size. This occurs chiefly in muscles used primarily for normal activities such as standing and walking. The goal of this flight experiment is to determine how this atrophy process impacts the strength and endurance of various muscles used by rodents for standing and walking.

One explanation is that in microgravity there is not enough stress or tension on the muscles to maintain adequate levels of certain proteins and enzymes. These proteins and enzymes enable cells to use oxygen to convert nutrients into energy. Under conditions of less gravitational stress, protein activity also decreases. Muscles become more dependent on glycogen stored in the liver and muscles for energy. As the body metabolizes glycogen, muscle endurance decreases.

The principal investigator hypothesizes that the muscle will lose its strength and ability to perform repetitive contractions when tested after spaceflight. The principal investigator will measure and compare muscle strength, muscle power, muscle performance capabilities and the ability of muscle to sustain work. He will compare results from flight animals with those from ground-control animals.

The results of this project should provide insight into the extent that muscle atrophy induces altered muscle performance. The experiment can be extended in the future to determine how this altered function can be prevented or corrected.

The problem of muscle atrophy associated with spaceflight is important because it may represent an accelerated process similar to what is seen in individuals as they get older. Aging involves a gradual atrophying process in the muscles, due largely to progressive inactivity. By identifying the causes and extent of atrophy and by developing appropriate counter measures for preventing muscle atrophy, scientists may be able to help a broad spectrum of population to live more productive lives with greater vitality.

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

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

Humans exposed to long-duration spaceflight can experience muscle weakness, fatigue, post-flight soreness and faulty coordination, despite strenuous inflight exercise. Experiment 303 will analyze the effects of spaceflight on the muscles from rat hindlimbs. Previous spaceflight missions have shown that rat skeletal muscles exhibit pathological changes, as well as the simple atrophy typically associated with decreased use. The changes of greatest concern include tears in muscle fibers, blood clots in capillaries and abnormal tissue swelling.

After almost 2 weeks in space, rats showed a nearly 40 percent shrinkage in the fibers of skeletal leg muscles. Previous studies on rats also suggest that muscle fiber shrinkage and death are progressive. Similar changes in humans could mean that with longer periods of living in space, astronauts could potentially risk irreversible loss of muscle strength.

This flight experiment will compare the atrophy rates of muscles used primarily to oppose gravity with muscles used for movement. It also will examine tissues for physical and chemical changes that may be related to the stress of launch, microgravity, re-entry and readaptation to Earth's gravity. Returning to Earth's gravity force probably produces muscle fiber tearing, blood clotting, tissue swelling and increased tissue necrosis.

These results will aid the development of inflight countermeasures. They may help prevent damage of the muscular system during adaptation to microgravity and following return to Earth. These findings also will help humans on Earth who are confined to bed for extended periods. Such people frequently experience muscle deterioration and slow recovery once they resume movement.

Pathophysiology of Mineral Loss During Spaceflight

Principal Investigator: Claude D. Arnaud, M.D.
University of California
San Francisco, CA

Experiment 305, " Pathophysiology of Mineral Loss During Spaceflight," will help researchers identify mechanisms causing changes in calcium homeostasis, or function, in microgravity. Those changes include increase calcium excretions and bone mineral loss.

According to the SLS-1 results, bone-dissolving cells called osteoclasts work at a higher rate than bone-building cells called osteoblasts. This trend causes bone and mineral abnormalities and revealed that ionized calcium in the blood reached levels that are considered clinically abnormal on Earth.

The SLS-2 activities will include a study of the role of active vitamin D metabolites and calciotropic hormones, such as parathyroid hormones, by measuring their circulating levels. A calcium absorption study examines the role of intestinal calcium handling.

Blood and urine samples will be drawn for both studies. The absorption study also will require crew members to ingest a calcium isotope tracer followed by an injection of a different calcium isotope tracer. The blood samples following the tracer ingestion will be refrigerated, centrifuged and then frozen for post-flight analysis.

Bone, Calcium and Space Flight

Principal Investigator: Emily R. Morey-Holton, Ph.D.
NASA-Ames Research Center
Moffett Field, CA

On Earth, the force imposed by gravity causes bone in growing animals to increase simultaneously in mass and strength. As a result, larger animals have larger and stronger bones. During spaceflight, however, bone strength does not increase in proportion to bone size as it would on Earth. The purpose of Experiment 194 is to delineate the early changes that occur in both weight bearing and non-weight bearing bone tissues in growing rats and to relate these changes to alterations in calcium metabolism. The experiment allows more precise calculations of the length of flight time required to significantly inhibit bone formation in juvenile rats.

Natural calcium in the diet will be replaced with a single stable non- radioactive isotope of calcium (40Ca). Since diet and bone are the major sources of calcium in the body, any calcium other than 40Ca found in blood, urine or feces must come from bone.

This study also will determine whether the production of new bone cells decreases or ceases entirely and whether bone mineralization is restored to preflight levels following spaceflight. Finally, it will determine the total amount of bone formed and the total amount of bone lost at intervals during the flight. Bone turnover also will be measured in the crew during this mission.

In space or during restricted exercise, changes in bone structure, coupled with the decrease in the mass of the gravity-dependent muscles, make movement difficult. Because of this instability, individuals may be prone to bone fractures when exercise or structural loading is increased (i.e., return to Earth from space).

We need to find out what components of the bone structure are changed, the extent to which they change, the impact of the changes on bone strength and if it is necessary to prevent the changes from occurring. Only then can we develop techniques to inhibit potentially damaging changes in bone structure during restricted physical use.

Research Animal Holding Facility

NASA Ames Research Center
Moffett Field, CA

The rodent Research Animal Holding Facility (RAHF) is a general-use facility for housing rodents in life sciences experiments in the Spacelab. It is a self-contained unit providing food, water, temperature and air-flow control, waste management and lighting for the animals on board. It can accommodate 24 400-gram rodents.

The rodent RAHF contains 12 cages that are removable for easy access to the animals. A cage can contain up to two animals, one in each of two compartments measuring 4 by 4-1/4 by 10 inches. Each cage contains a waste management system plus individual feeders and watering lixits. Food and water are available ad lib.

Additional control can be exercised over temperature and light/dark cycles. Protection against cross-contamination between crew and animal is provided through bacteriological isolation. An environmental control system is mounted on the back of each cage module to circulate conditioned air through the cages.

Cage temperature, animal activity, lighting, humidity and water consumption can be monitored by the ground crew and by the astronaut crew onboard. Food consumption on orbit is monitored by the crew. The rodent RAHF flew successfully on the 1991 Spacelab Life Sciences -1 mission. Two rodent RAHFs will fly on the SLS-2 mission.

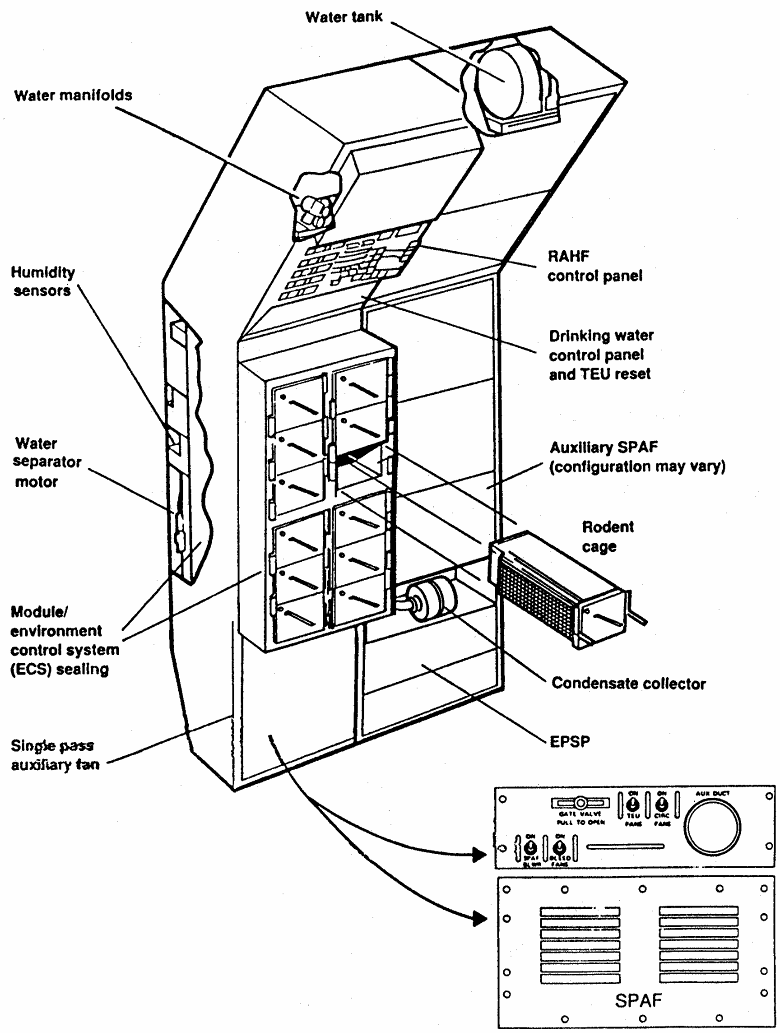
General Purpose Work Station

NASA Ames Research Center
Moffett Field, CA

The General Purpose Work Station (GPWS) is an enclosed, retractable cabinet providing broad-range support for general laboratory operations in isolation from the Spacelab environment. The GPWS can support animal experiments, biological sampling and microbiological experimentation. It also can serve as a closed environment for containment while routine equipment repair or other inflight operations are performed.

The GPWS provides the working space and accommodates the laboratory equipment and instruments for many life sciences investigations. The unit is self-contained, except for power, data and cooling interfaces with the Spacelab. Laboratory workbench accommodations, including airflow, power and lighting, are provided in a rack-mounted retractable cabinet. The cabinet has a full-size front door, which allows large experimental hardware to be mounted in the cabinet interior during flight. In addition, two crew members may simultaneously perform tasks inside the cabinet through ports on the front and side of the cabinet.

The GPWS was flown successfully on the first Spacelab Life Sciences mission in 1991 and on the Spacelab-J mission in 1992.



Generic Rodent RAHF - (Landing Orientation)

EDO MEDICAL PROJECT DSOS

Supplementing the Spacelab Life Sciences 2 Investigations, a series of detailed supplementary objectives (DSO) will provide additional information for on-going medical studies that support the Extended Duration Orbiter (EDO) Medical Project.

The EDO Medical Project is designed to assess the impact of long duration spaceflight (10 or more days) on astronaut health, identify any operational medical concerns and test countermeasures for the adverse affects of weightlessness on human physiology.

For STS-58, the Medical Sciences Division of the Johnson Space Center, Houston, is sponsoring seven DSOs that support the project. Most of the studies have been flown on previous Shuttle missions.

Three of the tests will take place inflight - DSO 611, “Air Monitoring Instrument Evaluation and Atmosphere Characterization;” DSO 612, “Energy Utilization;” and DSO 623, “Lower Body Negative Pressure (LBNP) Countermeasures.” The others will occur before and/or after the mission.

The LBNP activity employs a bag in which a vacuum can be created. The bag encases the lower body and seals at the waist. By lowering the pressure within the bag, the subject’s body fluids are drawn into his lower extremities, mimicking the natural fluid distribution that occurs on Earth. This conditions the cardiovascular system for the fluid shift that occurs upon re-entry and improves orthostatic tolerance.

For the LBNP protocols, Commander John Blaha and Mission Specialist Bill McArthur will serve as the subjects and Pilot Rick Searfoss will serve as the operator. Short 45-minute ramp protocols are scheduled for both subjects on Flight Days 3, 8, and 11, followed by a 4-hour soak protocol on Flight Day 14.

DSO 611 is designed to evaluate and verify equipment for collecting the microbial contaminate level of the orbiter air. This is done several times during the mission using a device that resembles a large flashlight. DSO 612 will assist researchers in determining the actual caloric requirements for spaceflight. Crew members will collect urine and saliva samples as well as keep a log of all fluid and food intake. Measurements also will be taken on astronaut’s blood glucose levels.

The post-flight DSOs include 603B, “Orthostatic Function During Entry, Landing and Egress;” 617, “Evaluation of Functional Skeletal Performance Following Space flight;” 620, Physiological Evaluation of Astronaut Seat Egress Ability at Wheel Stop;” and DSO 624, “Cardiorespiratory Responses to Submaximal Exercise.”

DSO 603B documents the relationship between mission duration and changes in orthostatic function of crew members during the actual stresses of landing and egress from the seat and crew cabin. This requires crew members to instrument themselves with Holter monitors and automated blood pressure monitors prior to donning their launch and entry suits. Data from the monitors will be recorded as will comments from the crew members during the operations.

DSO 620 also looks at changes in crew members’ ability to stand following landing but uses a video camera attached to the middeck lockers to document changes in sway and balance.

Determining the change in a crew member’s response to submaximal exercise (about 85 percent of the individual’s predetermined maximal exercise range) is the goal of DSO 624, while DSO 617 uses isokinetic equipment and electromyography to determine skeletal muscle strength, endurance and power. In both studies, the post-flight data will be compared to baseline measurements taken before the mission.

ORBITAL ACCELERATION RESEARCH EXPERIMENT (OARE)

The main goal of the experiment is to measure the Shuttle's aerodynamic forces (drag) in orbit and during the early stages of reentry. The OARE sensor is capable of discerning accelerations as small as one-billionth of the Earth's surface gravitational acceleration (i.e. 1:109).

OARE is designed to calibrate itself on-orbit so that absolute values of these low accelerations can be measured. All previous accelerometers onboard the Shuttle depended upon ground calibrations. This, of course, is done in a 1-g field on Earth and past experience has shown that, for the level of precision required for the OARE objectives, ground calibrations are not adequate.

The OARE sensor is mounted on top of a calibration-table platform which is free to rotate. The calibration system allows small drifts and offsets to be measured directly in flight. For example, the table can be spun at a precision rate to generate a known artificial gravity in orbit from which the output signals can be scaled.

The OARE equipment maiden flight was on STS-40 in June 1991. OARE was operated for about 3.5 days on orbit. However, some equipment problems were present and although much information was obtained, the flight data was partially compromised by an equipment malfunction. The problems were isolated after the flight, and the equipment has been repaired and has flown a second time on STS-50 (June 1992) where the instrument operated continuously for 14 days in orbit.

This was the first time in situ accelerometer calibrations were performed on the orbiter, and the data are of excellent quality. Although the entire 14 days of data has not been fully analyzed, the data has been sought by other investigators involved with microgravity experimentations on the flight.

The overall flight plan for OARE on STS-50 is about the same as on STS- 58. The plan is to operate the equipment over the entire 13 days in orbit. This means the OARE flight computer is pre-programmed to take into account the duration in orbit so that the flight data would fit into its 4 megabyte memory storage.

The OARE pitch, yaw and roll maneuvers, performed on STS-40 and STS-50, also will be performed on this flight. These maneuvers are an important source of information about the Shuttle physical characteristics such as vehicle center of gravity. In addition, the maneuvers can be used to check the automatic calibration procedures. For STS-58, the maneuvers will be performed on flight days 2, 7 and 13. In addition, the gravity gradient, turn-drag maneuver also will be performed on flight day 2.

The OARE flight hardware consists of 4 electronics boxes and a table assembly with a container mounted on its surface. This container houses the electrostatic-suspended proof-mass accelerometer sensor. The whole system weighs about 107 lbs. and is 17 x 13 x 41 inches and requires about 110 watts of power.

The OARE is manifested as a complex DTO and is mounted on a special keel bridge which spans bay 11 of the orbiter. This is essentially the floor of the orbiter payload bay, near the aft end of the bay.

The Principal Investigator for OARE is R. C. Blanchard, NASA Langley Research Center, Hampton, Va., and the Project Manager is R. Giesecke, NASA Johnson Space Center, Houston.

SHUTTLE AMATEUR RADIO EXPERIMENT (SAREX)

Students in the United States and France will have a chance to speak via amateur radio with astronauts aboard the Space Shuttle Columbia during STS-58. Ground-based amateur radio operators ("hams") will be able to contact the Shuttle through automated computer-to-computer amateur (packet) radio link. There also will be voice contacts with the general ham community as time permits.
Shuttle Pilot Richard A. Searfoss (license pending) and mission specialist William S. McArthur Jr. (KC5ACR) and payload specialist Martin J. Fettman (KC5AXA) will talk with students in 16 schools in the United States and in France using "ham radio."

Students in the following schools will have the opportunity to talk directly with orbiting astronauts for approximately 4 to 8 minutes:

- Russellville H.S., Russellville, Ariz. (K5PXP)
- Lloyd Ferguson Elementary, League City, Texas (KB5UFJ)
- Eastern Heights Jr. H.S., Elyria, Ohio (N8AM)
- Bloomfield Elementary, Bloomfield, Mo. (N0UOP)
- Carl Hayden Community H.S., Phoenix, Ariz. (N7UJJ)
- Sycamore Middle School, Pleasant View, Tenn. (AC9R)
- Alamo Heights Junior School, San Antonio, Texas (WA5FRF)
- Nashua H. S., Nashua, N. H. (N1NHS)
- Meyzeek Middle School, Louisville, Ky. (N4OKX)
- Webber Junior H.S., Fort Collins, Colo. (N0LHW)
- Red Springs H.S., Red Springs, N. C. (W4MZP)
- Ernest Elliott School, Munster, Ind. (AJ9N)
- Space Center Intermediate School, Houston (KA5GLX)
- St. Barnabas Episcopal School, Houston (N5NYD)
- Gardens Elementary School, Pasadena, Texas (N5VSP)
- Lycee Gaston Febus, Pau, France (FE1OBV)

The radio contacts are part of the SAREX project, a joint effort by NASA, the American Radio Relay League (ARRL), and the Amateur Radio Satellite Corp. (AMSAT).

The project, which has flown on 10 previous Shuttle missions, is designed to encourage public participation in the space program and support the conduct of educational initiatives through a program to demonstrate the effectiveness of communications between the Shuttle and low-cost ground stations using amateur radio voice and digital techniques.

Information about orbital elements, contact times, frequencies and crew operating schedules will be available during the mission from NASA, ARRL (Steve Mansfield, 203/666-1541) and AMSAT (Frank Bauer, 301/ 286-8421). AMSAT will provide information bulletins for interested parties on INTERNET and amateur packet radio.

The ham radio club at the Johnson Space Center(JSC), (W5RRR), will be operating on amateur short wave frequencies, and the ARRL station (W1AW) will include SAREX information in its regular voice and teletype bulletins.

There will be a SAREX information desk during the mission in the JSC newsroom. Mission information will be available on the computer bulletin board. To reach the bulletin board, use JSC BBS (8 N 1 1200 baud): dial 713/483-2500, then type 62511.

The amateur radio station at the Goddard Space Flight Center, Greenbelt, Md. (WA3NAN), will operate around the clock during the mission, providing SAREX information and retransmitting live Shuttle air- to-ground audio.

STS-58 SAREX Frequencies

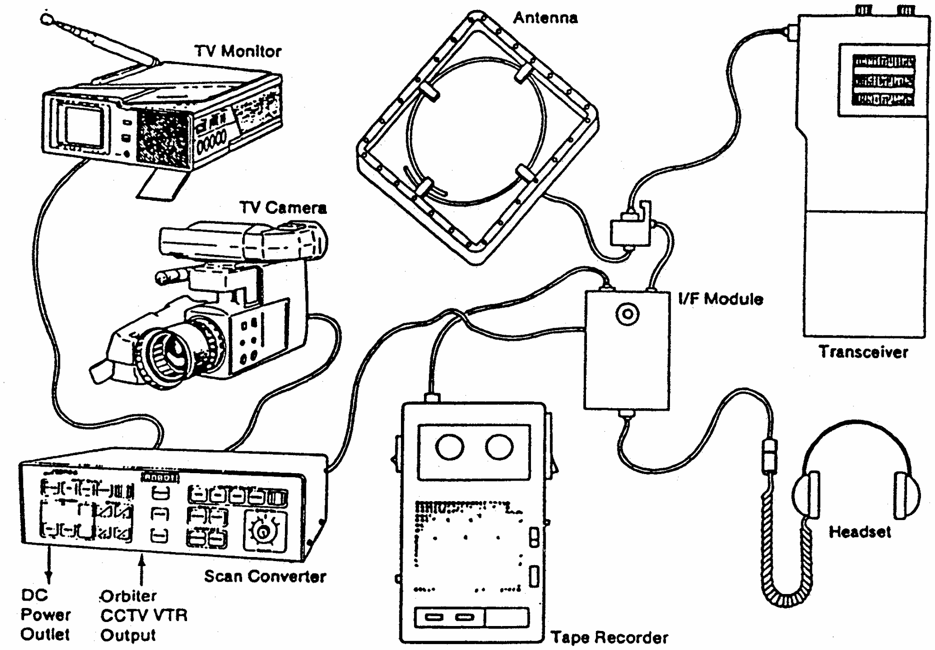
Routine SAREX transmissions from the Space Shuttle may be monitored on a downlink frequency of 145.55 MHz. The voice uplink frequencies are: 144.91 MHz 144.93 144.95 144.97 144.99 Note: The astronauts will not favor any one of the above frequencies. Therefore, the ability to talk with an astronaut depends on selecting one of the above frequencies chosen by the astronaut.

The amateur packet frequencies are:

Packet downlink	145.55 MHz	Packet uplink	144.49

The Goddard Space Flight Center amateur radio club planned HF operating frequencies:

3.860 MHz	7.185 MHz	14.295 MHz	21.395 MHz	28.650 MHz



SAREX optional configuration.

DTO-667: PILOT INFLIGHT LANDING OPERATIONS TRAINER (PILOT)

One of the challenges of flying long duration Shuttle missions is the issue of orbiter landing tasks. These tasks require a high level of skill and proficiency yet data shows that a pilot's landing skills degrade after an extended absence from a landing trainer such as the Shuttle Training Aircraft.

During Shuttle Mission STS-58, a portable scientific workstation designed to aid the Shuttle commander and pilot in maintaining those landing skills will be demonstrated for the first time.

The PILOT system hardware consists of a portable scientific workstation, a high resolution color display and a hand controller with orbiter look and feel. The software used in the system was transferred from the Shuttle Engineering Simulator software used to validate Shuttle flight software. This provides PILOT with orbiter handling and guidance characteristics.

The PILOT system is stowed in lockers on the flight deck and middeck areas of the Space Shuttle. When a member of the crew wants to use the system, the workstation is mounted on a console directly in front of the pilot's seat on the flight deck and the PILOT system hand controller is attached to the orbiter's hand controller.

In addition to evaluating the ability to maintain landing skills of a Shuttle crew in Earth-orbit, the PILOT system may be integrated into the standard training activities of all Shuttle crews at the Johnson Space Center, Houston.

STS-58 CREWMEMBERS

STS058-S-002 **--** *STS-58 crew portrait shows the crew wearing training versions of their launch and entry garments. Left to right (front) are David A. Wolf, and Shannon W. Lucid, both mission specialists; Rhea Seddon, payload commander; and Richard A. Searfoss, pilot. Left to right (rear) are John E. Blaha, mission commander; William S. McArthur Jr., mission specialist; and payload specialist Martin J. Fettman, DVM.*

BIOGRAPHICAL DATA

JOHN E. BLAHA, 51, Col., USAF, is Commander (CDR) of STS-58. Selected as an astronaut in May 1980, Blaha considers San Antonio, Texas, his hometown and will be making his fourth spaceflight.

Blaha graduated from Granby High School in Norfolk, Va., in 1960; received a bachelors degree in engineering science from the USAF Academy in 1965; and received a masters degree in astronautical engineering from Purdue University in 1966.

Blaha first flew as Pilot for Shuttle mission STS-29 in March 1989. On his second flight, he was Pilot for STS-33 in November 1989. On his most recent flight, he was Commander for STS-43 in August 1991. Blaha has logged more than 453 hours in space.

RICHARD A. SEARFOSS, 37, Lt. Col., USAF, serves as Pilot (PLT). Selected as an astronaut in January 1990, Searfoss was born in Mount Clemens, Mich., but considers Portsmouth, N. H., his hometown. He will be making his first spaceflight.

Searfoss graduated from Portsmouth Senior High School in 1974; received a bachelors degree in aeronautical engineering from the USAF Academy in 1978; and received a masters degree in aeronautics from the California Institute of Technology on a National Science Foundation Fellowship in 1979.

Searfoss graduated in 1980 from Undergraduate Pilot Training at Williams AFB, Ariz. He flew the F-111F aircraft at RAF Lakenheath, England, followed by a tour at Mountain Home AFB, Idaho. In 1988, he attended the Naval Test Pilot School, Patuxent River, Md., as a USAF exchange officer. He was a flight instructor at the Air Force Test Pilot School at Edwards AFB, Calif., when selected for the astronaut program. Searfoss has logged over 2,500 hours flying time in 54 different types of aircraft.

M. RHEA SEDDON, M.D., 45, serves as Payload Commander and Mission Specialist 1 (MS1). Selected as an astronaut in 1978, Seddon is from Murfreesboro, Tenn., and will be making her third spaceflight.

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

Seddon served as a mission specialist aboard Discovery on STS-51D in April 1985. Her next flight was as a mission specialist on STS-40 in May 1991. She has logged more than 218 hours in space.

WILLIAM S. MCARTHUR Jr., 42, Lt. Col., USA, serves as Mission Specialist 2 (MS2). Selected as an astronaut in January 1990, McArthur considers Wakulla, N. C., his hometown and will be making his first spaceflight.

McArthur graduated from Red Springs High School, Red Springs, N. C., in 1969; received a bachelors degree in applied science and engineering from the U.S. Military Academy in 1973; and received a masters degree in aerospace engineering from the Georgia Institute of Technology in 1983.

After West Point and following a tour with the 82nd Airborne Division, McArthur entered the U.S. Army Aviation School in 1975 and was designated an Army Aviator in June 1976. He served with the 2nd Infantry Division in Korea and with the 24th Combat Aviation Battalion in Savannah, Ga., and later was an assistant professor in the Department of Mechanics at West Point.
In June 1987, he graduated from the Naval Test Pilot School. At the time of his selection as an astronaut, he was assigned to NASA at the Johnson Space Center as a Space Shuttle Integration Test Engineer. McArthur has logged over 2,700 flight hours in 36 different aircraft.

BIOGRAPHICAL DATA

DAVID A. WOLF, M.D., 37, serves as Mission Specialist 3 (MS3). Selected as an astronaut in January 1990, Wolf considers Indianapolis, Ind., his hometown and will be making his first spaceflight.

Wolf graduated from North Central High School in Indianapolis in 1974; received a bachelors degree in electrical engineering from Purdue University in 1978; and received a doctorate in medicine from Indiana University in 1982. He completed his medical internship at Methodist Hospital in Indianapolis and later completed Air Force flight surgeon primary training at Brooks AFB, San Antonio, Texas.

Wolf worked as a research scientist at the Indianapolis Center for Advanced Research from 1980 to 1983. In 1983, he joined NASA in the Medical Sciences Division of the Johnson Space Center, where he was responsible for development of the American Flight Echocardiograph.

In 1986, he was assigned to direct development of the Space Bioreactor and associated cancer research and tissue culture applications which use controlled gravitational conditions. He is a flight surgeon in the Air National Guard and has logged over 500 hours in the F4 Phantom jet.

SHANNON W. LUCID, Ph.D., 50, serves as Mission Specialist 4 (MS4). Selected as an astronaut in January 1978, Lucid considers Bethany, Okla., her hometown and will be making her fourth spaceflight.

Lucid graduated from Bethany High School in 1960 and received a bachelors degree in chemistry, a masters degree and a doctorate in biochemistry from the University of Oklahoma in 1963, 1970 and 1973, respectively.

Lucid first flew as a mission specialist on STS-51G in June 1985. Her next flight was as a mission specialist on STS-34 in October 1989. Her third flight was as a mission specialist on STS-43 in August 1991. Lucid has logged over 502 hours in space.

MARTIN J. FETTMAN, D.V.M., Ph. D., 36, serves as payload specialist. Fettman considers Brooklyn, N. Y., his hometown and will be making his first spaceflight.

Fettman graduated from Midwood High School in Brooklyn in 1973; received a bachelors degree in animal nutrition from Cornell University in 1976; received a masters degree in nutrition and a doctor of veterinary medicine from Cornell University in 1980; and received a doctorate in physiology from Colorado State University in 1982. He is a diplomate of the American College of Veterinary Pathologists.

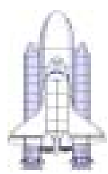
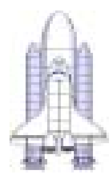
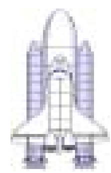
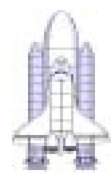
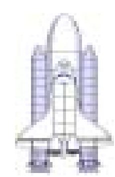
Fettman served in the Department of Pathology of the College of Veterinary Medicine and Biomedical Sciences at Colorado State University as an assistant professor of clinical pathology from 1982 to 1986.

From 1983 to the present, he has held a joint appointment in the Department of Physiology at Colorado State University. His research and teaching interests have focused on selected aspects of the pathophysiology of nutritional and metabolic diseases.

In 1988, Fettman assumed the duties of Section Chief of Clinical Pathology in the Veterinary Teaching Hospital, Colorado State University. From 1989 to 1990, Fettman took a sabbatical leave as a visiting professor of medicine at The Queen Elizabeth Hospital and the University of Adelaide in Australia. He was named a Professor of Pathology at Colorado State in 1992.

SHUTTLE FLIGHTS AS OF SEPTEMBER

57 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 32 SINCE RETURN TO FLIGHT

		STS-51 09/12/93 – 09/22/93		
		STS-56 04/08/83 - 04/17/93		
		STS-53 12/02/92 - 12/09/92		
STS-55 04/26/93 - 05/06/93		STS-42 01/22/92 - 01/30/92		
STS-52 10/22/92 - 11/01/92		STS-48 09/12/91 - 09/18/91		
STS-50 06/25/92 - 07/09/92		STS-39 04/28/91 - 05/06/91	STS-46 07/31/92 - 08/08/92	
STS-40 06/05/91 - 06/14/91		STS-41 10/06/90 - 10/10/90	STS-45 03/24/92 - 04/02/92	
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-57 06/21/93 - 07/01/93
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-54 01/13/93 - 01/19/93
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-47 09/12/92 - 09/20/92
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	STS-49 05/07/92 - 05/16/92
OV-102 Columbia (14 flights)	**OV-099 Challenger (10 flights)**	**OV-103 Discovery (17 flights)**	**OV-104 Atlantis (12 flights)**	**OV-105 Endeavour (4 flights)**