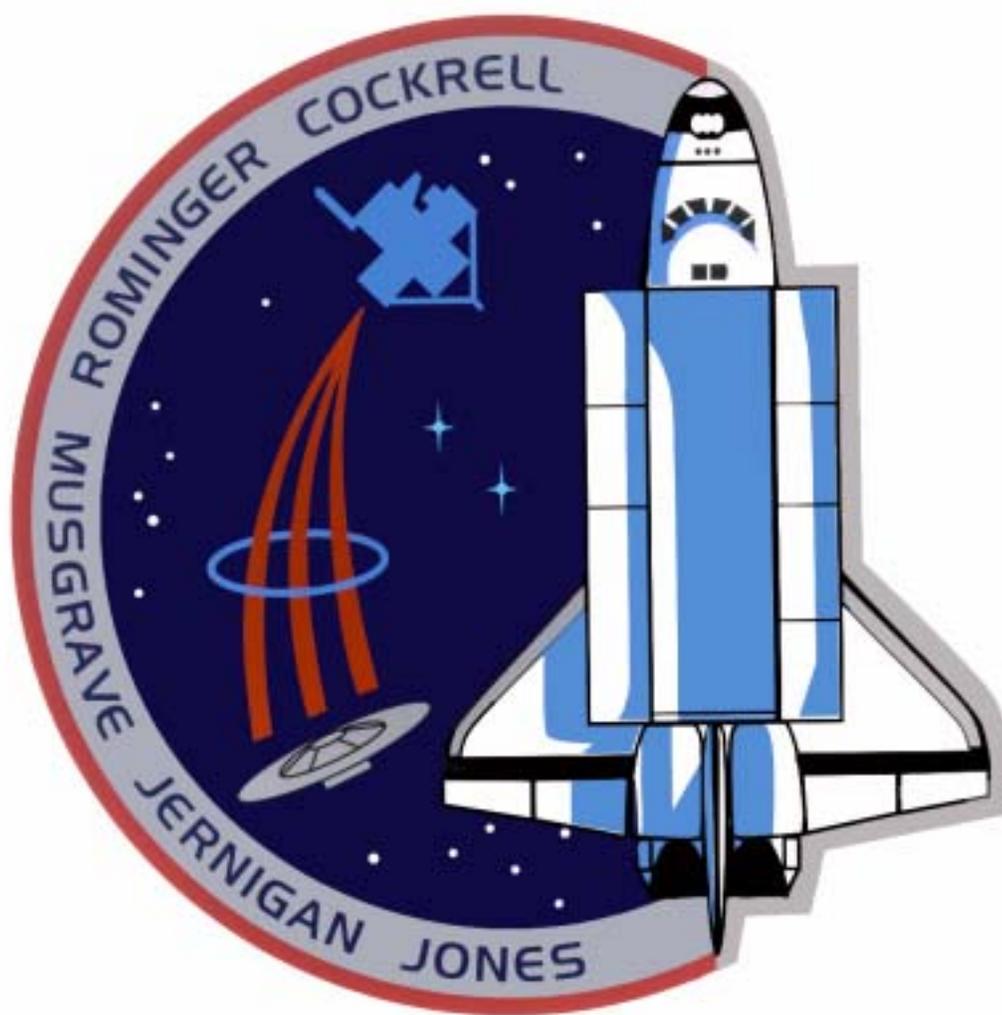


NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION STS-80

PRESS KIT
NOVEMBER 1996



WAKE SHIELD FACILITY
ORFEUS-SPAS

STS-80 INSIGNIA

STS080-S-001 – The STS-80 insignia depicts the space shuttle Columbia and the two research satellites its crew will deploy into the blue field of space. The uppermost satellite is the Orbiting Retrievable Far and Extreme Ultraviolet Spectrograph- Shuttle Pallet Satellite (ORFEUS-SPAS), a telescope aimed at unraveling the life cycles of stars and understanding the gases that drift between them. The lower satellite is the Wake Shield Facility (WSF), flying for the third time. It will use the vacuum of space to create advanced semiconductors for the nation's electronics industry. ORFEUS and WSF are joined by the symbol of the Astronaut Corps, representing the human contribution to scientific progress in space. The two bright blue stars represent the mission's extravehicular activities (EVA), final rehearsals for techniques and tools to be used in assembly of the International Space Station (ISS). Surrounding Columbia is a constellation of 16 stars, one for each day of the mission, representing the stellar talents of the ground and flight teams that share the goal of expanding knowledge through a permanent human presence in space.

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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NEWS MEDIA CONTACTS

For Information on the Space Shuttle

| | | |
|---|----------------------------------|--------------|
| Ed Campion NASA Headquarters Washington, DC | Policy/Management | 202/358-1778 |
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| Bruce Buckingham Kennedy Space Center, FL | Launch Processing, KSC Landing | 407/867-2468 |
| June Malone Marshall Space Flight Center Huntsville, AL | External Tank/Shuttle Propulsion | 205/544-0034 |
| Cam Martin Dryden Flight Research Center Edwards, CA | DFRC Landing Information | 805/258-3448 |

For Information on STS-80 Experiments & Activities

| | | |
|---|-----------------------|--------------|
| Jim Cast NASA Headquarters Washington, DC | WSF / VIEW-CPL / CMIX | 202/358-1779 |
| Doug Isbell NASA Headquarters Washington, DC | ORFEUS-SPAS | 202/358-1547 |
| Mike Braukus NASA Headquarters Washington, DC | NIH-R / BRIC | 202/358-1979 |
| Tammy Jones Goddard Space Flight Center Greenbelt, MD | SEM | 301/286-5566 |

RELEASE: 96-206

**TWO SATELLITES DEPLOYED & RETRIEVED, PAIR OF SPACE WALKS
HIGHLIGHT NASA'S FINAL MISSION FOR 1996**

NASA's final Shuttle flight for 1996 will again demonstrate the versatility of the Space Shuttle system. During Mission STS-80, Columbia's five person crew will deploy and retrieve two free-flying spacecraft, conduct two space walks and perform a variety of microgravity research experiments in the Shuttle's middeck area.

The STS-80 crew will be commanded by Kenneth D. Cockrell, who will be making his third space flight. The pilot, Kent V. Rominger, will be making his second flight. The three mission specialists for STS-80 are Tamara E. Jernigan who is making her fourth flight, Thomas D. Jones who is making his third flight and Story Musgrave who is making his sixth space flight.

Columbia is currently targeted for launch on Nov. 8, 1996, from NASA Kennedy Space Center's Launch Complex 39-B. The two-hour, thirty-minute launch window opens at 2:47 p.m. EST. The planned mission duration is 15 days, 16 hours, 44 minutes. A launch at the opening of the window would set Columbia and her crew up for a return to KSC's Shuttle Landing Facility on Nov. 24 at 7:31 a.m. EST.

The first of the two free-flying payloads being carried aboard Columbia is the Orbiting Retrievable Far and Extreme Ultraviolet Spectrometer (ORFEUS) satellite. The ORFEUS instruments are mounted on the reusable Shuttle Pallet Satellite (SPAS) and will study the origin and makeup of stars. About seven hours after launch, ORFEUS-SPAS will be deployed using the Shuttle's mechanical arm. It will fly free of the Shuttle for almost two weeks until it is retrieved on Flight Day 13.

The second of the two free-flying payloads aboard Columbia is the Wake Shield Facility (WSF). The WSF is designed to fly free of the Shuttle, creating a super vacuum in its wake in which to grow thin film wafers for use in semiconductors and other high-tech electrical components. WSF will be deployed on Flight Day 4 and retrieved on Flight Day 7.

Astronauts Tammy Jernigan and Tom Jones will perform two six-hour spacewalks during STS-80, one on Flight Day 10 and another on Day 12, to evaluate equipment and procedures that will be used during construction and maintenance of the International Space Station.

Two on-going collaborative efforts between NASA and the National Institutes of Health (NIH) will be a part of STS-80. One effort is NIH-R-4 which will study blood pressure regulation and function in rats fed either a high- or a low-calcium diet before and during space flight. This study will add to the body of knowledge necessary to maintain the health of astronauts during space flight. The other experiment, CCM-A, (formerly NIH-C-6) will continue the investigation into how microgravity affects bones at the cellular level. The bone loss experienced by astronauts in orbit is similar to that which occurs in people who undergo prolonged bed rest.

The Biological Research in Canister (BRIC) experiment will focus on the effects of genetic expression and microgravity on plants. Researchers hope that BRIC will help improve growth rates and biomass production of plants grown in space and may enhance crop productivity on the Earth.

The Space Experiment Module (SEM) flying on STS-80 is a NASA education initiative that provides increased educational access to space. The program targets kindergarten through university level participants. SEM stimulates and encourages direct student participation in the creation, development, and flight of zero-gravity and microgravity experiments on the Space Shuttle. Other experiments aboard the shuttle will conduct research in a multitude of areas including acid rain, developing better treatments for the human body and excess heat generated by spacecraft instruments.

STS-80 will be the 21st flight of Columbia and the 80th mission flown since the start of the Space Shuttle program in April 1981.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

MEDIA SERVICES INFORMATION

NASA Television Transmission

NASA Television is available through the Spacenet-2 satellite system. Spacenet-2 is located on Transponder 5, channel 9, C- Band, at 69 degrees West longitude, frequency 3880.0 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, FL; Marshall Space Flight Center, Huntsville, AL; Dryden Flight Research Center, Edwards, CA; Johnson Space Center, Houston, TX; and NASA Headquarters, Washington, DC. The television schedule will be updated to reflect changes dictated by mission operations.

Television schedules also may be obtained by calling COMSTOR at 713/483-5817. COMSTOR is a computer data base service requiring the use of a telephone modem. A voice update of the television schedule is provided 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 before launch. During the mission, status briefings by a flight director or mission operations representative and when appropriate, representatives from the payload team, will occur at least once each day. The updated NASA television schedule will indicate when mission briefings are planned.

Internet Information

Information on STS-80 is available through several sources on the Internet. The primary source for mission information is the NASA Shuttle Web, part of the World Wide Web. This site contains information on the crew and their mission and will be regularly updated with status reports, photos and video clips throughout the flight. The NASA Shuttle Web's address is:

<http://shuttle.nasa.gov>

If that address is busy or unavailable, Shuttle information is available through the Office of Space Flight Home Page:

<http://www.osf.hq.nasa.gov/>

General information on NASA and its programs is available through the NASA Home Page and the NASA Public Affairs Home Page:

<http://www.nasa.gov>

or

http://www.gsfc.nasa.gov/hqpao/hqpao_home.html

Information on other current NASA activities is available through the Today@NASA page:

<http://www.hq.nasa.gov/office/pao/NewsRoom/today.html>

The NASA TV schedule is available from the NTV Home Page:

<http://www.hq.nasa.gov/office/pao/ntv.html>

Status reports, TV schedules and other information are also available from the NASA Headquarters FTP (File Transfer Protocol) server, [ftp.hq.nasa.gov](ftp://ftp.hq.nasa.gov). Log in as anonymous and go to the directory /pub/pao. Users should log on with the user name "anonymous" (no quotes), then enter their E-mail address as the password. Within the /pub/pao directory there will be a "readme.txt" file explaining the directory structure:

- Pre-launch status reports (KSC): **[ftp.hq.nasa.gov/pub/pao/statrpt/ksc](ftp://ftp.hq.nasa.gov/pub/pao/statrpt/ksc)**
- Mission status reports(JSC): **[ftp.hq.nasa.gov/pub/pao/statrpt/jsc](ftp://ftp.hq.nasa.gov/pub/pao/statrpt/jsc)**
- Daily TV schedules: **[ftp.hq.nasa.gov/pub/pao/statrpt/jsc/tvsked](ftp://ftp.hq.nasa.gov/pub/pao/statrpt/jsc/tvsked)**.

NASA's Spacelink, a resource for educators, also provides mission information via the Internet. The system fully supports the following Internet services:

- World Wide Web: **<http://spacelink.msfc.nasa.gov>**
- Gopher: **[spacelink.msfc.nasa.gov](gopher://spacelink.msfc.nasa.gov)**
- Anonymous FTP: **[spacelink.msfc.nasa.gov](ftp://spacelink.msfc.nasa.gov)**
- Telnet : **[spacelink.msfc.nasa.gov](telnet://spacelink.msfc.nasa.gov)**

Spacelink's dial-up modem line is 205/895-0028.

Access by CompuServe

Users with CompuServe accounts can access NASA press releases by typing "GO NASA" (no quotes) and making a selection from the categories offered.

STS-80 QUICK LOOK

Launch Date/Site: Nov. 8, 1996/KSC Launch Pad 39-B
Launch Time: 2:47 PM EST
Launch Window: 2 hours, 30 minutes
Orbiter: Columbia (OV-102), 21st flight
Orbit Altitude/Inclination: 190 nautical miles, 28.5 degrees
Mission Duration: 15 days, 16 hours, 44 minutes
Landing Date: Nov. 24, 1996
Landing Time: 7:31 AM EST
Primary Landing Site: Kennedy Space Center, FL
Abort Landing Sites: Return to Launch Site: KSC
Transoceanic Abort Sites: Ben Guerir, Morocco
Moron, Spain
Abort-Once Around: Edwards AFB, CA

Crew: Ken Cockrell, Commander (CDR), 3rd flight
Kent Rominger, Pilot (PLT), 2nd flight
Tammy Jernigan, Mission Specialist 1 (MS 1), 4th flight
Tom Jones, Mission Specialist 2 (MS 2), 3rd flight
Story Musgrave, Mission Specialist 3 (MS 3), 6th flight

EVA Crew: Tammy Jernigan (EV 1), Tom Jones (EV 2)

Cargo Bay Payloads: ORFEUS-SPAS-02
WSF-03
EDFT-05

In-Cabin Payloads: PARE-NIH-R
CMIX
VIEW-CPL
BRIC
CMIX
CCM-A

CREW RESPONSIBILITIES

| Payloads | Prime | Backup |
|-----------------------------|---------------------------------|--------------------|
| ORFEUS-SPAS | Jernigan | Musgrave |
| Wake Shield Facility | Musgrave | Jones |
| EVA | Jernigan (EV 1) Jones (EV-2) | |
| Intravehicular Crewmember | Musgrave | ----- |
| RMS | Jones | Jernigan, Rominger |
| Rendezvous | Cockrell | Rominger, Musgrave |
| Orbiter Space Vision System | Jernigan | Jones |
| CMIX | Rominger | Musgrave |
| BRIC | Jones | Jernigan |
| Earth Observations | Musgrave | Jones |
| VIEW-CPL | Rominger | Jernigan |
| PARE-NIH | Cockrell | Musgrave |

**DEVELOPMENTAL TEST OBJECTIVES,
DETAILED SUPPLEMENTARY OBJECTIVES**

DTO 255: Wraparound DAP Flight Test Verification
DTO 312: ET TPS Performance
DTO 667: Portable In-Flight Landing Operations Trainer
DTO 671: EVA Hardware for Future Scheduled EVA Missions
DTO 700-10: Orbiter Space Vision System Flight Video Taping
DTO 700-11: Orbiter Space Vision System Flight Unit Testing
DTO 833: EMU Thermal Comfort and EVA Worksite Thermal Evaluation
DTO 840: Hand-Held Lidar Procedures

DSO 485: ITEPC Bay 3 Starboard, Aft
DSO 487: Immunological Assessment of Crewmembers
DSO 901: Documentary Television
DSO 902: Documentary Motion Picture Photography
DSO 903: Documentary Still Photography

MISSION SUMMARY TIMELINE

Flight Day 1

Launch/Ascent
OMS-2 Burn
Payload Bay Door Opening
RMS Checkout
ORFEUS-SPAS Deploy

Flight Day 2

Orbiter Space Vision System
Operations
CMIX Operations
VIEW-CPL Operations

Flight Day 3

EMU Checkout
WSF Predeploy Preparations
SPAS Rendezvous Burns

Flight Day 4

Wake Shield Deploy
Rendezvous Burns

Flight Day 5

VIEW-CPL Operations
Secondary Experiments

Flight Day 6

Off Duty Time
VIEW-CPL Operations
Rendezvous Burns

Flight Day 7

Wake Shield Facility Rendezvous
and Grapple
SPAS Rendezvous Burns

Flight Day 8

Wake Shield Facility Grapple,
Unberth and Attached Science
VIEW-CPL Operations
Orbiter Space Vision Operations
Secondary Experiments
Cabin Depress
SPAS Rendezvous Burns

Flight Day 9

EVA Tool Setup
Middeck Preparations for EVA
SPAS Rendezvous Burns

Flight Day 10

EVA Preparations
Prebreathe
EVA 1 (6 hours)

Flight Day 11

EVA Tool Setup
EMU Maintenance
SPAS Rendezvous Burns

Flight Day 12

EVA Preparations
Prebreathe
EVA 2 (6 hours)

Flight Day 13

SPAS Rendezvous Burns
Off Duty Time
Orbiter Space Vision System
Operations
EVA Questionnaires
EVA Tool Stowage
PILOT Operations

Flight Day 14

ORFEUS-SPAS Rendezvous and
Grapple
Orbiter Space Vision System
Operations
PILOT Operations

Flight Day 15

Crew News Conference
Hubble Space Telescope Vernier
RCS Reboost Demonstration
PILOT Operations
Flight Control System Checkout
Reaction Control System Hot-Fire
Cabin Stow

Flight Day 16/17

Deorbit Preparation Briefing
Deorbit Prep
Payload Bay Door Closing
Deorbit Burn
KSC Landing

STS-80 ORBITAL EVENTS SUMMARY

(Based on a Nov. 8, 1996 Launch)

| Event | MET | Time of Day (EST) |
|------------------------------|------------|--------------------------|
| Launch | 0/00:00 | 2:47 PM, Nov. 8 |
| ORFEUS-SPAS Deploy | 0/07:00 | 9:47 PM, Nov. 8 |
| Wake Shield Facility Deploy | 3/05:10 | 7:57 PM, Nov. 11 |
| Wake Shield Facility Grapple | 6/09:07 | 11:54 PM, Nov. 14 |
| EVA 1 Begins (6 1/2 hrs.) | 9/06:20 | 9:07 PM, Nov. 17 |
| EVA 2 Begins (6 1/2 hrs.) | 11/06:50 | 9:37 PM, Nov. 19 |
| ORFEUS-SPAS Grapple | 13/10:35 | 1:22 AM, Nov. 22 |
| Crew News Conference | 14/06:05 | 8:52 PM, Nov. 22 |
| Deorbit Burn | 15/15:38 | 6:25 AM, Nov. 24 |
| KSC Landing | 15/16:44 | 7:31 AM, Nov. 24 |

MET: Mission Elapsed Time (Days/Hours:Minutes after launch.)

PAYLOAD AND VEHICLE WEIGHTS

| | <u>Pounds</u> |
|--------------------------------------|----------------------|
| Orbiter (Columbia) empty and 3 SSMEs | 181,740 |
| Shuttle System at SRB Ignition | 4,524,590 |
| Orbiter Weight at Landing with Cargo | 226,954 |
| ORFEUS-SPAS | 7,876 |
| Wake Shield Facility | 4,650 |
| WSF Carrier System | 4,750 |

SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, Orbiter and its payload. Abort modes for STS-80 include:

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

ORFEUS-SPAS II

The Orbiting and Retrievable Far and Extreme Ultraviolet Spectrograph-Shuttle Pallet Satellite II (ORFEUS-SPAS II) mission is the third flight to use the German-built ASTRO-SPAS science satellite. The ASTRO-SPAS program is a cooperative endeavor between NASA and the German Space Agency, DARA.

ORFEUS-SPAS II, a free-flying satellite, will be deployed and retrieved using the Space Shuttle Columbia's Remote Manipulator System (RMS). The goal of this astrophysics mission is to investigate the rarely explored far- and extreme-ultraviolet regions of the electromagnetic spectrum, and study the very hot and very cold matter in the universe.

ORFEUS-SPAS II will be attempting a large number of observing programs. Among the many areas in which scientists hope to gain new insights during this mission are the evolution of stars, the structure of galaxies, and the nature of the interstellar medium, and others. Many of the objects they are planning to look at have never before been observed in the far-ultraviolet.

ASTRO-SPAS is a carrier designed for launch, deployment and retrieval by the Space Shuttle. Once deployed from the Shuttle's RMS, ASTRO-SPAS will operate quasi-autonomously for 14 days in the vicinity of the Shuttle. The carrier's inclination will be 28.4 degrees with an altitude of 218 statute miles. After completion of the free flight phase, the satellite will be retrieved by the RMS, returned to the Shuttle cargo bay and returned to Earth.

The one-meter diameter ORFEUS-Telescope with the Far Ultraviolet (FUV) Spectrograph and the Extreme Ultraviolet (EUV) Spectrograph comprises the main payload. A secondary, but highly complementary, payload is the Interstellar Medium Absorption Profile Spectrograph (IMAPS). In addition to the astronomy payloads, ORFEUS-SPAS II carries the Surface Effects Sample Monitor (SESAM), the ATV Rendezvous Pre-Development Project (ARP), and the Student Experiment on ASTRO-SPAS (SEAS).

SCIENTIFIC OBJECTIVES

The ORFEUS-SPAS II mission is dedicated to astronomical observations at very short wavelengths, specifically the two spectral ranges Far Ultraviolet (FUV, 90-125 nanometers) and Extreme Ultraviolet (EUV, 40-90 nanometers). This part of the electromagnetic spectrum, which is obscured by the Earth's atmosphere precluding ground-based observations and not observed by the Hubble Space Telescope, includes a high density of spectral lines (especially from various states of hydrogen and oxygen), which are emitted or absorbed by matter covering a wide range of temperatures.

The primary scientific objectives are:

- Investigation of the nature of hot stellar atmospheres
- Investigation of cooling mechanisms of white dwarf stars
- Determination of the nature of accretion disks around collapsed stars
- Investigation of supernova remnants
- Investigation of the interstellar medium and potential star forming regions

The ORFEUS-SPAS I mission, which flew on the Shuttle Discovery STS-51 mission in September 1993, provided valuable information in this largely unexplored region of the electromagnetic spectrum. ORFEUS-SPAS I provided information on the details of the structure and dynamics of interstellar gas clouds and insight into how molecular hydrogen is created in interstellar space. Also studied were neutral and ionized gas in the interstellar medium from the local solar neighborhood out to the distant halo of our galaxy. ORFEUS-SPAS I also obtained spectra of a very diverse group of important astrophysical objects, including a compact interacting binary star with an enormous magnetic field, three hot white dwarf stars and the distant active galaxy PKS2155-304.

Star formation is not yet completely understood. Stars are, however, known to be formed in dense clouds of interstellar gas and dust. Under gravitational contraction, these clouds can become dense enough to trigger star formation. ORFEUS-SPAS II data will help to measure the size, distance, density and temperature of such clouds, which in turn aids in understanding of the circumstances under which interstellar clouds collapse and new stars are born.

Once a star is formed, its evolution is mainly ruled by its mass. High mass stars burn energy through nuclear fusion more than 100,000 times faster than Earth's Sun, through processes which give rise to bright ultraviolet emission and strong winds of hot ionized material. ORFEUS-SPAS II will study the surfaces and winds of such objects.

Low-mass stars like Earth's Sun burn their energy reserves relatively slowly, not emitting large amounts of ultraviolet radiation. The outermost layers of their atmospheres can become very hot, however, due to turbulent convection which creates shock waves. ORFEUS-SPAS II will measure ultraviolet spectra of such layers of relatively cold stars to help understand the physics of these processes.

Most stars end up as compact white dwarfs. These stars take a very long time to cool down. During that time, they emit most of their energy in the ultraviolet wavelength range, and are among the brightest EUV sources. ORFEUS-SPAS II will observe compact white dwarfs to gain a new understanding of their cooling mechanisms.

Once their energy reserves have been depleted, larger stars explode as supernovae and return their mass back to the interstellar medium. ORFEUS-SPAS II is capable of tracing supernova remnants.

Under certain conditions, the stars of binary systems can exchange material, forming hot accretion disks. ORFEUS-SPAS II observations of these systems are aimed at determining how fast the stars exchange material and other characteristics of the disk. Scientists believe that a similar phenomenon takes place on a much larger scale in the centers of some galaxies, known as Active Galactic Nuclei (AGN). In AGN, massive black holes are believed to be surrounded by huge accretion disks. Direct observation of a possible AGN in the Milky Way galaxy is obscured by dense clouds of dust. AGNs are inherently bright, but appear faint because of their enormous distance from Earth. Because very little data is available on AGNs, even a single spectrum of these exotic objects obtained by ORFEUS-SPAS II could lead to an important new understanding.

For the science community ORFEUS-SPAS II offers one additional major advantage over the first flight: half the observing time during the mission has been made available to the general science community. Including the instrument teams, ORFEUS-SPAS II will have more than 40 research teams around the world receiving and analyzing data from the mission.

Science Payload

The ORFEUS-SPAS II science payload is provided by German and U.S. research institutions with funding provided by DARA and NASA. Science operations will be conducted in the mobile German SPAS Payload Operations Center (SPOC) at Kennedy Space Center. The core instrument is the ORFEUS telescope with the FUV Echelle spectrograph and the EUV spectrograph, built into the telescope structure. The 1-meter diameter ultraviolet telescope has a 2.4-meter focal length. An iridium coating on the primary mirror serves as a reflection enhancement for ultraviolet wavelengths. Essential stability against mechanical and thermal load deformations is provided by the carbon fiber epoxy compound tube structure.

The EUV spectrograph is directly exposed to light reflected off the main mirror. It covers the spectral range 40-115 nanometers, offering a resolution of about 5,000 over the whole bandwidth. In order to achieve this unprecedented high resolution over such a wide band-width, a completely new design was used, which produces high quality spectra.

The FUV Echelle spectrograph is operated alternatively with the EUV spectrograph, by flipping a mirror into the beam reflected off the primary mirror. The FUV spectrograph covers the wavelength range 90-125 nanometers and provides a spectral resolution on the order of 10,000. Two reflection gratings disperse the light into a spectrum, which is projected onto a two-dimensional micro channel-plate-detector. The detector is optimized for high spatial resolution.

IMAPS, the Interstellar Medium Absorption Profile Spectrograph is a separate instrument, attached to the ASTRO-SPAS framework. IMAPS operates independently of the ORFEUS telescope. IMAPS will be operated for more than two days over the duration of the free flight mission and during that time will observe the brightest galactic objects at extremely high resolutions. This resolution allows study of fine structure in interstellar gas lines. The individual motions of interstellar gas clouds can be determined to an accuracy of 1.6 kilometers per second. IMAPS was successfully flown on several sounding rocket missions as well as on ORFEUS- SPAS I.

To fulfill their obligations to the scientific community, DARA and NASA have initiated an ORFEUS Guest Investigator (GI) program. Both parties envision a 50-50 split in mission observing time between the GI and instrument Principal Investigator programs. NASA and DARA have agreed to share equally the available GI observing time. The proposals received at both agencies were evaluated in competitive scientific peer reviews and from the successful U.S. and German proposals a combined, non-overlapping list of recommended targets was generated.

Another science payload is the Surface Effects Sample Monitor (SESAM), a passive carrier for state-of-the-art optical surfaces and potential future detector materials. SESAM will investigate the impact of the space environment on materials and surfaces in different phases of a Space Shuttle mission, from launch, orbit phase to re-entry into the Earth's atmosphere. Among the SESAM samples are also witness samples to the telescope mirror, allowing for accurate calibration measurements after landing. Sample spaces are available to scientific and industrial users.

The ATV Rendezvous Pre-Development Project (ARP), part of the European Space Agency's Automated Transfer Vehicle (ATV), is an element of the European manned space transportation program. Among the objectives of the ARP are to develop and validate ground simulation facilities; develop and demonstrate on-board control software and in-orbit relative GPS capabilities; and to demonstrate the operation of the optical rendezvous sensor in orbit.

The Student Experiment on ASTRO-SPAS (SEAS) is an electrolysis experiment built by students of the German high school of Ottobrunn. It consists of eight experiment chambers containing various metal salt solutions and two electrodes. Metal 'trees' of different shapes will grow on one electrode. Photographs taken of this process during the mission will be compared to those of identical experiments conducted on the ground under the full influence of Earth's gravity.

THE DARA SCHOOL PROJECT

For this second ORFEUS-SPAS mission, DARA has developed an innovative educational program designed to reach students in 170 German schools teaching astronomy, physics and computer science. The classes, which already are in progress, have been tailored to prepare the students to use ORFEUS-SPAS data in the study of general astronomy, the life and death of stars, stellar spectral analysis, as well as how to work with the data on computers via the Internet. DARA supplied the necessary written course information and developed an ORFEUS-SPAS Internet home page, where students will receive and work directly with the data obtained during the mission.

The ASTRO-SPAS Carrier

The ASTRO-SPAS being used during the ORFEUS-SPAS II mission provides standardized equipment support panels, extensive onboard facilities and resources to the scientific payloads. Energy is provided by a powerful lithium-sulfur dioxide battery pack. Precise attitude-control is achieved by a three-axis stabilized cold gas system in combination with a star tracker and a specially developed space-borne GPS receiver. ASTRO-SPAS is a unique carrier for a wide variety of scientific applications, as in the case of ORFEUS-SPAS, to infrared Earth sensing, as in the case of CRISTA-SPAS, which maps trace gases in Earth's middle and upper atmosphere. Additional information and updates during the mission can be found on the ORFEUS-SPAS II Home Pages on the Internet at:

<http://snoopy.gsfc.nasa.gov/orfeus2/orfeus.html>
or **http://ourworld.compuserve.com/homepages/RWatt_DARA**.

WAKE SHIELD FACILITY-3 (WSF-3)

On STS-80, the free-flying Wake Shield Facility (WSF-3) will be making its third flight into orbit. The Facility is a 12-foot diameter, free-flying stainless steel disk designed to generate an "ultra-vacuum" environment in space in which to grow semiconductor thin films for use in advanced electronics. The STS-80 astronaut crew will deploy and retrieve the WSF during the 16-day mission using Columbia's "robot arm," or Remote Manipulator System. Wake Shield is sponsored by the Space Processing Division in NASA's Office of Life and Microgravity Sciences and Applications. Wake Shield was designed, built and is operated by the Space Vacuum Epitaxy Center at the University of Houston--a NASA Commercial Space Center--in conjunction with its industrial partner, Space Industries, Inc., also in Houston.

Low Earth Orbit (LEO) space has only a moderate natural vacuum, one that can be greatly improved through the generation of an "ultra vacuum" wake behind an object moving through orbit. The WSF, as it flies, moves the residual LEO gas atoms out of the way, leaving few, if any, behind in its wake.

This unique ultra vacuum produced in the wake of the WSF has been shown in past flights to be 100 to 1,000 times better than the best operating ground-based laboratory chamber vacuums. Using this ultra-vacuum in space, the WSF has already grown the highest purity aluminum gallium arsenide thin films, and holds the promise of producing the next generation of semiconductor materials along with the devices they will make possible.

Wake Shield has flown twice before. The first flight on STS-60, in 1994, although experiencing a hardware problem that resulted in the vehicle remaining attached to the robot arm, proved the vacuum wake concept, and realized the space epitaxy concept by growing the first-ever crystalline semiconductor thin films in the vacuum of space.

The major objective of this third flight aboard STS-80 is to grow thin "epitaxial" films which could have a significant impact on the microelectronics industry because the use of advanced semiconducting thin film materials in electronic components holds a very promising economic advantage. The commercial applications for high quality semiconductor devices are most critical in the consumer technology areas of personal communications systems, fiber optic communications, high-speed transistors and processors, and opto-electronic devices.

The majority of electronic components used today are made of silicon semiconductors; however, there are many other semiconductors, principally compound semiconductors, that have higher predicted performance than silicon. Epitaxy, growing atomically ordered thin films in a vacuum environment, is one method of generating such advanced semiconductor materials. A prime barrier to improving epitaxial films is the limit on the quality of the vacuum which can be generated in an industrial growth chamber. To improve the material, the vacuum in which it is grown must be improved. A wake-generating satellite can provide this enhancement in vacuum conditions.

The WSF consists of the Cross Bay Carrier and the Free Flyer. The Carrier remains in the Shuttle payload bay and has a latch system which holds the Free Flyer to it. Weighing approximately 9,300 pounds, (the Free Flyer itself is 4,625 pounds), the WSF occupies one quarter of the Shuttle payload bay. The Shuttle Remote Manipulator System (RMS), is used to remove the Free Flyer from the Carrier and deploy it for free flight in space.

The WSF follows behind Columbia at a station-keeping distance of approximately 25 nautical miles. The Free Flyer is a fully- equipped spacecraft, with cold gas propulsion for separation from the Shuttle and a momentum bias attitude control system. Seventy- two kilowatt-hours of energy, stored in silver-zinc batteries, power the thin-film growth furnaces, substrate heaters, process controllers, and a sophisticated array of vacuum characterization devices, including mass spectrometers and total pressure gauges. Flight plans call for WSF-3 to be deployed on Flight Day 4. Rendezvous is planned for Flight Day 7 with operations and investigations continuing in the payload bay for an additional day.

A number of cooperative payloads are flying in conjunction with WSF-3. For further information on these experiments, and for more detailed information on the mission and the Space Vacuum Epitaxy Center itself, please access the Internet at the following addresses:

<http://www.svec.uh.edu/wsf.html>

or

<http://www.svec.uh.edu/svec.html>.

At the University of Houston, the Wake Shield Program Manager is:

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Wake Shield Facility Deploy And Rendezvous

The Wake Shield Facility will be deployed using Columbia's robotic arm on Flight Day 4 by Mission Specialist Tom Jones. After Jones locks the arm onto the WSF's grapple fixture, he will release latches that hold the satellite in Columbia's cargo bay and lift it out. He will then maneuver the WSF into a position extended above and to the port side of the cargo bay with the satellite's underside facing into Columbia's direction of travel. This position, which may be held for as long as two and a half hours, will allow atomic oxygen molecules scattered in low Earth orbit to "cleanse" the underside of the satellite in preparation for its free-flying experiment operations.

Once the atomic oxygen exposure is completed, Jones will maneuver the satellite above and to starboard of the cargo bay, with the underside of the satellite facing away from Columbia's direction of travel, to check out WSF's Automatic Data Acquisition and Control System (ADACS). This orientation is similar to the orientation the satellite will keep while flying free from the Shuttle.

After checkout of the ADACS is completed, Jones will raise the WSF high above the cargo bay, with the underside facing away from the Shuttle's direction of travel, and release it.

Proximity Operations With WSF-3 And ORFEUS-SPAS-2

The WSF will fly free from Columbia for three days, and during that time, the ORFEUS-SPAS also will be flying free from Columbia. At the time the WSF is released, Columbia will be about 50 nautical miles ahead of ORFEUS-SPAS. WSF will fire thrusters to begin a slow separation, with the WSF trailing Columbia along with ORFEUS-SPAS. The WSF will reach a maximum distance of approximately 20 nautical miles from Columbia and no less than 25 nautical miles from ORFEUS-SPAS during its free-flight.

While the WSF and ORFEUS-SPAS are both in free-flight, Columbia may perform as many as two small engine firings per day to maintain the proper distance from the satellites. The WSF also may fire a thruster daily to maintain its position. Once the WSF has been retrieved on Flight Day 7, Columbia will maintain a distance of about 25 nautical miles from ORFEUS-SPAS until it is retrieved on Flight Day 14.

STS-80 EXTRAVEHICULAR ACTIVITIES

EVA Development Flight Tests (EDFT)

Astronauts Tammy Jernigan and Tom Jones will perform two six- hour spacewalks during STS-80, one on Flight Day 10 and another on Day 12, to evaluate equipment and procedures that will be used during construction and maintenance of the International Space Station.

The spacewalks are the fifth in a continuing series of Extravehicular Activities (EVAs) called the EVA Development Flight Tests (EDFT). This flight test series of spacewalks is designed to evaluate equipment and procedures planned for the station and to build spacewalking experience in preparation for assembly of the station. Jernigan is designated Extravehicular Crewmember 1 (EV- 1) and will be distinguished by red bands worn on the legs of her spacesuit. Jones is designated EV-2. Astronaut Story Musgrave will serve as the Intravehicular (IV) crewmember, assisting Jernigan and Jones from inside Columbia's crew cabin. STS-80 Pilot Kent Rominger also will assist with the spacewalks, controlling the robotic arm from inside the cabin.

On the first spacewalk, an end-to-end demonstration of a maintenance task simulating the changing out of an International Space Station battery will be performed. A crane designed for use in moving large Orbital Replacement Units (ORUs) on the space station will be evaluated as part of the task. ORUs can be any piece of equipment that may be replaced on the station's exterior, and, for this evaluation, the simulated station battery will be moved using the crane.

The evaluation should take almost three hours of the first spacewalk. Following the large-ORU evaluation, the astronauts will evaluate the crane's ability to move a small ORU, a cable caddy that previously was used during an STS-72 spacewalk.

The second spacewalk will evaluate working with the simulated battery from a mobile platform designed for the end of the International Space Station's robotic arm. Both spacewalkers will evaluate working with the simulated battery from the platform, which will be attached to the end of Columbia's robotic arm, for a total of almost two hours each.

The astronauts also will evaluate a variety of other work aids and tools designed for use during station operations, including a Body Restraint Tether (BRT), a type of "third hand" stabilizing bar for spacewalkers; a Multi-Use Tether (MUT), a type of stabilizing tether similar to the BRT that can be anchored to either round U.S. handrails or square Russian handrails; and a power tool designed for the station.

Detailed descriptions of the major items to be evaluated:

Crane

The 156-pound crane is 6 feet tall and has a boom that telescopes from lengths of 4 feet to 17.5 feet. It is designed to aid spacewalkers in transporting objects with a mass as great as 600 pounds to various worksites on the International Space Station's truss. The crane boom's attachment mechanism may also provide temporary stowage for large units during maintenance. The crane will be unstowed and installed to a socket along the left middle side of Columbia's cargo bay for the evaluations. The crane's boom can be extended by turning a ratchet fitting using a power tool or by using a manually operated hand crank. The crane can also be moved from side to side and up and down by hand cranks.

Battery Orbital Replacement Unit

A simulated battery for the International Space Station will be used for evaluations performed during STS-80 because the batteries will be among the most massive station ORUs. The station batteries will be mounted on the truss near the solar arrays and will provide power when the station moves into night on each orbit. The object to be used during STS-80 is not a real battery, although its size, 41 x 39 x 19 inches, and mass, about 354 pounds, closely imitate a station battery. It is also stowed in Columbia's cargo bay in fittings similar to those planned for stowing such replacement units during space station operations.

Cable Caddy

The Cable Caddy is a small carrier designed to hold about 20 feet of replacement electrical line for the space station. The operations of the Cable Caddy were flight-tested on STS-72, and on STS-80 it will be used only to simulate a small ORU for the space station. No cable will be unwound. The Cable Caddy has a mass of almost 50 pounds.

Portable Work Platform

The platform, a mobile EVA worksite designed for the end of the International Space Station's mechanical arm, was first flight- tested on STS-72. Similar to the platform used at the end of the Shuttle arm during past spacewalks, such as those to service the Hubble Space Telescope on STS-61, the platform offers greater movement with a swiveling foot restraint; a storage location for tools and temporary storage for large space station ORUs. The platform is composed of several components. An Articulating Portable Foot Restraint, a foot platform that can be swiveled to various orientations using two foot pedals, allows a spacewalker to reposition the platform without dismounting. A Portable Foot Restraint Work Stanchion (PFRWS) holds tools and equipment. A Temporary Equipment Restraint Aid (TERA) will hold large ORUs. Jernigan and Jones will evaluate the platform by using it mounted at the end of Columbia's mechanical arm to perform operations with the simulated station battery.

Body Restraint Tether

The Body Restraint Tether (BRT) seeks to provide the astronaut with a "third hand" to add stability while working. The tether is designed to hold a spacewalker steady when clamped to a handrail, freeing the astronaut's hands for work. It was first flown on STS- 69 and further evaluated on STS-72. The tether should provide a quick method of supplying stability for a spacewalker when a foot restraint is not available.

Multi-Use Tether

The Multi-Use Tether (MUT) is similar to the BRT, but it has can perform a greater variety of tasks. Different end effectors can be attached to the tether to grip station ORUs, various spacewalking tools or handrails.

SPACE EXPERIMENT MODULE

The Space Experiment Module (SEM) is a NASA Goddard Space Flight Center Shuttle Small Payloads Project education initiative that provides increased educational access to space. The program targets kindergarten through university level participants. SEM stimulates and encourages direct student participation in the creation, development, and flight of zero-gravity and microgravity experiments on the Space Shuttle.

The SEM system provides reusable modules for experiments within a 5-cubic-foot Getaway Special Canister. The system uses a Goddard-provided internal support structure, battery, power distribution system, data sampling and storage device and harness. Experiments may be active (requiring power to run mechanisms) or passive (having no mechanisms or requiring no power). Customized data sampling schemes are programmed before flight for each experiment, and data reduction and processing are completed after flight.

SEM's first flight includes a number of experiments sponsored by the Charleston, SC, school district (CAN-DO). Their experiments include Gravity & Acceleration Readings, Bacteria-Agar Research Instrument, Crystal Research in Space, Magnetic Attraction Viewed in Space, and numerous passive items such as algae, bones, yeast, and photographic film.

Purdue University in West Lafayette, IN, also is sponsoring a number of experiments: Fluid Thermal Convection, NADH Oxidase Absorbance in Shrimp, and a Passive Particle Detector experiment. Hampton Elementary School in Lutherville, MD, is experimenting with seeds, soil, chalk, crayon, calcite, Silly Putty, bubble solution, popcorn, mosquito eggs, and other organic compounds.

Glenbrook North High School in Northbrook, IL, has a Surface Tension experiment. Albion Jr. High in Strongsville, OH, is flying a heat transfer experiment and will study the heating properties of copper tubes and pennies. Poquoson Middle School in Poquoson, VA, will conduct a Bacteria Inoculation in Space experiment and NORSTAR (Norfolk Public Schools Science and Technology Advanced Research) in Norfolk, VA, will observe the behavior of immiscible fluids.

The SEM mission manager and project engineer is Dr. Ruthan Lewis of the Shuttle Small Payloads Project at Goddard Space Flight Center, Greenbelt, MD. The SEM Home Page on the World Wide Web may be accessed directly at:

<http://sspp.gsfc.nasa.gov/sem.html>

NIH-R4

NIH-R4 is the fourth in a series of collaborative experiments developed by NASA and the National Institutes of Health. NASA's Ames Research Center, Mountain View, CA, is the experiment developer.

Principal investigators of the NIH-R4 experiment, "Calcium, Metabolism and Vascular Function After Space Flight," are Drs. David McCarron and Daniel Hatton of the Oregon Health Sciences University, Portland. For many years, they have investigated the role of calcium in blood pressure regulation. Calcium has long been recognized as a critical mineral in the normal development and function of bone and muscle. These researchers were among the first to demonstrate that calcium also is essential for normal cardiovascular function.

In the microgravity environment, there is an overall loss of calcium from the body, associated with well-documented decreases in bone and muscle mass. Changes in cardiovascular function also have been noted, although the role of calcium in cardiac function in microgravity has not been investigated.

This flight experiment will study blood pressure regulation and function in rats fed either a high- or a low-calcium diet before and during space flight. Seven rats with genetically induced hypertension will be housed in each of two enclosures, which fit in lockers in the Space Shuttle's middeck. The high-calcium diet will be available in one enclosure and the low-calcium diet in the other. The researchers expect that the high calcium diet will be beneficial in maintaining good cardiovascular function (as well as bone and muscle mass), while the low calcium diet will exaggerate the effects of microgravity.

This study will add to the body of knowledge necessary to maintain the health of astronauts during space flight. In addition, it will add new and exciting data to a growing body of evidence that calcium is a mineral with myriad functions critical to the normal function of human life on Earth.

The NIH-R4 investigators previously investigated pregnancy- induced hypertension (elevated blood pressure). Their studies have shown that during pregnancy, when there is a large requirement for calcium during development of the fetus, increasing the intake of calcium in the diet reduces the elevated blood pressure often seen in pregnant women. Using rats with genetically induced hypertension, they investigated the chemical and biological mechanisms by which calcium produces these beneficial effects. Other studies have shown that calcium is important in preventing the development of high blood pressure in normal humans and rats. Finally, studies by other researchers have shown that increased dietary calcium can reduce blood levels of cholesterol, reduce the symptoms of premenstrual syndrome and be beneficial in the treatment of osteoporosis.

CCM-A (formerly STL/NIH-C-6)

NASA/CCM-A is one in a series of bone cell experiments to be conducted aboard the Space Shuttle. Results from a previous Shuttle flight, NIH.C4 on STS-69, indicate that bone is affected by microgravity at the cellular level. The investigators participating in the STS-80 CCM-A mission hope to confirm their previous findings, and further test the hypothesis that the absence of gravity has a negative effect on bone formation.

Weightlessness results in bone loss in astronauts, similar to what occurs in people who undergo prolonged bed rest or, in some cases, lose the use of one of their limbs due to injury or disease. The exact cause of the bone loss is not yet clear, but it is at least partially due to decreased activity of osteoblasts, the cells which produce the matrix which mineralizes to become bone. Weightlessness results in similar decreased bone formation in both rodents and humans.

Studies performed on rats implicate transforming growth factor-b (TGF-b) as having an important role in decreased bone formation during space flight. TGF-b, a protein produced by bone cells, is important in the communication between cells. The gene for TGF-b was found to be expressed in bone at a reduced level following space flight, but the level was dramatically increased (within 24 hours) when normal activity was reestablished following space flight.

This experiment to be flown on STS-80 will determine if TGF-b gene expression is reduced in cultured bone cells following space flight and how quickly the levels of TGF-b return to normal after flight. Results from this experiment will help us determine the usefulness of cultured bone cells in understanding how the acceleration due to gravity functions to maintain bone cell activity. Although cultured bone cells have enormous potential to be used to increase our understanding, there are many pitfalls. Unless the culture can be shown to mimic a response occurring in the whole organism, it will not be possible to interpret the relevance of the findings.

The cells to be used in this study are unique. They are derived from human bone and are normal in the sense that they are not transformed (tumor-cell-like). The cells have been genetically altered to allow them to grow nearly indefinitely at a low temperature (35 degrees F, 161 C) but when cultured at a higher temperature (39) they stop growing and become mature osteoblasts that synthesize bone matrix. This experiment will study the effects of weightlessness and recovery on the mature form of the osteoblast-like cells.

The Principal Investigator for this study is Dr. Russell T. Turner of the Mayo Clinic, Rochester, MN. The co-investigators are Drs. Thomas C. Spelsberg and Steven A. Harris, also of the Mayo Clinic.

Osteoblast adhesion and phenotype in microgravity

Bone loss during space flight is well documented, but remains incompletely understood. Among the unanswered questions are the direct effects that microgravity exerts on bone cells, and the mechanisms by which these cells recognize changes in gravity. This study will focus on bone cells of the osteoblast family, which synthesize bone matrix and also may participate in its breakdown (resorption) by regulating the formation and activity of bone-resorbing cells, osteoblasts.

Because osteoblastic cells are direct targets for breakdown- stimulating agents like parathyroid hormone (PTH), the experiment will test the hypothesis that microgravity can produce direct effects on osteoblastic cells similar to those of PTH. In addition, the study will examine whether microgravity alters the interaction of osteoblastic cells with their matrix, resulting in changes in shape or cellular organization known to affect the function of numerous cell types.

In this study, a permanent line of osteoblastic cells will be cultured in the middeck compartment of the Space Shuttle. Parallel control cells will be maintained on Earth under identical conditions. During flight,

batches of both control and experimental cells will be fixed for analysis and samples of culture medium will be collected for biochemical studies. Following the flight, the cells will be analyzed to identify changes in shape and function.

Medium samples will be analyzed to identify the presence of bone matrix proteins and matrix-degrading enzymes that may participate in early stages of bone turnover. The principal investigator of this study is Dr. Robert Majeska, Department of Orthopaedics, Mount Sinai School of Medicine, New York; the co-investigator is Dr. Sandra Masur, Department of Ophthalmology at Mount Sinai. The project is sponsored by NASA's Office of Life and Microgravity Sciences and Applications Small Payloads Program, and the National Institute of Arthritis and Musculoskeletal Diseases.

BIOLOGICAL RESEARCH IN CANISTER (BRIC)-09 EXPERIMENT

Research on the effects of genetic expression and microgravity on plants will help improve growth rates and biomass production of plants grown in space and may enhance crop productivity on the Earth.

Although various effects of microgravity on plants have been observed, little is known about the underlying mechanisms involved. BRIC-09 will study the influence of microgravity on genetically altered tomato and tobacco seedlings that have been modified to contain elements of soybean genes. This study should provide information about plants' molecular biology and insight into understanding the transport and distribution mechanisms for hormones within plants. The proposed research could provide crucial information on how to improve growth rates and biomass production of space-grown plants as well as information on how to enhance crop productivity on the Earth.

The basic hypothesis of the research is that alterations in genetic expression should be responsible for many changes in growth and development of microgravity-grown plants. The proposed research should identify the mechanisms involved in these changes at the molecular level.

The principal investigator will observe genetic changes in the altered tomato and tobacco seedlings as molecular markers to study the effects of microgravity on the plants' development.

The principal investigator is Dr. Yi Li, Kansas State University, Division of Biology, Manhattan, KS. The experiment uses approximately 200 seeds evenly distributed on the Nylon membrane inside 22 petri dishes, which will be loaded into five BRIC-60 canisters. Ground controls will be run at the Kennedy Space Center with a 48-hour delay. Some plant material will be fixed or frozen for microscopic and enzymatic analysis. Some material will be stained so it can be detected by light microscopy. Some material will be photographed and fixed for morphology studies.

Two types of genes will be isolated: one is the genes whose expression is eliminated or reduced under the microgravity environment, and the other are the ones whose expression is enhanced under the microgravity environment.

The proposed research will provide information that will help improve growth rates and biomass production of plants grown in space and may enhance crop productivity on the Earth. The improvement of growth rate and biomass production of space-grown plants is particularly useful for the development of life support systems to support crews over long-duration flights. The improvement of growth and biomass production of space-grown plants is also an important step toward commercial application of space using plants as bioreactors for pharmaceutical products and for other commercial purposes.

COMMERCIAL MDA ITA EXPERIMENT (CMIX-5)

CMIX-5 is the last in a series of five Shuttle flights linking NASA and the University of Alabama/Huntsville (UAH) Consortium for Materials Development in Space, with flight hardware privately developed by Instrumentation Technology Associates (ITA) of Exton, PA.

UAH research will include diabetes treatment; cell reaction in microgravity that may lead to tissue replacement techniques; the development of gene combinations that are toxic to insect pests but not harmful to other species, thus creating a natural pesticide; and an environmental monitoring model using mysid shrimp.

A key activity for ITA will be the ongoing effort to grow large protein crystals of urokinase for research linked to breast cancer inhibitors. There will also be an ITA materials analysis study to see if the use of sealants in microgravity can lead to better protection of national monuments against acid rain. ITA also is sponsoring seven elementary and high school research activities as well as experiments linked to the National Space Society and the International Space University.

Three flight hardware elements will be used on CMIX-5. The Bioprocessing Modules developed by UAH are valves connected by tubing to syringes containing research samples. ITA's hardware consists of a Liquid Mixing Apparatus, vial containers to mix multiple fluids and an enhancement of their materials dispersion apparatus. The Dual Materials Dispersion Apparatus (DMDA) experiment container increases the number of data points and also provides video capability to record changes in the research samples as they develop. CMIX-5 will employ three DMDA labs containing more than 900 experiments. The CMIX contacts are:

JOHN CASSANTO, ITA AT 610/363-8343

MARIAN LEWIS, UAH AT 205/890-6553

VISUALIZATION IN AN EXPERIMENTAL WATER CAPILLARY PUMPED LOOP (VIEW-CPL)

Capillary Pumped Loop (CPL) technology, to be flown on Columbia's middeck, is an option for spacecraft thermal management. A CPL collects and transports excess heat generated by spacecraft instruments. The heat is transported to a spacecraft radiator for rejection into space. Requiring no mechanical pump, a CPL can transport more energy for longer distances than heat pipes currently used today.

The purpose of the STS-80 experiment is to help develop a complete understanding of CPL physics in a microgravity environment by viewing the fluid flow inside the evaporator. The liquid and vapor visual data, collected on video tape through a special window in the evaporator, along with temperature and pressure data, will be used to refine theories on CPL operation modes. The ultimate goal is to apply the results of this experiment to improve CPLs of the future.

VIEW-CPL was developed by the Department of Mechanical Engineering at the University of Maryland, College Park, as part of NASA's In-Space Technology Experiment Program (IN-STEP). For further information on VIEW-CPL, please contact: Dr. Keith E. Herold via e-mail at herold@eng.umd.edu or Kimberly R. Kolos at krkolos@glue.umd.edu

STS-80 CREWMEMBERS



STS080-S-001 -- These five NASA astronauts are in training for the STS-80 mission, scheduled for launch aboard the space shuttle Columbia in the fall of this year. From the left are astronauts Kent V. Rominger, pilot; Tamara E. Jernigan, Story Musgrave and Thomas D. Jones, all mission specialists; and Kenneth D. Cockrell, mission commander.

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BIOGRAPHICAL DATA

Kenneth D. Cockrell will serve as Commander (CDR) for STS-80. Cockrell was born on April 9, 1950, in Austin, TX. He graduated from Rockdale High School, Rockdale, TX, in 1968, received a bachelor of science degree in mechanical engineering from the University of Texas in 1972 and a master of science degree in aeronautical systems from the University of West Florida in 1974.

Cockrell was selected as an astronaut by NASA in January 1990 and became qualified for a flight assignment July 1991. A veteran of two space flights, STS-56 in 1993 and STS-69 in 1995, he has logged over 482 hours in space.

Kent V. Rominger (Commander, USN) will serve as Pilot (PLT) on Mission STS-80. Rominger was born on August 7, 1956, in Del Norte, CO. He graduated from Del Norte High School in 1974, received a bachelor of science degree in civil engineering from Colorado State University in 1978 and a master of science degree in aeronautical engineering from the U.S. Naval Postgraduate School in 1987.

Rominger reported to the Johnson Space Center in August 1992 and after completing the one year of required training became qualified for future flight assignment. He made his first space flight from Oct. 20 to Nov. 5, 1995, on STS-73 during which Rominger served as pilot. Rominger has logged a total of 15 days, 21 hours, 52 minutes and 21 seconds in space.

Tamara E. Jernigan (Ph.D.) will serve as Mission Specialist-1 (MS-1) on STS-80. Jernigan was born on May 7, 1959, in Chattanooga, TN. She graduated from Santa Fe High School, Santa Fe Springs, CA, in 1977, received a bachelor of science degree in physics (with honors) and a master of science degree in engineering science from Stanford University in 1981 and 1983. Jernigan also earned a master of science degree in astronomy from the University of California-Berkeley in 1985 and a doctorate in space physics and astronomy from Rice University in 1988.

Jernigan was selected as an astronaut candidate by NASA in June 1985 and became an astronaut in July 1986. A veteran of three space flights, Jernigan was a mission specialist on STS-40 in 1991 and STS-52 in October 1992. She was the payload commander on STS- 67 in March 1995 and has logged over 854 hours in space.

Thomas D. Jones (Ph.D.) will serve as Mission Specialist-2 (MS-2) on STS-80. Jones was born January 22, 1955, in Baltimore, MD. He graduated from Kenwood Senior High School, Essex, MD, in 1973, and received a bachelor of science degree in basic sciences from the United States Air Force Academy in Colorado Springs in 1977, and a doctorate in planetary science from the University of Arizona in Tucson in 1988.

After a year of training following his selection by NASA in January 1990, Dr. Jones became an astronaut in July 1991. In 1994 he flew as a mission specialist on successive flights of Space Shuttle Endeavour and the Space Radar Laboratory payload. His first flight was in April 1994 on STS-59 and then in October 1994 on STS-68. Dr. Jones has logged over 22 days (539 hours) in space.

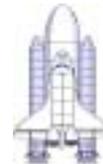
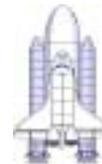
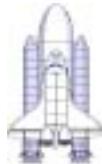
Story Musgrave (M.D.) will serve as Mission Specialist-3 (MS- 3) on STS-80. Musgrave was born on August 19, 1935, in Boston, MA, but considers Lexington, KY, to be his hometown. He graduated from St. Mark's School, Southborough, MA, in 1953, received a bachelor of science degree in mathematics and statistics from Syracuse University in 1958, a master of business administration degree in operations analysis and computer programming from the University of California at Los Angeles in 1959, a bachelor of arts degree in chemistry from Marietta College in 1960, a doctorate in medicine from Columbia University, New York, NY, in 1964, a master of science in physiology and biophysics from the University of Kentucky in 1966, and a master of arts in literature from the University of Houston in 1987.

Musgrave was selected as a scientist-astronaut by NASA in August 1967. A veteran of five space flights, Dr. Musgrave was a mission specialist on STS-6 in 1983, STS 51-F in 1985, STS-33 in 1989 and STS-44 in 1991. He was the payload commander on STS-61 in 1993 and currently has more than 858 hours in space.

Musgrave's sixth flight into space aboard Columbia on STS-80 will have two noteworthy aspects to it. First, he will tie NASA astronaut John Young's record for most number of space flights by any human being. Secondly, at age 61, Musgrave will be the oldest person ever to fly in space.

SHUTTLE FLIGHTS AS OF NOVEMBER 1996

79 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 54 SINCE RETURN TO FLIGHT



| | | | | |
|--------------------------------|--------------------------------|---------------------------------|--------------------------------|-------------------------------|
| STS-78 06/20/96 - 07/07/96 | | STS-70 07/13/95 - 07/22/95 | | |
| STS-75 02/22/96 - 03/09/96 | | STS-63 02/03/95 - 02/11/95 | | |
| STS-73 10/20/95 - 11/05/95 | | STS-64 09/09/94 - 09/20/94 | | |
| STS-65 07/08/94 - 07/23/94 | | STS-60 02/03/94 - 02/11/94 | | |
| STS-62 03/04/94 - 03/18/94 | | STS-51 09/12/93 - 09/22/93 | STS-79 09/16/96 - 09/26/96 | |
| STS-58 10/18/93 - 11/01/93 | | STS-56 04/08/83 - 04/17/93 | STS-76 03/22/96 - 03/31/96 | |
| STS-55 04/26/93 - 05/06/93 | | STS-53 12/02/92 - 12/09/92 | STS-74 11/12/95 - 11/20/95 | |
| STS-52 10/22/92 - 11/01/92 | | STS-42 01/22/92 - 01/30/92 | STS-71 06/27/95 - 07/07/95 | |
| STS-50 06/25/92 - 07/09/92 | | STS-48 09/12/91 - 09/18/91 | STS-66 11/03/94 - 11/14/94 | |
| STS-40 06/05/91 - 06/14/91 | | STS-39 04/28/91 - 05/06/91 | STS-46 07/31/92 - 08/08/92 | |
| STS-35 12/02/90 - 12/10/90 | | STS-41 10/06/90 - 10/10/90 | STS-45 03/24/92 - 04/02/92 | STS-77 05/19/96 - 05/29/96 |
| STS-32 01/09/90 - 01/20/90 | STS-51L 01/28/86 | STS-31 04/24/90 - 04/29/90 | STS-44 11/24/91 - 12/01/91 | STS-72 01/11/96 - 11/20/96 |
| STS-28 08/08/89 - 08/13/89 | 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-69 09/07/95 - 09/18/95 |
| STS-61C 01/12/86 - 01/18/86 | 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-67 03/02/95 - 03/18/95 |
| STS-9 11/28/83 - 12/08/83 | 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-68 09/30/94 - 10/11/94 |
| STS-5 11/11/82 - 11/16/82 | 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-59 04/09/94 - 04/20/94 |
| STS-4 06/27/82 - 07/04/82 | 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-61 12/02/93 - 12/13/93 |
| STS-3 03/22/82 - 03/30/82 | 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-2 11/12/81 - 11/14/81 | 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-1 04/12/81 - 04/14/81 | 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-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
(20 flights)

OV-099
Challenger
(10 flights)

OV-103
Discovery
(21 flights)

OV-104
Atlantis
(17 flights)

OV-105
Endeavour
(11 flights)