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Last Updated: 01/06/2026

(Noonan)
January 28, 1986
Draft

PRESIDENTIAL REMARKS: DEATH OF SPACE SHUTTLE CHALLENGER CREW
TUESDAY, JANUARY 28, 1986

Ladies and gentlemen, I had planned to speak to you tonight to report on the State of the Union, but the events of earlier today have led me to change those plans. Today is a day for mourning, and remembering.

Nancy and I are pained to the core by the tragedy of the Shuttle Challenger. We know we share this pain with all of the people of our country. This is truly a national loss.

In more than a quarter century of the United States space program, we have never lost an astronaut in flight. ~~We have~~ never had a tragedy like this. And perhaps we have forgotten the courage it took for the crew of the shuttle. But they, the Magnificent Seven, were aware of the dangers -- and overcame them and did their jobs brilliantly.

We mourn seven heroes -- Michael J. Smith, Francis R. Scobee, Judith A. Resnick, Ronald E. McNair, Ellison S. Onizuka, Gregory B. Jarvis and Christa McAuliffe. We mourn their loss as a Nation, together.

/ S. Christa Corrigan McAuliffe.

To the families of the Seven: We cannot bear, as you do, the full impact of this tragedy -- but we feel the loss, and we are thinking about you so very much. Your relatives were daring and brave and they had that special grace, that special spirit that said: Give me a challenge and I'll meet it with joy. They had a hunger to explore the universe and discover its truths. They wished to serve and they did -- they served all of us.

We have grown used to wonders in this century -- it's hard to dazzle us. But for 25 years the United States space program has been doing just that. We have grown used to the idea of space, and perhaps we forget that we've only just begun, we're still pioneers -- they the members of the Challenger crew, were pioneers.

And I want to say something to the children of America who were watching the live coverage of the shuttle's takeoff. I know it's hard to understand but sometimes painful things like this happen -- it's all part of the process of exploration and discovery -- it's all part of taking a chance and expanding man's horizons. The future doesn't belong to the faint-hearted -- it belongs to the brave. The Challenger crew was pulling us into the future -- and we'll continue to follow them.

I've always had great faith in and respect for our space program -- and what happened today does nothing to diminish it. We don't hide our space program, we don't keep secrets and cover things up, we do it all up front and in public. That's the way freedom is, and we wouldn't change it for a minute.

We'll continue our quest in space. There will be more shuttles and more shuttle crews and, yes, more civilians, more teachers, in space. Nothing ends here -- our hopes and our journeys continue.

I want to add that I wish I could talk to every man and woman who works for NASA or who worked on this mission, and tell them: your dedication and professionalism have moved and impressed us for decades, and we know of your anguish, but we're sure you did your best to ensure a safe and successful flight.

(There's a coincidence today. On this day 390 years ago the great explorer Sir Francis Drake died aboard ship off the coast of Panama. In his lifetime the great fronteirs were the oceans. And a historian later said, "He lived by the sea, died on it, and was buried in it." Today we can say of the Challenger Crew -- they lived by space, died in it and were buried in it. For their dedication was, like Drake's, complete.)

The crew of the space shuttle Challenger honored us by the manner in whcih they lived their lives. We will never forget them, nor the last time we saw them -- this morning, as they prepared for their jorney, and waved goodbye, and "slipped the surly bonds of earth" to "touch the face of God."

Thank you.

THE WHITE HOUSE
WASHINGTON

August 17, 1988

Speechwriters:

Could you check on this + return it with an answer? We'll draft the White House reply.

Thanks.

Dean F. Clancy

Correspondence
SLR, Rm. 93
x2279

7 SUF

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20 July 1988

The Office of the President
The White House
1600 Pennsylvania Avenue NW
Washington DC 20500
USA

Dear Office of the President:

In the President's broadcast address following the loss of the space shuttle Challenger on 28 January 1986, he quoted a description of Sir Francis Drake and said, 'He lived by the sea, died on it and was buried in it.'

For a 'quotation companion' book which I am writing and which will be published next year, I should be most grateful if you could tell me the source of this quotation as I have not been able to verify it myself.

Your help in this matter would be much appreciated.

With every good wish,

Yours sincerely,

Nigel Rees

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Drake, Sir Francis

Sir Francis Drake, a 16th-century English admiral, was the greatest, as well as the most renowned, of the English seamen of the Elizabethan age.

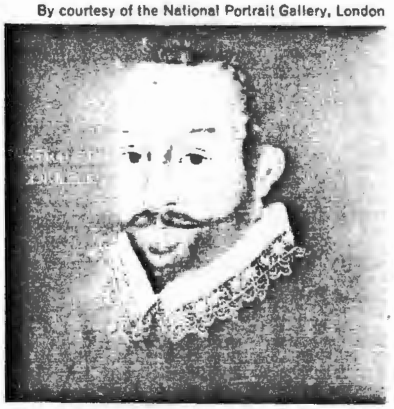
Born *c.* 1540/43 in Devonshire, in southern England, on the Crowndale estate of Lord Francis Russell, second earl of Bedford, Francis Drake was the son of one of the latter's tenant farmers. His father was an ardent Protestant lay preacher, an influence that was to have an immense effect on Drake's character. His detestation of Catholicism had its origins not only in his father's teaching but in his own early experiences, when his family had to flee the West Country during the Catholic uprising of 1549. They made their way to Kent in southeast England and, in exchange for their former country cottage home, found lodging in one of the old naval hulks that were moored near Chatham on the south bank of the Thames Estuary. Had he stayed in Devon he might have become a yeoman farmer, but his family's poverty drove him to sea while still a boy. When Drake was about 13 years old, he was apprenticed to a small coastal vessel plying between North Sea ports. Thus, sailing one of the harshest stretches of water in the world, he learned early how to handle small vessels under arduous conditions. The knowledge of pilotage he acquired during these years was to serve him in good stead throughout his life. The old sea captain left Drake his ship when he died, so that Drake, thereafter, became his own master.

Early voyages. Drake might have spent all his life in the coastal trade but for the happy accident that he was related to the powerful Hawkins family of Plymouth, Devon, who were then embarking on trade with the New World—the New World that, as Drake never forgot, had been given by Pope Alexander VI to the kingdom of Spain. When he was about 23, dissatisfied with the limited horizons of the North Sea, he sold his boat and enlisted in the fleet belonging to the Hawkins family. Now he first saw the ocean swell of the Atlantic and the lands where he was to make his fame and fortune.

Voyages to the West Indies

On a voyage to the West Indies, as second-in-command, Drake had his first experience of the Spaniards and of the way in which foreigners were treated in their realms; their cargoes, for example, were liable to be impounded. At a later date he referred to some "wrongs" that he and his companions had suffered—wrongs that he was determined to right in the years to come. His second voyage to the West Indies, this time in company with John Hawkins, ended disastrously at San Juan de Ulúa off the coast of Mexico, when the English seamen were treacherously attacked by the Spanish and many of them killed. Drake returned to England in command of a small vessel, the "Judith," with an even greater determination to have his revenge upon Spain and the Spanish king (Philip II). Although the expedition was a financial failure, it served to make Drake's reputation, for he had proved himself an outstanding seaman. People of importance, including Queen Elizabeth I, who had herself invested in the venture, now heard his name. In the years that followed he made two expeditions in small boats to the West Indies, in order "to gain such intelligence as might further him to get some amend for his loss. . . ." In 1572—having obtained from the Queen a privateering commission, which amounted to a license to plunder in the King of Spain's lands—Drake set sail for America in command of two small ships, the "Pasha," of 70 tons, and the "Swan," of 25 tons. He was nothing if not ambitious, for his aim was to capture the important town of Nombre de Dios, Panama. Although himself wounded in the attack, he and his men managed to get away with a great deal of plunder—the foundation of his fortune. Not content with this, he went on to cross the Isthmus of Panama. Standing on a high ridge of land, he first saw the Pacific, that ocean hitherto barred to all but Spanish ships. It was then, as he put it, that he "besought Almighty God of His goodness to give him life and leave to sail once in an English ship in that sea." His name as well as fortune were established by this expedition, and he returned to England both rich and famous. Unfortunately, his return coincided with a moment when Queen Elizabeth and King Philip II of Spain had reached a temporary truce. Although delighted with Drake's success in the empire of her great enemy, Elizabeth could not officially acknowledge it. Drake, who was as politically discerning as he was navigationally brilliant, saw that the time was inauspicious and sailed with a small squadron to Ireland, where he served under the Earl of Essex, who was then engaged in suppressing a rebellion in that strife-torn land. This is an obscure period of Drake's life, and he does not emerge into the clear light of history until two years later.

By courtesy of the National Portrait Gallery, London



Drake, oil painting by an unknown artist. In the National Portrait Gallery, London.

Circumnavigation of the world. In 1577 he was chosen as the leader of an expedition intended to pass around South America through the Strait of Magellan and to explore the coast that lay beyond. The object was to conclude trading treaties with the people who lived south of the Spanish sphere of influence and, if possible, to explore an unknown continent that was rumoured to lie far in the South Pacific. The expedition was backed by the Queen herself. Nothing could have suited Drake better. He had official approval to benefit himself and the Queen, as well as to cause the maximum damage to the Spaniards. It was now that he met the Queen for the first time and heard from her own lips that she "would gladly be revenged on the King of Spain for divers injuries that I have received." He set sail in December with five small ships, manned by less than 200 men, and reached the Brazilian coast in the spring of 1578. His flagship, the "Pelican," which Drake later renamed "The Golden Hind," was only about 100 tons. It seemed little enough with which to undertake a venture into the domain of the most powerful monarch and empire in the world.

The voyag "The Golde Hind"

Upon arrival in South America, it was discovered that there was a plot against Drake, and its leader, Thomas Doughty, was tried and executed. Drake was always a stern disciplinarian, and he clearly did not intend to continue the venture without making sure that all his small company were loyal to him. Two of his smaller vessels, having served their purpose as store ships, were then abandoned, after their provisions had been taken aboard the others, and, on August 21st, 1578, he entered the Strait. It took 16 days to sail through, after which Drake had his second view of the Pacific Ocean—this time from the deck of an English ship. Then, as he wrote, "God by a contrary wind and intolerable tempest seemed to set himself against us." During the gale, Drake's vessel and that of his second-in-command had been separated; the latter, having missed a rendezvous with Drake, ultimately returned to England, presuming that the "Hind" had sunk. It was, therefore, only Drake's flagship that made its way into the Pacific and up the coast of South America. He passed along the coast like a whirlwind, for the Spaniards were quite unguarded, having never known a hostile ship in their waters. He seized provisions at Valparaíso, attacked passing Spanish merchantmen, and captured two very rich prizes. "The Golden Hind" was below her watermark, loaded with bars of gold and silver, minted Spanish coinage, precious stones, and pearls, when he left South American waters to continue his voyage around the world. Before sailing westward, however,

Ency. Britannica vol. 5

he sailed to the north as far as 48° N, on a parallel with Vancouver, to seek the Northwest Passage back into the Atlantic. The bitterly cold weather defeated him, and he coasted southward to anchor just north of modern San Francisco. He named the surrounding country New Albion and took possession of it in the name of Queen Elizabeth. In his search for a passage around the north of America he was the first European to sight the west coast of what is now Canada.

In July 1579 he sailed west across the Pacific and after 68 days sighted a line of islands (probably the remote Palau group). From there he went on to the Philippines, where he watered ship before sailing to the Moluccas. There he was well received by the local sultan, and appears to have concluded a treaty with him giving the English the right to trade for spices. Drake's deep-sea navigation and pilotage were always excellent, but in those totally uncharted waters his ship struck a reef. He was able to get her off without any great damage and, after calling at Java, set his course across the Indian Ocean for the Cape of Good Hope. Two years after she had nosed her way into the Strait of Magellan, "The Golden Hind" came back into the Atlantic with only 56 of the original crew of 100 left aboard.

On September 26, 1580, Francis Drake brought his ship into Plymouth Harbour. She was laden with treasure and spices, and Drake's fortune was permanently made. He thus became the first captain ever to sail his own ship around the world—the Portuguese navigator Ferdinand Magellan having been killed before completing his circumnavigation—and the first Englishman to sail the Pacific, the Indian Ocean, and the South Atlantic. Despite Spanish protests about his piratical conduct while in their imperial waters, Queen Elizabeth herself came aboard "The Golden Hind," which was lying at Deptford in the Thames Estuary, and knighted the farmer's son.

yor of mouth

In the same year, 1581, Drake was made mayor of Plymouth, an office he fulfilled with the same thoroughness that he had shown in all other matters. He organized a water supply for Plymouth that served the city for 300 years. In 1585 he married again, his first wife, a Cornish girl named Mary Newman, whom he had married in 1569, having died in 1583. His second wife, Elizabeth Sydenham, was an heiress and the daughter of a local Devonshire magnate, Sir George Sydenham. In keeping with his new station, Drake bought himself a fine country house—Buckland Abbey (now a national museum)—a few miles from Plymouth. Drake's only grief was that neither of his wives bore him any children.

During these years of fame when Drake was a popular hero, he could always obtain volunteers for any of his expeditions. But he was very differently regarded by many of his great contemporaries. Such well-born men as the naval commander Sir Richard Grenville and the navigator and explorer Sir Martin Frobisher disliked him intensely. He was the parvenu, the rich but common upstart, with West Country manners and accent and with none of the courtier's graces. Drake had even bought Buckland Abbey from the Grenvilles by a ruse, using an intermediary, for he knew that the Grenvilles would never have sold it to him directly. It is doubtful, in any case, whether he cared about their opinions, so long as he retained the goodwill of the Queen. This was soon enough demonstrated, for in 1585 Elizabeth placed him in command of a fleet of 25 ships. Hostilities with Spain had broken out once more, and he was ordered to cause as much damage as possible to the Spaniard's overseas empire. Drake fulfilled his commission, capturing Santiago in the Cape Verde Islands and taking and plundering the cities of Cartagena in Colombia, St. Augustine in Florida, and San Domingo (Santo Domingo, Dominican Republic). The effect of his triumph in the West Indies was cataclysmic. Spanish credit, both moral and material, almost foundered under the losses. The Bank of Spain broke, the Bank of Venice (to which Philip II was principal debtor) nearly foundered, and the great German bank of Augsburg refused to extend the Spanish monarch any further credit. Even Lord Burghley, Elizabeth's principal minister, who had never approved of Drake or his methods, was forced to concede that "Sir Francis Drake is a fearful man to the King of Spain."

Defeat of the Spanish Armada. By 1586 it was known that Philip II was preparing a fleet for what was called "The Enterprise of England," and that he had the blessing of Pope Sixtus V to conquer the heretic island and return it to the fold of Rome. Drake was given carte blanche by the Queen to "impeach the provisions of Spain." In the following year, with a fleet of some 30 ships, he showed that her trust in him had not been misplaced. He stormed into the Spanish harbour of Cádiz and in 36 hours destroyed thousands of tons of shipping and supplies, all of which had been destined for the Armada. This action, which he laughingly referred to "as singeing the king of Spain's beard," was sufficient to delay the invasion fleet for a further year. But the resources of Spain were such that by July 1588 the Armada was in the English Channel. Lord Howard had been chosen as English admiral to oppose, with Drake as his vice admiral. It was, however, the latter's dash and fire that largely turned the scales, Drake himself managing to capture a rich prize during the long sea fight in the Channel. It was also Drake who prompted the use of fire ships to drive the Armada out of Calais, where it had taken refuge. Then, to delight his Protestant heart, "The Winds of God blew," so that the Spanish fleet was dispersed and largely wrecked. Drake was England's hero, achieving a popularity never to be equalled by any man until Horatio Nelson emerged more than 200 years later. Innumerable souvenirs were struck in his name, and he was immortalized in poems and broadsheets.

Last years

His later years were not happy, however. An expedition that he led to Portugal proved abortive, and his last voyage, in 1596, against the Spanish possessions in the West Indies was a failure, largely because the fleet was decimated by fever. Drake himself succumbed and was buried at sea off the town of Puerto Bello (modern Portobelo, Panama) on January 28th, 1596. Few men have been more famous in their lifetimes. As the Elizabethan historian John Stow wrote:

> He was more skilful in all points of navigation than any . . . He was also of perfect memory, great observation, eloquent by nature . . . In brief he was as famous in Europe and America, as Timur Lenk (Tamerlane) in Asia and Africa.

At a later date, Dr. Samuel Johnson wrote eulogistically of his character and bravery. But to the Spaniards he was, as their ambassador to England remarked, "the master-thief of the unknown world." He was "low of stature, of strong limb, round-headed, brown hair, full-bearded, his eyes round, large and clear, well-favoured face and of a cheerful countenance." A devout churchman and an able businessman, Sir Francis Drake was one of the world's greatest seamen. He embodied many of the virtues of expansionist Elizabethan England.

BIBLIOGRAPHY. There is no definitive biography of Drake. Of the comparatively short biographies available, the most useful is probably that by C.C. LLOYD (1957). J.A. WILLIAMSON, *Sir Francis Drake* (1951), is the work of an author expert in the naval and exploratory history of the period. E.D.S. BRADFORD, *Drake* (1965), is light and readable. Books placing Drake in his contemporary setting include J.A. WILLIAMSON, *The Age of Drake*, 5th ed. (1965); JULIAN CORBETT's old but still valuable classic, *Drake and the Tudor Navy*, 2 vol. (1898); and K.R. ANDREWS, *Drake's Voyages: A Reassessment of Their Place in Elizabethan Maritime Expansion* (1967). Collections of documents, such as letters and narratives referring to the voyages, include *New Light on Drake: A Collection of Documents Relating to His Voyage of Circumnavigation, 1577–1580*, ed. by ZELIA NUTTALL (1914); *The World Encompassed: Analogous Contemporary Documents Concerning Sir Francis Drake's Circumnavigation of the World*, ed. by N.M. PENZER (1926, reprinted 1969); *The Last Voyage of Drake and Hawkins*, ed. by K.R. ANDREWS (1972); and CALIFORNIA HISTORICAL SOCIETY, *Drake's Plate of Brass: Evidence of His Visit to California in 1597* (1937).

(E.Br.)

Drake Passage

The Drake Passage is a deep waterway, 600 miles (1,000 kilometres) wide, connecting the Atlantic and Pacific

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New York

THE WHITE HOUSE
WASHINGTON

A TRIBUTE TO THE CHALLENGER

Like the heart of a bird with severed wings
  which cannot touch the sky,
Nor glide above the shadowing clouds
  upon the blue so high.
Our hearts are driven by instinct of love,
  when tragedy comes nigh,
To back time up and bind their wounds,
  But all we can do is cry.

As we helplessly watch life depart,
  in the twinkling of an eye;

Unable to assemble them again, though
  desiring to futilely try.

We shall keep them in our hearts,
  For each time we lift into flight
They are there,
Urging us on,
As Earth's curvature comes into sight.

Glen C.

THE WHITE HOUSE
WASHINGTON

As we helplessly watch life depart,
In the twinkling of an eye;
Unable to assemble them again,
~~Desir~~ Though DESIRING to futilely try.
We shall keep them in our hearts,
for each time we lift into flight
they are there,
Urging us on,
As Earth's curvature comes into sight.

GLEN C. BOOHER
P.O. 87101
SAN DIEGO CA 92138

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(619) 273-9530

A Tribute To The Challenger

Like the heart of a bird
With severed wings,
~~That~~ Which cannot touch the sky,
Nor glide above the shadowing clouds
upon the blue so high

Our hearts are drawn
by instinct of love,
When tragedy comes nigh
To back time up and bind their wounds,
But all we can do is cry.

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NASA
National Aeronautics and
Space Administration

Space Shuttle Mission 51-L

Press Kit

January 1986

SHUTTLE MISSION 51-L -- QUICK LOOK

Crew: Francis R. Scobee, Commander
Michael J. Smith, Pilot
Judith A. Resnik, Mission Specialist
Ellison S. Onizuka, Mission Specialist
Ronald E. McNair, Mission Specialist
Gregory Jarvis, Payload Specialist
S. Christa McAuliffe, Teacher Observer

Orbiter: Challenger (O99)

Launch Site: Pad 39-B, Kennedy Space Center, Fla.

Launch Date/Time: Jan. 24, 1986 -- 3:43 p.m. EST

Orbital Inclination: 28.45 degrees

Insertion Orbit: 153.5 n.mi circular

Mission Duration: 6 days, 34 minutes

Orbits: 96 full orbits; landing on 97

Landing Date/Time: Jan. 30, 1986, 4:17 p.m. EST

Primary Landing Site: Kennedy Space Center, Fla., Runway 33
Weather Alternate: Edwards Air Force Base, Calif., Runway 17
Return to Launch Site: Kennedy Space Center
Abort-Once-Around: Edwards Air Force Base
Trans-Atlantic Abort: Dakar, Senegal

Cargo and Payloads:
Tracking and Data Relay Satellite (TDRS-B)
Spartan-Halley Mission
Teacher in Space Project
Comet Halley Active Monitoring Program
Fluid Dynamics Experiment
Phase Partitioning Experiment
Radiation Monitoring Experiment
3 Student Experiments

RELEASE NO: 86-5 January 1986

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RELEASE NO: 86-5 January 1986

CONTENTS

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202-453-8400

For Release:

RELEASE NO: 86-5 January 1986

TEACHER IN SPACE AND COMET HALLEY STUDY HIGHLIGHT 51-L FLIGHT

The launch of a high school teacher as America's first private citizen to fly aboard the Shuttle in NASA's Space Flight Participant Program will open a new chapter in space travel when Challenger lifts off on the 25th Space Shuttle mission.

A science payload programmed for 40 hours of comet Halley observations and the second of NASA's Tracking and Data Relay Satellites (TDRS-B) will be aboard for Challenger's 10th flight, targeted for launch at 3:43 p.m. EST on Jan. 24.

Challenger's liftoff will mark the first use of Pad 39-B for a Shuttle launch. Pad B was last used for the Apollo Soyuz Test Project in July 1975 and has since been modified to support the Shuttle program.

Four Shuttle veterans will be joined by rookie astronaut Michael Smith, teacher observer Christa McAuliffe and Hughes payload specialist Gregory Jarvis for a mission that will extend just beyond 6 days.

Commanding the seven-member crew will be Francis R. Scobee, who served as pilot aboard Challenger on mission 41-C. Michael Smith will be 51-L Pilot.

-more-

Mission specialists Judith Resnik, Ellison Onizuka and Ronald McNair each will be making their second trip into space.

Challenger will be launched into a 177-statute-mile circular orbit inclined 28.45 degrees to the equator for the 6-day, 34-minute mission. The orbiter is scheduled to make its end-of-mission landing on the 3-mile-long Shuttle Landing Facility at Kennedy Space Center.

Deployed on the first day of the flight, TDRS-B will join TDRS-1 in geosynchronous orbit to provide high-capacity communications and data links between Earth and the Shuttle, as well as other spacecraft and launch vehicles.

After deployment from the Shuttle cargo bay, TDRS-B will be boosted to geosynchronous transfer orbit by the Inertial Upper Stage (IUS). Its orbit will be circularized and it will be positioned over the Pacific Ocean at 171 degrees west longitude.

TDRS-1, launched from Challenger in April 1983 on the sixth Space Shuttle flight, is located over the Atlantic Ocean at 41 degrees west longitude.

With the addition of the second satellite, realtime coverage through the single ground station at White Sands, N.M., is expected to be available for about 85 percent of each orbit of a user spacecraft.

The TDRS satellites, built by TRW Space Systems, are owned by Space Communications Company (SPACECOM) and leased by NASA for a period of 10 years. A third TDRS satellite will be launched on a later mission to serve as an in-orbit spare.

Spartan-Halley is the second payload in the NASA-sponsored Spartan program for flying low-cost experiment packages aboard the Shuttle.

The scientific objective of Spartan-Halley is to measure the ultraviolet spectrum of comet Halley as the comet approaches the point of its orbit that will be closest to the sun.

The Spartan mission peculiar support structure will be deployed from the Shuttle cargo bay and retrieved later in the mission for return to Earth.

Ultraviolet measurements and photographs of comet Halley will be made by instruments on the Spartan support structure during 40 hours of free flying in formation with the Shuttle.

Several middeck experiments, including those associated with the Teacher in Space Project, and three student experiments complete Challenger's payload manifest.

Teacher observer Christa McAuliffe will perform experiments that will demonstrate the effects of microgravity on hydroponics, magnetism, Newton's laws, effervescence, chromatography and the operation of simple machines.

The Teacher in Space experiments will be filmed for use after the flight in educating students.

McAuliffe also will assist in operating three student experiments being carried aboard Challenger. These experiments include a study of chicken embryo development in space, research on how microgravity affects a titanium alloy and an experiment in crystal growth.

The Fluid Dynamics Experiment, a package of six experiments, will be flown on the middeck. They involve simulating the behavior of liquid propellants in low gravity. The fluid dynamics experiments will be conducted by Hughes payload specialist Gregory Jarvis.

Among the fluid investigations will be simulations to understand the motion of propellants during Shuttle frisbee deployments, which have been employed for the Hughes Leasat satellites.

Another middeck experiment will be the Radiation Monitoring Experiment consisting of handheld and pocket monitors to measure radiation levels at various times in orbit. This is the seventh flight for the RME.

Challenger will perform its deorbit maneuver and burn over the Indian Ocean on orbit 96 with landing at Kennedy occurring on orbit 97 at a mission elapsed time of 6 days, 34 minutes.

Touchdown on the Florida runway should come at 4:17 p.m. EST on Jan. 30.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

GENERAL INFORMATION

NASA Select Television Transmission

NASA-Select television coverage of Shuttle mission 51-L will be carried on a full satellite transponder:

Satcom F-2R, Transponder 13, C-Band
Orbital Position: 72 degrees west longitude
Frequency: 3954.5 MHz vertical polarization
Audio Monaural: 6.8 MHz

NASA-Select video also is available at the AT&T Switching Center, Television Operation Control in Washington, D.C., and at the following NASA locations:

NASA Headquarters, Washington, D.C.
Langley Research Center, Hampton, Va.
John F. Kennedy Space Center, Fla.
Marshall Space Flight Center, Huntsville, Ala.
Johnson Space Center, Houston, Texas
Dryden Flight Research Facility, Edwards, Calif.
Ames Research Center, Mountain View, Calif.
Jet Propulsion Laboratory, Pasadena, Calif.

The schedule for television transmissions from the orbiter and for the change-of-shift briefings from Johnson Space Center will be available during the mission at Kennedy Space Center, Marshall Space Flight Center, Johnson Space Center and NASA Headquarters.

The television schedule will be updated daily to reflect changes dictated by mission operations. Television schedules also may be obtained by calling COMSTOR (713/280-8711). COMSTOR is a computer data-base service requiring the use of a telephone modem.

Special Note to Broadcasters

Beginning Jan. 22 and continuing throughout the mission, approximately 7 minutes of audio interview material with the crew of 51-L will be available to broadcasters by calling 202/269-6572.

Briefings

Flight control personnel will be on 8-hour shifts. Change-of-shift briefings by the off-going flight director will occur at approximately 8-hour intervals.

51-L BRIEFING SCHEDULE

TIME (EST)	BRIEFING	ORIGIN
T-1 Day		
9:00 a.m.	TDRS-B	KSC
9:45 a.m.	Spartan-Halley Mission	KSC
10:30 a.m.	Teacher in Space	KSC
11:15 a.m.	Shuttle Student Involement Program	KSC
12:00 noon	Fluid Dynamics Experiment	KSC
3:00 p.m.	Pre-launch Press Conference	KSC
T-Day		
Launch + 1 hour	Post-launch Briefing	KSC
Launch Through End-of-Mission		
Times announced on NASA Select	Flight Director Change-of-Shift Briefings.	JSC
Landing Day		
Landing + 1 hour	Post-landing Briefing	KSC

51-L TRAJECTORY SEQUENCE OF EVENTS

EVENT	ORBIT	TIG MET (D:H:M)	BURN DURATION Min-Sec	DELTA V (fps)	POST BURN Apogee/Perigee (S.Mi.)
Launch		0:00:00			
OMS-1	1	0:00:10	2:26	223	
OMS-2	1	0:00:44	2:03	185	153 x 154
Deploy TDRS	7	0:10:02			153 x 154
RCS-1 Separation	7	0:10:03	08	2.2	153 x 154
OMS-3 Separation	8	0:10:21	26	40.0	153 x 177
OMS-4	21	1:06:00	27	43.3	152 x 153
Deploy Spartan	37	05:51			151 x 153
RCS Separation	37	2:06:01	08	2.0	152 x 154
Aft RCS Sep	53	3:06:06	16	4.3	150 x 153
Aft RCS	63	3:21:08	16	4.2	148 x 152
Aft RCS	64	3:23:12	00	0.2	148 x 152
Aft RCS	65	4:00:08	12	3.2	150 x 153
TPF	66	4:01:28	19	5.0	150 x 154
Deorbit				285.0	
Entry Interface		6:04:19			
Landing	97	6:00:34			

SUMMARY OF MAJOR ACTIVITIES

	MET
Day 1	
Payload bay doors open	
Tracking and Data Relay Satellite (TDRS) and Inertial Upper Stage (IUS) checkout	
TDRS deploy	0/10:01
Day 2	
Comet Halley Active Monitoring Program (CHAMP) data take	
Spartan health check	
Fluid Dynamics Experiment (FDE)	
Teacher in Space activities	
Day 3	
Spartan deploy preparations	2/04:40
Spartan deploy	2/06:51
Student Experiments	
FDE	
Day 4	
CHAMP data take	
Student Experiments	
FDE	
Teacher in Space activities	
Day 5	
Spartan rendezvous	4/01:32
Spartan capture	4/02:15
FDE	
Student Experiments	

Day 6

RCS hot fire
FCS checkout

Teacher lesson (Field Trip)	4/21:00
Teacher lesson (Exploration)	4/23:00

Day 7

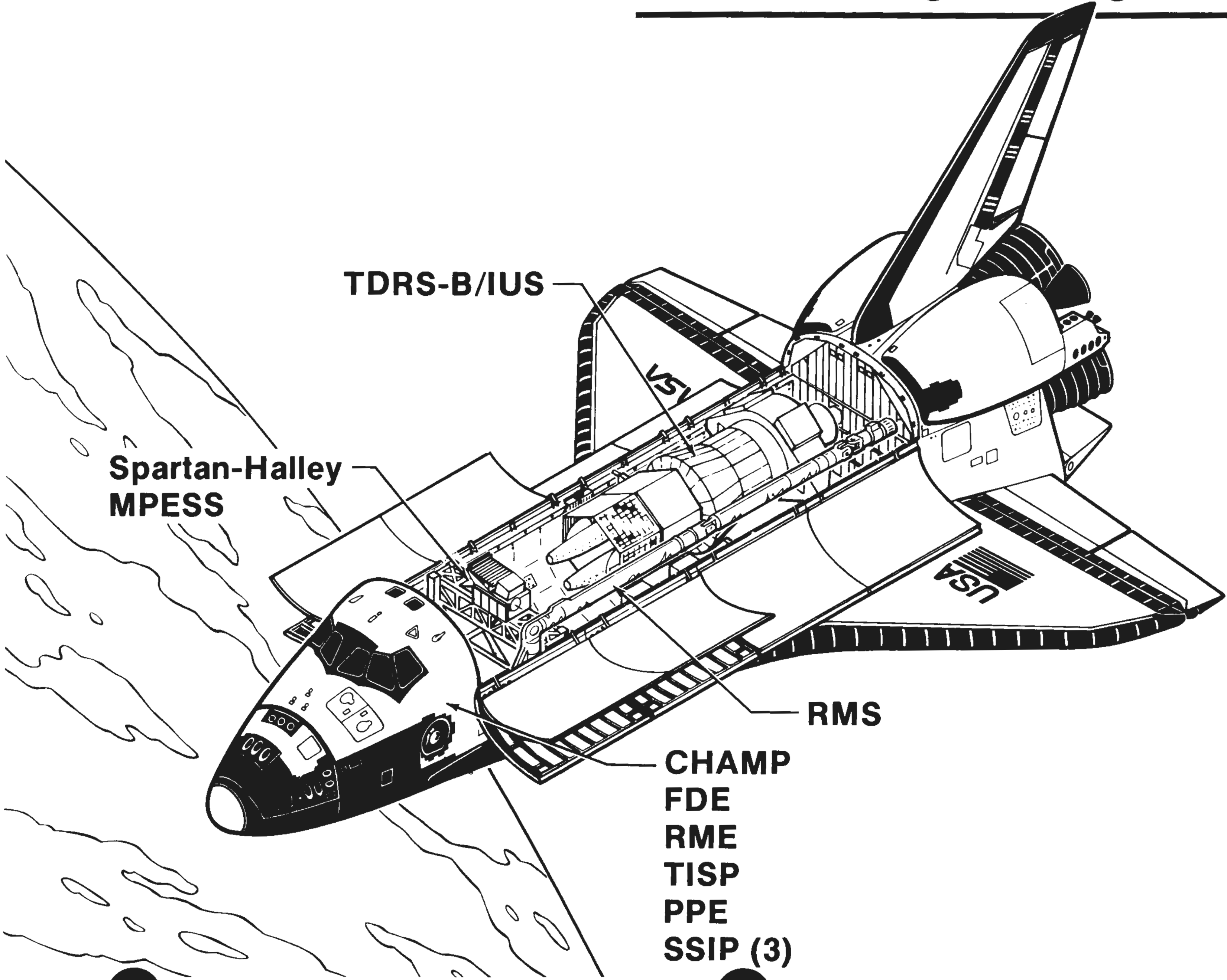
Landing at KSC	6/00:34

STS 51-L PAYLOAD AND VEHICLE WEIGHTS SUMMARY

	Pounds
Orbiter Without Consumables	176,403
TDRS-B/IUS	37,636
Total Payload Including Other Experiments	48,361
Orbiter Including Cargo at SRB Ignition	268,471
Total Vehicle at SRB Ignition	4,529,122
Orbiter Landing Weight	199,700

NASA

National STS Program
STS 51-L Cargo Configuration



TRACKING AND DATA RELAY SATELLITE SYSTEM (TDRSS) AND TDRS-B

The Tracking and Data Relay Satellite (TDRS-B) is the second TDRSS advanced communications spacecraft to be launched from the orbiter Challenger. The first was launched during Challenger's maiden flight in April 1983.

TDRS-1 is now in geosynchronous orbit over the Atlantic Ocean just east of Brazil (41 degrees west longitude). It initially failed to reach its desired orbit following successful Shuttle deployment because of booster rocket failure. A NASA-industry team conducted a series of delicate spacecraft maneuvers over a 2-month period to place TDRS-1 into the desired 22,300-mile altitude.

Following its deployment from the orbiter, TDRS-B will undergo a series of tests prior to being moved to its operational geosynchronous position over the Pacific Ocean south of Hawaii (171 degrees W. longitude).

A third TDRSS satellite is scheduled for launch in July 1986, providing the Tracking and Data Relay Satellite System with an on-orbit spare located between the two operational satellites.

TDRS-B will be identical to its sister satellite and the two-satellite configuration will support up to 23 user spacecraft simultaneously, providing two basic types of service: a multiple access service which can relay data from as many as 19 low-data-rate user spacecraft at the same time and a single access service which will provide two high data rate communications relays from each satellite.

TDRS-B will be deployed from the orbiter approximately 10 hours after launch. Transfer to geosynchronous orbit will be provided by the solid propellant Boeing/U.S. Air Force Inertial Upper Stage (IUS). Separation from the IUS occurs approximately 17 hours after launch.

The concept of using advanced communication satellites was developed following studies in the early 1970s which showed that a system of communication satellites operated from a single ground terminal could support Space Shuttle and other low Earth-orbit space missions more effectively than a worldwide network of ground stations.

NASA's Space Tracking and Data Network ground stations eventually will be phased out. Three of the network's present 12 ground stations -- Madrid, Spain; Canberra, Australia; and Goldstone, Calif. -- have been transferred to the Deep Space Network managed by the Jet Propulsion Laboratory in Pasadena, Calif., and the remainder -- except for two stations considered necessary for Shuttle launch operations -- will be closed or transferred to other agencies after the successful launch and checkout of the next two TDRS satellites.

The ground station network, managed by the Goddard Space Flight Center, Greenbelt, Md., provides communications support for only a small fraction (typically 15-20 percent) of a spacecraft's orbital period. The TDRSS network of satellites, when established, will provide coverage for almost the entire orbital period of user spacecraft (about 85 percent).

A TDRSS ground terminal has been built at White Sands, N.M., a location that provides a clear view to the TDRSS satellites and weather conditions generally good for communications.

The NASA Ground Terminal at White Sands provides the interface between the TDRSS and its network elements, which have their primary tracking and communication facilities at Goddard. Also located at Goddard is the Network Control Center, which provides system scheduling and is the focal point for NASA communications with the TDRSS satellites and network elements.

The TDRSS satellites are the largest privately-owned telecommunications spacecraft ever built, each weighing about 5,000 lb. Each satellite spans more than 57 ft., measured across its solar panels. The single-access antennas, fabricated of molybdenum and plated with 14K gold, each measure 16 ft. in diameter, and, when deployed, span more than 42 ft. from tip to tip.

The satellite consists of two modules. The equipment module houses the subsystems that operate the satellite. The telecommunications payload module has electronic equipment for linking the user spacecraft with the ground terminal. The spacecraft has seven antennas.

The TDRS spacecraft are the first designed to handle communications through S, Ku and C frequency bands.

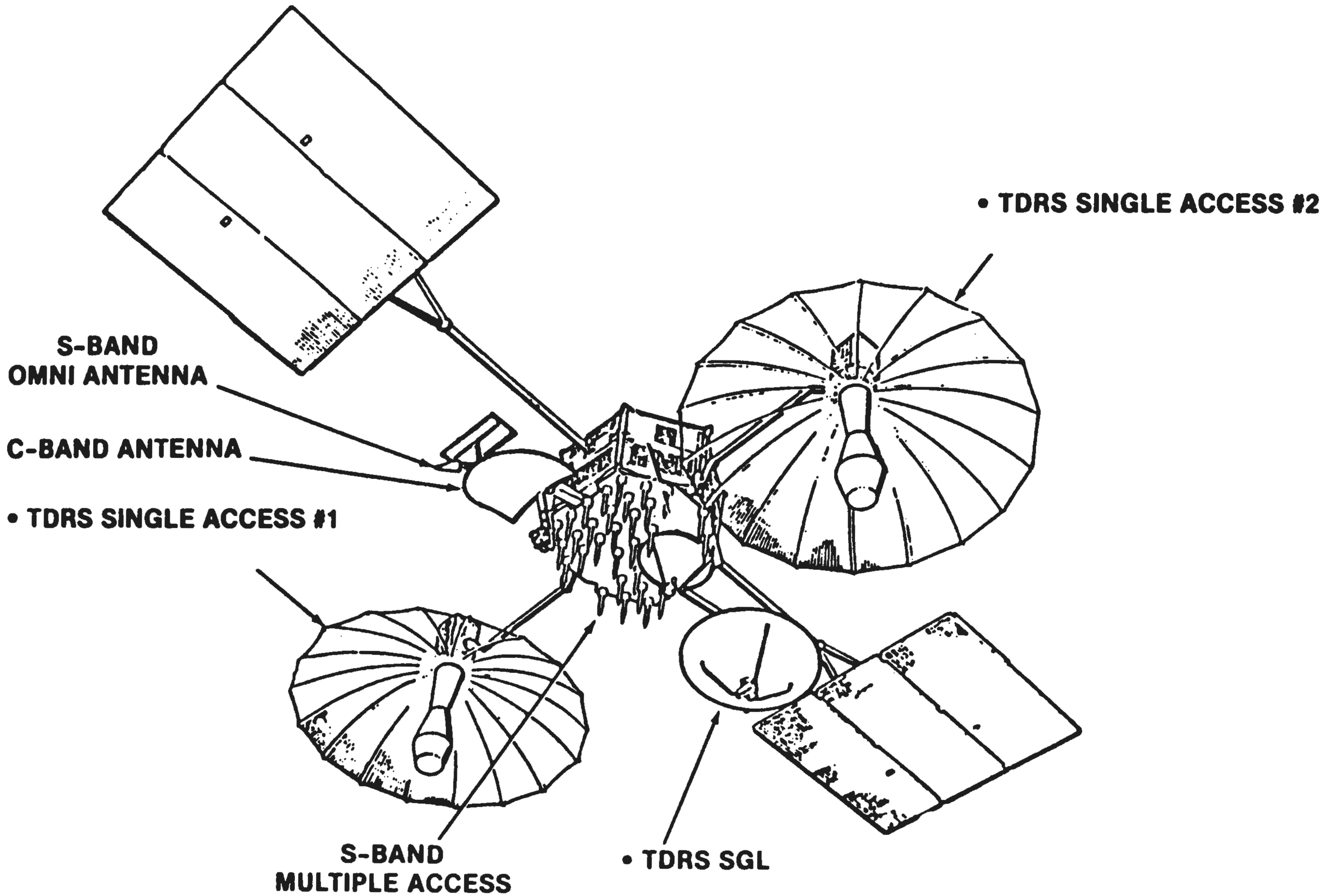
Under contract, NASA has leased the TDRSS service from the Space Communications Co. (Spacecom), Gaithersburg, Md., the owner, operator and prime contractor for the system.

TRW Space and Technology Group, Redondo Beach, Calif., and the Harris Government Communications System Division, Melbourne, Fla., are the two primary subcontractors to Spacecom for spacecraft and ground terminal equipment, respectively. TRW also provided the total software for the ground segment operation and did the integration and testing for the ground terminal and the TDRSS, as well as the systems engineering.

Primary users of the TDRSS satellite have been the Space Shuttle, Landsat Earth resources satellites, the Solar Mesosphere Explorer, the Earth Radiation Budget Satellite, the Solar Maximum Mission satellite and Spacelab.

Future users include the Hubble Space Telescope, scheduled for launch Oct. 27, 1986; the Gamma Ray Observatory, due to be launch in 1988; and the Upper Atmosphere Research Satellite in 1989.

SPACECRAFT CONFIGURATION



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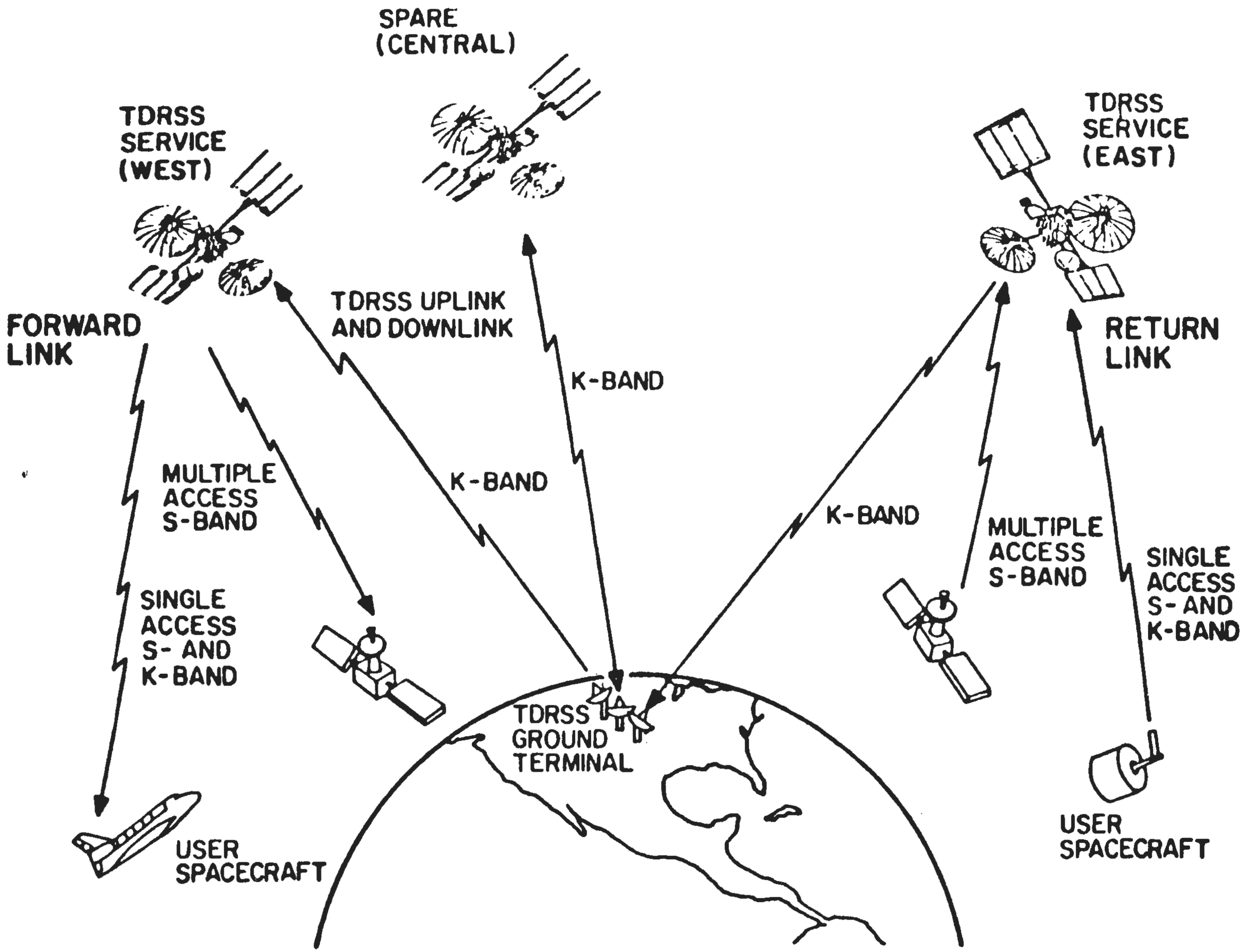
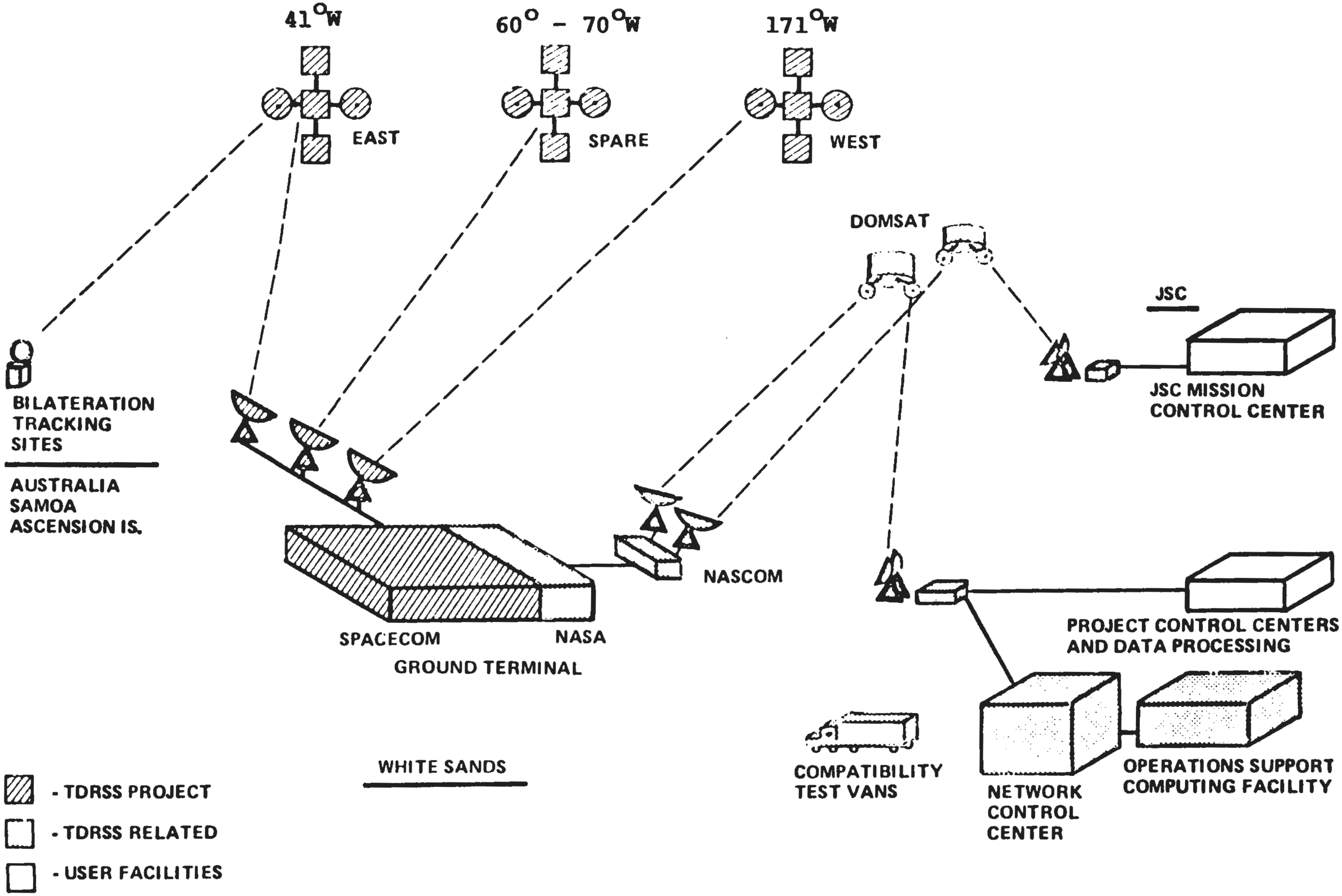
TDRSS CONCEPT



TDRSS SYSTEM ELEMENTS



INERTIAL UPPER STAGE

The Inertial Upper Stage (IUS) will be used to place NASA's second Tracking and Data Relay Satellite (TDRS-B) into geosynchronous orbit. The first TDRS was launched by an IUS aboard Challenger in April 1983 during mission STS-6.

The 51-L crew will deploy IUS/TDRS-B approximately 10 hours after liftoff from a low-Earth orbit of 153.5 nautical miles. Upper stage airborne support equipment, located in the orbiter payload bay, positions the combined IUS/TDRS-B into the proper deployment attitude -- an angle of 59 degrees -- and ejects it into low-Earth orbit. Deployment from the orbiter will be by a spring eject system.

Following deployment from the payload bay, the orbiter will move away from the IUS/TDRS-B to a safe distance. The first stage will fire about 55 minutes after deployment.

Following the aft (first) stage burn of 2 minutes, 26 seconds, the solid fuel motor will shut down and the two stages will separate. After coasting for several hours, the forward (second) stage motor will ignite at 6 hours, 14 minutes after deployment to place the spacecraft in its desired orbit. Following a 1-minute, 49-second burn, the forward stage will shut down as the IUS/TDRS-B reaches the predetermined geosynchronous orbit position.

Six hours, 54 minutes after deployment from Challenger, the forward stage will separate from TDRS-B and perform an anti-collision maneuver with its onboard reaction control system.

After the IUS reaches a safe distance from TDRS-B, the upper stage will relay performance data back to a NASA tracking station and then shut itself down 7 hours, 5 minutes after deployment from the payload bay.

As with the first NASA IUS launched in 1983, the second has a number of features which distinguish it from other previous upper stages. It has the first completely redundant avionics system ever developed for an unmanned space vehicle. The system has the capability to correct in-flight features within milliseconds.

Other advanced features include a carbon composite nozzle throat that makes possible the high-temperature, long-duration firing of the IUS motors and a redundant computer system in which the second computer is capable of taking over functions from the primary computer if necessary.

The IUS is 17 ft. long, 9 ft. in diameter and weighs more than 32,000 lb., including 27,000 lb. of solid fuel propellant. The IUS consists of an aft skirt; an aft stage containing 21,000 lb. of solid propellant fuel, generating 45,000 lb. of thrust; an interstage; a forward stage containing 6,000 lb. of propellant, generating 18,500 lb. of thrust; and an equipment support section. The equipment support section contains the avionics which provide guidance, navigation, telemetry, command and data management, reaction control and electrical power.

Solid propellant rocket motors were selected in the design of the IUS because of their compactness, simplicity, inherent safety, reliability and lower cost.

The IUS is built by Boeing Aerospace Corp., Seattle, under contract to the U.S. Air Force Systems Command. Marshall Space Flight Center, Huntsville, Ala., is NASA's lead center for IUS development and program management of NASA-configured IUSs procured from the Air Force.

SPARTAN-HALLEY MISSION

For the Spartan-Halley mission, NASA's Goddard Space Flight Center and the University of Colorado's Laboratory for Atmospheric and Space Physics (LASP) have recycled several instruments and designs to produce a low-cost, high-yield spacecraft to watch Halley's Comet when it is too close to the sun for other observatories to do so.

It will record ultraviolet light emitted by the comet's chemistry when it is closest to the sun and most active so that scientists may determine how fast water is broken down by sunlight, search for carbon and sulfur atoms and related compounds, and understand how the tail evolves.

Principal investigator is Dr. Charles Barth of the University of Colorado LASP. Mission manager is Morgan Windsor of Goddard Space Flight Center.

The Instruments

Two spectrometers, derived from backups for a Mariner 9 instrument which studied the Martian atmosphere in 1971, have been rebuilt to survey Halley's Comet in ultraviolet light from 128 to 340 nanometers (nm) wavelength, stopping just above the human eye's limit of about 400 nm.

Each spectrometer uses the Ebert-Fastie design: an off-axis reflector telescope, with magnesium fluoride coatings to enhance transmission which focuses light from Halley, via a spherical mirror and a spectral grating, on a coded anode convertor with 1,024 detectors in a straight line. The grating is ruled at 2,400 lines per millimeter.

The detectors are made of cesium iodide (CsI) for the G-spectrometer (128-168 nm) and cesium telluride (CsTe) for the F-spectrometer (180-340 nm). The system has a focal length of 250 mm and an aperture of 50 mm.

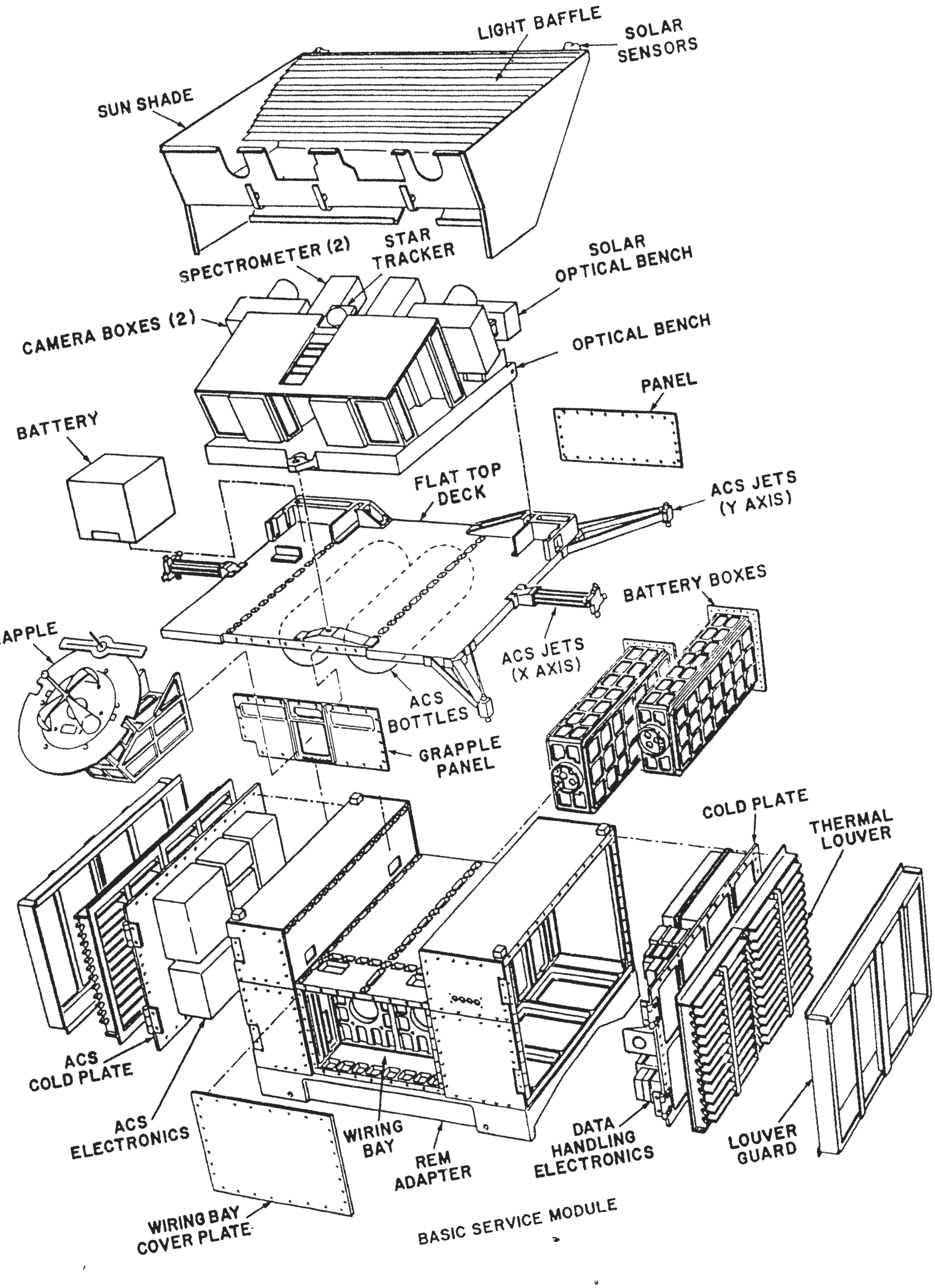
The F-spectrometer grating can be rotated to cover its wider range in six 40 nm sections. A slit limits its field of view to a strip of sky 1 by 80 arc-minutes (the apparent diameter of the moon is about 30 arc-minutes). The G-spectrometer has a 3 x 80 arc-minute slit because emissions are fainter at shorter wavelengths.

With Halley as little as 10 degrees away from the sun, two sets of baffles must be used to reduce stray light. An internal set is part of the Mariner design. A new external set serves both instruments. It has two knife-edge baffles 38.5 inches away from the spectrometer entrances, and 20 secondary baffles to stop earthlight. Together the two baffle sets reduce stray light by a factor of a trillion. It is this system that will make it possible for Spartan-Halley to observe the comet while so close to the sun. In addition, internal filters reduce solar lyman-alpha light (121.6 nm), scattered by the Earth's hydrogen corona, which would saturate the instruments.

Two film cameras, boresighted with the spectrometers, will photograph Halley to assure pointing accuracy in post-flight analysis and to match changes in the tail with spectral changes. The 35mm Nikon F3 cameras have 105 mm and 135 mm lenses and are loaded with 65-frame rolls of QX-851 thin-base color film. The cameras will capture large-scale activity such as the separation angle between the dust and ion tails, bursts from the nucleus, and asymmetries in the shape of the coma.

The whole instrument package is mounted on an aluminum optical bench -- 35 by 37 inches and weighing 175 lb. -- attached to the Spartan carrier. This provides a clean interface with the carrier and aligns the spectrometers with the Spartan attitude control sensors. A 15-inch high housing covers the spectrometers and the cameras.

The instrument package is controlled by a LASP-developed microprocessor which stores the comet Halley ephemeris and directs the Spartan carrier attitude control system.



SPARTAN-HALLEY

Mission Operations

Halley's Comet will be of greatest scientific interest from Jan. 20 to Feb. 22; perihelion is on Feb. 9. At that time Halley will be 139.5 million miles from Earth and 59.5 million mi. from the sun. The Shuttle will go into an orbit 176 miles high and inclined 28.5 degrees to the equator. This will have Halley visible for more than 3,000 seconds per orbit (about 56 percent of the orbit), including more than 90 seconds with the sun occulted by the Earth.

After a predeployment health check of Spartan voltages and currents, the Shuttle robot arm will pick up the spacecraft and hold it over the side. Upon release, Spartan will perform a 90-second "pirouette" to confirm that it is working and the Shuttle will back away to at least 5 miles so light reflected from the Shuttle does not confuse Spartan's sensors. After two orbits of preparation, the 40-hour science mission will begin. A backup timer will ensure that the spectrometer doors open 70 minutes after release.

Spartan-Halley will conduct 20 orbits of science observations interspersed with five orbits of attitude control updates. A typical science orbit will start with four 100-second calibration scans of Earth's atmosphere, followed by a 900-second tail scan. Observing will be interrupted for 15 minutes of pointing updates and housekeeping. It then resumes with four 200-second scans of the coma, followed by sunset and four coma scans while the sun is occulted. At the end of the mission, Spartan-Halley will be retrieved by the Shuttle robot arm and placed in the payload bay.

After the mission, the processed film and data tapes will be returned to the University of Colorado team for scientific analysis.

The Science

Current theories hold that comets are "dirty snowballs" made up largely of water ice and lightweight elements and compounds left over from the creation of the solar system. Remote sensing of the chemistry of Halley's Comet, by measuring how sunlight is reflected, will help in assaying the comet. The "dirt" in the snowball is detectable in visible light, and the "snow" (water ice) and other gases are detectable, indirectly, in ultraviolet.

The most important objective of the Spartan-Halley mission is to obtain ultraviolet spectra of comet Halley when it is less than 67 million miles from the sun. As Halley nears the sun, temperatures rise, releasing ices and clathrates, compounds trapped in ice crystals.

The highest science priority for Spartan is to determine the rate at which water is broken down (dissociated) by sunlight. This must be measured indirectly from the spectra of hydroxyl radicals (OH) and atomic oxygen which are the primary and secondary products. The hydroxyl coma of the comet will be more compact than the atomic oxygen coma because of its short life when exposed to sunlight. Hydrogen, the other product, will not be detectable because of the lyman-alpha filters in the spectrometers.

Heavier compounds will be sought by measuring spectral lines unique to carbon, carbon monoxide (CO), carbon dioxide (CO2), sulfur, carbon sulfide (CS), molecular sulfur (S2), nitric oxide (NO) and cyanogen (CN), among others.

Spartan-Halley's spectrometers will not produce images, but will reveal the comet's chemistry through the ultraviolet spectral lines they record. With these data, scientists will gain a better understanding of how:

* Chemical structure of the comet evolves from the coma and proceeds down the tail;

* Species change with relation to sunlight and dynamic processes within the comet; and

* Dominant atmospheric activities at perihelion relate to the comet's long-term evolution.

Other observatories will be studying Halley's comet, but only Spartan can observe near perihelion.

The Spartan Program

The Spartan-Halley 200 carrier measures 52 by 43 by 51 in. and weighs 2,250 lb. without payload. The attitude control system and other components use elements from the sounding rocket program. All data are stored on a Bell & Howell MARS 1400 recorder; 500 megabytes of storage are available to the experimenter. The spacecraft sits on the Spartan Flight Support Structure and is held in place by a release-and-engage mechanism.

TEACHER IN SPACE PROJECT

Project History

President Reagan announced on Aug. 27, 1984, that a teacher would be chosen as the first private citizen to fly on the Space Shuttle. The Teacher in Space Project is part of NASA's Space Flight Participant Program designed to expand Shuttle opportunities to a wider segment of private citizens with the purpose of communicating the experience and flight activities to the public through educational and public information programs.

The Council of Chief State School Officers (CCSSO) was selected by NASA to coordinate the selection process. The Council is a nonprofit organization comprised of the public officials responsible for education in each state.

In November 1984, an Announcement of Opportunity was distributed, listing the eligibility requirements and a description of the selection process and criteria, medical requirements and responsibilities of the teacher selected to fly on the Shuttle mission.

Applications were accepted from Dec. 1, 1984 to Feb. 1, 1985. More than 11,000 teachers from the 50 states, the District of Columbia, Puerto Rico, Guam, the Virgin Islands, Department of Defense overseas schools, Department of State overseas schools and Bureau of Indian Affairs schools applied for the flight. State, territorial and agency review panels each selected two nominees for a total of 114 nominees.

The 114 nominees met in Washington, D.C., from June 22-27, 1985, for a National Awards Conference which focused on various aspects of space education.

During their stay in Washington, all nominees met formally and informally with the National Review Panel, which selected the 10 finalists.

On July 1, 1985, the 10 finalists were announced and on July 7 they traveled to Johnson Space Center for a week of thorough medical examinations and briefings about space flight.

From July 15-18, each of the finalists was interviewed by a NASA Evaluation Committee made up of senior NASA officials. The committee made recommendations to the NASA Administrator who selected Christa McAuliffe and Barbara Morgan as the primary and backup candidates for the NASA Teacher in Space Project.

Live Lessons

Teacher observer Christa McAuliffe will conduct two lessons on Flight Day 6 of the mission. The first lesson will begin at approximately 11:40 a.m. EST; the second is scheduled for approximately 1:40 p.m. EST.

The first lesson entitled "The Ultimate Field Trip" will allow students to compare daily life on the Shuttle with that on Earth. Conducting a tour of the Shuttle for viewers, McAuliffe will explain crewmembers' roles, show the location of computers and controls and describe experiments being conducted on the mission. She also will demonstrate how daily life in space is different from that on Earth in the preparation of food, movement, exercise, personal hygiene, sleep and the use of leisure time.

The second lesson, "Where We've Been, Where We're Going, Why?" will help the audience understand why people use and explore space by demonstrating the advantages of manufacturing in the microgravity environment, highlighting technological advances that evolve from the space program and projecting the future of humans in space.

Mission Watch

Classrooms with access to a satellite dish or cable network that carries NASA Select television will have, in addition to the live broadcast, the opportunity to participate in a "Mission Watch" which covers aspects of the entire Shuttle flight. The Mission Watch during 51-L will start the day before the launch and continue through the conclusion of the mission and will be carried only on NASA Select. Barbara Morgan, backup candidate for the NASA Teacher in Space Project, will act as moderator for the Mission Watch broadcast to schools. Morgan will give daily briefings on that day's planned events and update viewers on McAuliffe's activities.

Classroom Earth, a Spring Valley, Ill., organization dedicated to direct satellite transmission to elementary and secondary schools, will serve as the center for information and materials for schools that wish to use satellite dish antennas to receive both the live broadcast and the Mission Watch.

Specific information about the satellite transmission is available by writing to Classroom Earth, Spring Valley, Ill. 61362 or by calling 815/664-4500.

In-Flight Activities

During the 51-L mission, McAuliffe will be involved in several activities which will be filmed and later used in educational products.

* Magnetism -- Photograph and observe the lines of magnetic force in three dimensions in a microgravity environment.

* Newton's Law -- Demonstrate Newton's first, second and third laws in microgravity.

* Effervescence -- Understand why products may or may not effervesce in a microgravity environment.

* Simple Machines/Tools -- Understand the use of simple machines/tools and the similarities and differences between their uses in space and on Earth.

* Hydroponics in Microgravity -- Show the effect of microgravity on plant growth, growth of plants without soil (hydroponics) and capillary action.

* Chromatographic Separation of Pigments -- Demonstrate chromatography in a microgravity environment and show capillary action (the mechanism by which plants transport water and nutrients).

SHUTTLE STUDENT INVOLVEMENT PROGRAM

Utilizing a Semi-Permeable Membrane to Direct Crystal Growth

This is an experiment proposed by Richard S. Cavoli, formerly of Marlboro Central High School, Marlboro, N.Y. Cavoli is now enrolled at Union College, Schenectady, N.Y.

The experiment will attempt to control crystal growth through the use of a semi-permeable membrane. Lead iodide crystals will be formed as a result of a double replacement reaction. Lead acetate and potassium iodide will react to form insoluble lead iodide crystals, potassium ions and acetate ions. As the ions travel across a semi-permeable membrane, the lead and iodide ions will collide, forming the lead iodide crystal.

Cavoli's hypothesis states that the shape of the semipermeable membrane and the concentrations of the two precursor compounds will determine the growth rate and shape of the resultant crystal without regard to other factors experienced in earthbound crystal growing experiments.

Following return of the experiment aparatus to Cavoli, an analysis will be performed on the crystal color, density, hardness, morphology, refractive index, and electrical and thermal characteristics. Crystals of this type are useful in imaging systems for detecting gamma and X-rays and could be used in spacecraft sensors for astrophysical research purposes.

Cavoli's high school advisor is Annette M. Saturnelli of Marlboro Central High School and his college advisor and experiment sponsor is Dr. Charles Seaise of Union College.

Effects of Weightlessness on Grain Formation and Strength in Metals

This is an experiment proposed by Lloyd C. Bruce formerly of Sumner High School, St. Louis. Bruce is now a sophomore at the University of Missouri.

The experiment proposes to heat a titanium alloy metal filament to near the melting point to observe the effect that weightlessness has on crystal reorganization within the metal. It is expected that heating in microgravity will produce larger crystal grains and thereby increase the inherent strength of the metal filament. The experiment uses a battery supply, a timer and thermostat to heat a titanium alloy filament to 1,000 degrees C. At a temperature of 882 degrees C, the titanium-aluminum alloy crystal lattice network undergoes a metamorphosis from closely packed hexagonal crystals to centered cubic crystals.

Following return of the experiment gear to Sumner, he will perform an analysis comparing the space-tested alloy sample with one heated on Earth to analyze any changes in strength, size and shape of the crystal grains, and any change in the homogeneity of the alloy. If necessary microscopic examination, stress testing and X-ray diffraction analysis also will be used. Any changes between the two samples could lead to variations on this experiment, to be proposed for future Shuttle flights. A positive test might lead to a new and stronger titanium-aluminum alloy or a new type of industrial process.

Bruce's student advisor is Vaughan Morrill of Sumner High School. His sponsor is McDonnell Douglas Corp., St. Louis, and his experiment advisor is Julius Bonini of McDonnell Douglas.

Chicken Embryo Development in Space

This is an experiment of John C. Vellinger, formerly of Jefferson High School, Lafayette, Ind., to determine any effects of spaceflight on the development of a fertilized chicken embryo. Vellinger is now a sophomore at Purdue University.

The experiment will fly 12 White Leghorn chicken eggs which have been fertilized immediately prior to launch to see if any changes in the developing embryo can be attributed to weightlessness or space radiation effects. The development of a chicken embryo is greatest during the first several weeks following fertilization.

Eight eggs will be subjected to both weightlessness and radiation from space. The four remaining eggs will have lead shields placed around them to assist in determining any peculiar effects from space radiation. All 12 eggs will be placed in an incubator box and sent aboard Challenger while a similar group of 12 eggs will remain on Earth as a control group. Vellinger's hypothesis is that chickens could form a basis for food developed and grown in space but only if their development from fertilized eggs proceeds normally.

Upon return to Earth, the space incubators will remain at KSC for a period of about 10 days to allow the chicks to hatch. Vellinger will attend to the earthbound eggs much as a mother hen would, turning them five times a day to counter the effects of Earth's gravity on the yolk sack. Following hatching of both groups, Vellinger will attempt to determine if there are any statistically significant differences between the bone structure, nervous systems and internal organs of the two groups.

Vellinger's student advisor is Stanley W. Poelstra of Jefferson High School. Kentucky Fried Chicken, Louisville, is sponsoring the experiment and Dr. Lisbeth Kraft, NASA Ames Research Center, Mountain View, Calif., is serving as technical advisor.

COMET HALLEY ACTIVE MONITORING PROGRAM (CHAMP)

Objectives of the CHAMP payload include investigating the dynamical/morphological behavior as well as the chemical structure of Halley's Comet. Photographic images and spectra will be obtained through Columbia's windows using a handheld 35mm camera and associated equipment. A crew member will enclose himself in a camera shroud to eliminate all cabin light interference. Using International Halley Watch standard comet filters, several image-intensified monochromatic exposures will be made. In addition, spectra of the comet will be photographed using a grating and image intensifier.

Similar observations were made on the last flight and will be made on the March flight to study the variations of the comet with time. CHAMP requires no spacecraft power or other systems support and is stored in two-thirds of one middeck locker.

The principal investigators for CHAMP are S. Alan Stern, Laboratory for Atmospheric and Space Physics (LASP), University of Colorado-Boulder, and Dr. Stephen Mende, Lockheed Palo Alto Research Laboratory. Mission management support is provided by the Engineering Directorate, Johnson Space Center for the Office of Space Science and Applications, NASA Headquarters.

PHASE PARTITIONING EXPERIMENT

Phase partitioning is a selective, gentle and inexpensive technique, ideal for the separation of biomedical materials such as cells and proteins. It involves establishing a two-phase system by adding various polymers to a water solution containing the materials to be separated. Two phase systems most familiar are oil and water or cream and milk. When two phase polymer systems are established, the biomedical materials they contain tend to separate or "partition" into the different phases.

Theoretically, phase partitioning should separate cells with significantly higher resolution than is presently obtained in the laboratory. It is believed that when the phases are emulsified on Earth, the rapid, gravity-driven fluid movements, occurring as the phases coalesce, tend to randomize the separation process. It is expected that the theoretical capabilities of phase partitioning systems can be more closely approached in the weightlessness of orbital spaceflight where gravitational effects of buoyancy and sedimentation are minimized.

The first exploratory flight of Phase Partitioning Experiment (PPE) equipment involves the use of a small, handheld device, a little larger than a cigarette box and weighing about 1 pound. This unit will fit within a small part of a standard middeck locker. The unit has 15 chambers to allow the test of different volume ratios and compositions of the phases and differences in wall coatings within the chambers.

The Microgravity Science and Applications Division of the Office of Space Science and Applications, NASA Headquarters, sponsors the experiment. Marshall Space Flight Center is responsible for mission implementation.

FLUID DYNAMICS IN SPACE

Hughes payload specialist Greg Jarvis will perform experiments to investigate fluid dynamics in microgravity. These experiments will improve Hughes' understanding of how fluids act in orbiting spacecraft and may lead to the design of more efficient and less costly spacecraft.

Hughes is now designing larger, more massive spacecraft to take advantage of the Shuttle capabilities. This evolution in design has led to the replacement of solid rocket motors with highly efficient liquid propulsion systems for transfer orbit maneuvers. Spacecraft design has always taken into account the possible destabilizing effects of liquid propellants. However, as the quantity of liquid increases it becomes more important to understand the interaction between the fluid and the spacecraft.

There are two categories of experiments to be performed: fluid behavior in enclosed tanks and fluid motion interactions with spacecraft motions.

For the enclosed tank experiments, Jarvis will try to determine the behavior of a fluid in a partially-filled tank for different levels of fill. A metal base plate will be used to support the experiment and will be attached with Velcro tape to the cabin walls of Challenger. A metal shaft attaches to the base plate and supports a hub assembly connecting to two 6-inch diameter tanks.

The tanks and hub do not move in one of these experiments and are set spinning at about 10 revolutions/minute in a second experiment. Throughout these experiments, Jarvis will record the fluid motions using orbiter video cameras and recorders. A third experiment in this series will use a spring to spin up the hub assembly (much as a helicoptor toy uses a spring to impart a one-time spin-up). Once spun up, the hub assembly will be videotaped to record the transfer of motion from the simulated spacecraft to the fluid inside. The spheres are transparent so the motions of the fluid inside can be seen readily.

Another set of experiments will observe the effects of energy dissipation between spacecraft motions and fluid motions within the spacecraft. In these experiments, a four-tank spherical tank model will first be attached to the hub and used for observations. This model consists of four 3 1/4-inch diameter clear plastic tanks. Following those, an ellipsoidal centerline tank model will be used. The ellipsoidal tank is 3 1/4 in. long by 4 1/4 in. in diameter.

This experiment will measure transmitted motions from the simulated spacecraft tanks to the fluids in the tanks using very sensitive accelerometers which transmit their information via infrared light emitting diodes (similar to the way most television and video recorder remote control units work).

This technique removes any potential drag which might result from cabling between the moving tank models and the instrument recorders. For this series of experiments, the models will be spun up to about 100 revolutions a minute by Jarvis.

A third series of experiments will measure the fluid dynamics of "frisbee" style deployed satellites using a cradle model in lieu of the base plate used in earlier experiments.

The videotapes and recorded accelerometer data will be analyzed by Hughes engineers once the mission is over.

U.S. LIBERTY COINS

Two complete sets of the newly-minted U.S. Liberty coins will become the first legal tender American coinage to make a trip into orbit on mission 51-L.

The Liberty coins -- a silver dollar, half dollar and $5 gold coin -- are being minted by authorization from Congress to honor the Statue of Liberty's centennial anniversary in 1986 and to help raise funds for the restoration and future maintenance of the statue and Ellis Island. They are the first and only government-issue coins to feature the Statue of Liberty.

School children in grades 4 through 8 will be given the chance to learn about coins and American history in a special education package -- Commemorating Liberty Though Coins -- which will be delivered to every public, private and parochial school in the nation in early March 1986.

The U.S. Liberty coins will be available at financial institutions and department stores across the country in April 1986.

51-L FLIGHT CREW

FRANCIS R. (DICK) SCOBEE is spacecraft commander. Born May 19, 1939, in Cle Elum, Wash., he became a NASA astronaut in 1978. He received a B.S. degree in aerospace engineering from the University of Arizona in 1965.

Scobee was a reciprocating engine mechanic in the Air Force. He was commissioned in 1965, and after receiving his wings in 1966, completed a number of assignments including a combat tour in Vietnam. He attended the Aerospace Research Pilot School at Edwards Air Force Base, flying such varied aircraft as the Boeing 747, the X-24B, the transonic aircraft technology (TACT) F-111 and the C-5. He has logged more than 6,500 hours in 45 types of aircraft.

Scobee was pilot of STS 41-C in 1984. During this mission the crew deployed the Long Duration Exposure Facility (LDEF); and retrieved, repaired aboard the orbiting Challenger, and returned to orbit, the ailing Solar Maximum Mission satellite.

MICHAEL J. SMITH, Commander, USN, is pilot. Born April 30, 1945, in Beaufort, N.C., he became a NASA astronaut in 1980.

Smith received a B.S. degree in naval science from the U.S. Naval Academy and an M.S. degree in aeronautical engineering from the U.S. Naval Postgraduate School.

Smith flew A-6 Intruders and completed a Vietnam cruise while assigned to Attack Squadron 52 aboard the USS Kitty Hawk. He was awarded the Navy Distinguished Flying Cross, 3 Air Medals, 13 Strike Flight Air Medals, the Navy Commendation Medal with "V", the Navy Unit Citation and the Vietnamese Cross of Gallantry with Silver Star.

He has flown 28 diferent types of civilian and miliary aircraft, logging over 4,300 hours -- 4,000 in jet aircraft.

JUDITH A. RESNIK, Ph.D., is one of three mission specialists aboard 51-L. She was born April 5, 1949, in Akron, Ohio. She received a B.S. degree in electrical engineering from Carnegie-Mellon University and a Ph.D. in electrical engineering from the University of Maryland. She became an astronaut in 1978.

Resnik worked for RCA, Moorestown, N.J., designing circuits and developing custom integrated circuitry for phased-array radar control systems. She was a biomedical engineer and staff fellow in the laboratory of neurophysiology at the National Institutes of Health, Bethesda, Md. She also served as senior systems engineer in product development with Xerox Corp., El Segundo, Calif.

Resnik was mission specialist on STS 41-D. During this mission, the crew deployed three satellites. Resnik has logged 144 hours, 57 minutes in space.

RONALD E. McNAIR, Ph.D, mission specialist, became an astronaut in 1978. Born Oct. 21, 1950, in Lake City, S.C., he received a B.S. degree in physics from North Carolina A&T State University and a Ph.D. in physics from the Massachusetts Institute of Technology.

While at MIT, McNair performed some of the earliest development of chemical HF/DF and high pressure CO lasers. He became a staff physicist with Hughes Research Laboratories in Malibu, Calif., and conducted research on electro-optic laser modulation for satellite-to-satellite space communications.

McNair was a mission specialist on Shuttle mission 41-B. During the flight, two Hughes 376 communications satellites were deployed. It was the first flight of the Manned Maneuvering Unit and first use of the Canadian arm (operated by McNair) to position EVA crewman around Challenger's payload bay. McNair has 191 hours in space.

ELLISON S. ONIZUKA, Lt. Col., USAF, is a mission specialist. He became an astronaut in 1978. Born June 24, 1946 in Kealakekua, Kona, Hawaii, he received B.S. and M.S. degrees in aerospace engineering from the University of Colorado. He became a NASA astronaut in 1978.

Onizuka was an aerospace flight test engineer with the Sacramento Air Logistics Center at McClellan Air Force Base. He participated in flight test programs and systems safety engineering for the F-84, F-100, F-105, F-111, EC-121T, T-33, T-39, T-28 and A-1 aircraft. He has logged more than 1,700 hours flying time.

Onizuka was a mission specialist on STS 51-C, the first dedicated Department of Defense mission. He has logged 74 hours in space.

GREGORY B. JARVIS, payload specialist, was born Aug. 24, 1944, in Detroit. He received a B.S. degree in electrical engineering from the State University of New York at Buffalo; an M.S. degree in electrical engineering from Northeastern University, Boston; and has completed the course work for an M.S. degree in management science at West Coast University, Los Angeles. Jarvis was selected as a payload specialist candidate in 1984.

Jarvis worked at Raytheon, Bedford, Mass., designing circuits on the SAM-D missile. Later, as a communications payload engineer in the Satellite Communications Program Office, he worked on advanced tactical communications satellites. He later joined Hughes Aircraft Co.'s Space and Communications Group where he worked as subsystem engineer on the MARISAT Program.

He was test and integration manager for the F-1, F-2 and FD-3 spacecraft and cradle in 1983. The F-1 and F-2 Leasat spacecraft were successfully deployed.

S. CHRISTA CORRIGAN McAULIFFE is the Teacher is Space participant. Born Sept. 2, 1948, in Boston, she received a B.A. degree from Framingham State College and a masters degree in education from Bowie State College, Bowie, Md.

McAuliffe has taught English and American History since 1970. Until her selection as NASA Teacher in Space, she taught economics, law, American history, and a course she developed, "The American Woman," to 10th through 12th grade students.

McAuliffe was selected as primary candidate for the NASA Teacher in Space Project in July 1985.

-end-

(NOONAN) JANUARY 28, 1986

PRESIDENT's BACKUP COPY

ADDRESS TO THE NATION:

DEATH OF SPACE SHUTTLE CHALLENGER CREW

LADIES AND GENTLEMEN, I HAD PLANNED TO SPEAK TO YOU TONIGHT TO REPORT ON THE STATE OF THE UNION, BUT THE EVENTS OF EARLIER TODAY HAVE LED ME TO CHANGE THOSE PLANS. TODAY IS A DAY FOR MOURNING, AND REMEMBERING.

NANCY AND I ARE PAINED TO THE CORE BY THE TRAGEDY OF THE SHUTTLE CHALLENGER. WE KNOW WE SHARE THIS PAIN WITH ALL OF THE PEOPLE OF OUR COUNTRY. THIS IS TRULY A NATIONAL LOSS.

NINETEEN YEARS AGO ALMOST TO THE DAY, WE LOST THREE ASTRONAUTS IN A TERRIBLE ACCIDENT ON THE GROUND. BUT WE HAVE NEVER LOST AN ASTRONAUT IN FLIGHT. WE HAVE NEVER HAD A TRAGEDY LIKE THIS. AND PERHAPS WE HAVE FORGOTTEN THE COURAGE IT TOOK FOR THE CREW OF THE SHUTTLE. BUT THEY, THE CHALLENGER SEVEN, WERE AWARE OF THE DANGERS -- AND OVERCAME THEM AND DID THEIR JOBS BRILLIANTLY.

WE MOURN SEVEN HEROES -- MICHAEL SMITH, DICK SCOBEE, JUDITH RESNIK, RONALD McNAIR, ELLISON (OH-NIH-ZOO-KUH), GREGORY JARVIS, AND CHRISTA McAULIFFE. WE MOURN THEIR LOSS AS A NATION, TOGETHER.

TO THE FAMILIES OF THE SEVEN: WE CANNOT BEAR, AS YOU DO, THE FULL IMPACT OF THIS TRAGEDY -- BUT WE FEEL THE LOSS, AND WE ARE THINKING ABOUT YOU SO VERY MUCH. YOUR LOVED ONES WERE DARING AND BRAVE AND THEY HAD THAT SPECIAL GRACE, THAT SPECIAL SPIRIT THAT SAYS: GIVE ME A CHALLENGE AND I'LL MEET IT WITH JOY. THEY HAD A HUNGER TO EXPLORE THE UNIVERSE AND DISCOVER ITS TRUTHS. THEY WISHED TO SERVE AND THEY DID --
THEY SERVED ALL OF US.

WE HAVE GROWN USED TO WONDERS IN THIS CENTURY -- IT's HARD TO DAZZLE US. BUT FOR 25 YEARS THE UNITED STATES SPACE PROGRAM HAS BEEN DOING JUST THAT. WE HAVE GROWN USED TO THE IDEA OF SPACE, AND PERHAPS WE FORGET THAT WE'VE ONLY JUST BEGUN, WE'RE STILL PIONEERS -- THEY, THE MEMBERS OF THE CHALLENGER CREW,
WERE PIONEERS.

AND I WANT TO SAY SOMETHING TO THE SCHOOL CHILDREN OF AMERICA WHO WERE WATCHING THE LIVE COVERAGE OF THE SHUTTLE's TAKEOFF. I KNOW IT's HARD TO UNDERSTAND BUT SOMETIMES PAINFUL THINGS LIKE THIS HAPPEN -- IT's ALL PART OF THE PROCESS OF EXPLORATION AND DISCOVERY -- IT's ALL PART OF TAKING A CHANCE AND EXPANDING MAN's HORIZONS. THE FUTURE DOESN'T BELONG TO THE FAINT-HEARTED -- IT BELONGS TO THE BRAVE.
THE CHALLENGER CREW WAS PULLING US INTO THE FUTURE -- AND WE'LL CONTINUE TO FOLLOW THEM.

I'VE ALWAYS HAD GREAT FAITH IN AND RESPECT FOR OUR SPACE PROGRAM -- AND WHAT HAPPENED TODAY DOES NOTHING TO DIMINISH IT. WE DON'T HIDE OUR SPACE PROGRAM, WE DON'T KEEP SECRETS AND COVER THINGS UP, WE DO IT ALL UP FRONT AND IN PUBLIC. THAT's THE WAY FREEDOM IS, AND WE WOULDN'T CHANGE IT FOR A MINUTE.

WE'LL CONTINUE OUR QUEST IN SPACE. THERE WILL BE MORE SHUTTLE FLIGHTS AND MORE SHUTTLE CREWS AND, YES, MORE VOLUNTEERS, MORE CIVILIANS, MORE TEACHERS, IN SPACE. NOTHING ENDS HERE -- OUR HOPES AND OUR JOURNEYS CONTINUE.

I WANT TO ADD THAT I WISH I COULD TALK TO EVERY MAN AND WOMAN WHO WORKS FOR NASA OR WHO WORKED ON THIS MISSION AND TELL THEM: YOUR DEDICATION AND PROFESSIONALISM HAVE MOVED AND IMPRESSED US FOR DECADES, AND WE KNOW OF YOUR ANGUISH. WE SHARE IT.

THERE's A COINCIDENCE TODAY. ON THIS DAY 390 YEARS AGO, THE GREAT EXPLORER SIR FRANCIS DRAKE DIED ABOARD SHIP OFF THE COAST OF PANAMA. IN HIS LIFETIME THE GREAT FRONTIERS WERE THE OCEANS. AND A HISTORIAN LATER SAID, "HE LIVED BY THE SEA, DIED ON IT, AND WAS BURIED IN IT." TODAY WE CAN SAY OF THE CHALLENGER CREW: THEIR DEDICATION WAS, LIKE DRAKE's, COMPLETE.

THE CREW OF THE SPACE SHUTTLE CHALLENGER HONORED US BY THE MANNER IN WHICH THEY LIVED THEIR LIVES. WE WILL NEVER FORGET THEM, NOR THE LAST TIME WE SAW THEM -- THIS MORNING, AS THEY PREPARED FOR THEIR JOURNEY, AND WAVED GOODBYE, AND "SLIPPED THE SURLY BONDS OF EARTH" TO "TOUCH THE FACE OF GOD."

High Flight
John Gillespie Magee Jr.
Golden Treasury of the Familiar; compiled by Ralph Woods; Macmillan Publishing Co., Inc; NY; p. 381

THERESA HOUSER
453-8364
NASA Public affairs

THANK YOU.

# # #

KW-FYI

THE WHITE HOUSE
WASHINGTON

Date: 1-29-86

To: ~~Ben / Peggy~~

nice reaction here - beautiful job -

I've sent to P

Love

ANNE HIGGINS
Special Assistant to the
President and Director
of Correspondence
Room 94, x7610

4-033656S028 01/28/86
ICS IPMRNCZ CSP
6192703828 POM TDRN SAN DIEGO CA 45 01-28 0512P EST
PMS PRESIDENT RONALD REAGAN
WHITE HOUSE DC 20500
I DID NOT VOTE FOR YOU IN '80 AND '84. I AM VERY OPPOSED TO MANY OF YOUR PROGRAMS AND POLICIES. HOWEVER, I WAS MOVED, TOUCHED, INSPIRED BY YOUR SPEECH THIS AFTERNOON CONCERNING OUR SPACE SHUTTLE HEROES. YOUR STRENGTH HAS BOLSTERED OUR COUNTRY IMMENSELY.

SINCERELY,

BRIAN DAVID ANDERSON
3665 KEARNY VILLA RD APT 307
SAN DIEGO CA 92123

M/ Offer of service

1-013301A028 01/28/86
ICS IPMWGWC WSH
01511 01-28 0412P EST
PMS WHITE HOUSE DC 20500
4-017371S028 01/28/86
ICS IPMBNGZ CSP
2018657315 TDBN WEEHAWKEN NJ 52 01-28 0127P EST
ICS IPMMOZZ
PRESIDENT RONALD REAGAN RPT DLY MGM
WHITE HOUSE DC

CAST MEMBERS OF THE BROADWAY THEATRICAL COMMUNITY WOULD LIKE TO OFFER THEIR MUSICAL SERVICES FOR THE MEMORIAL SERVICES FOR OUR ASTRONAUTS. APPROPRIATE MUSICAL SELECTIONS ARE CURRENTLY BEING REHEARSED. PLEASE ADVISE. CONTACT MR CHAPMAN ROBERTS, MUSICAL DIRECTOR BROADWAY PRODUCTIONS OF "YOUR ARMS TOO SHORT TO BOX WITH GOD", "EUBIE", AND "BUBBLING BROWN SUGAR"

CHAPMAN ROBERTS
21 ELDORADO PL
WEEHAWKEN NJ 07087

1522 EST

1610 EST

1613 EST

4-033531S028 01/28/86

ICS IPMMTZZ CSP

3055634764 POM TDMT FORT LAUDERDALE FL 8 01-28 0511P EST

PMS PRESIDENT RONALD REAGAN

WHITE HOUSE DC 20500

THE MOST PERFECT FITTING SPEECH OF ALL TIME

ISABEL STAPLES

3000 EAST SUNRISE BLVD

FORT LAUDERDALE FL 33304

1712 EST

4-033692S028 01/28/86

ICS IPMBNGZ CSP

4142710492 POM TDBN MILWAUKEE WI 34 01-28 0513P EST

PMS PRESIDENT RONALD REAGAN RPT DLY MGM

WHITE HOUSE DC 20500

DEAR MR. PRESIDENT,

YOU HAVE MY FINANCIAL SUPPORT AS A TAXPAYER TO CONTINUE THE SPACE PROGRAM. YOU HAVE ALSO CONVERTED A DEMOCRAT INTO A REPUBLICAN. YOU ARE ONE OF A KIND. KEEP STRONG.

SINCERELY,

BERNIE MILLER

1626 NORTH PROSPECT AVE APT 1901

MILWAUKEE WI 53202

4-038269S028 01/28/86

ICS IPMBNGZ CSP

5048345764 POM TDBN METAIRIE LA 49 01-28 0630P EST

PMS PRESIDENT RONALD REAGAN

WHITE HOUSE DC 20500

DEAR MR. PRESIDENT, I SUPPORT YOUR DECISION IN CONTINUING AMERICAS EFFORTS IN THE SPACE PROGRAM AS A TEACHER I ENCOURAGE THE OPPORTUNITY OF ENLISTING AS A SPACE PASSENGER ON ANY FUTURE MISSION AS A WIFE MOTHER AND DAUGHTER I GRIEVE FOR THE TRAGIC LOSS OF SEVEN SPLENDID AMERICANS SINCERELY

MARY HELEN LAGASSE
1036 PAPWORTH AVE
METAIRIE LA 70005

1831 EST

4-033497S028 01/28/86

ICS IPMMTZZ CSP

7189670739 POM TDMT STATEN ISLAND NY 46 01-28 0910P EST

86 JAN 28 P 5: 11

PMS PRESIDENT RONALD REAGAN

WHITE HOUSE DC 20500

DEAR MR PRESIDENT

YOUR FIVE MINUTE SPEECH TO THE NATION REGARDING THE TRAGEDY THIS MORNING WAS NOT ONLY ELOQUENT BUT SHOWED THE TRUE EMOTIONS OF A GREAT PRESIDENT

YOUR REFERENCE TO THE SCHOOL CHILDRED SHALL ALWAYS BE REMEMBERED.

WITH SINCERELY RESPECT AND AFFECTION

VERY TRULY YOURS

FRED MEDNICK

PO BOX 195

STATEN ISLAND NY 10312

4-031033S028 01/28/86
ICS IPMRNCZ CSP
5032216614 POM TDRN PORTLAND 145 01-28 0437P EST

PMS PRESIDENT RONALD REAGAN
WHITE HOUSE DC 20500

MR. PRESIDENT, I AM SURE YOU SHARE WITH ME THE DEEP LOSS OF OUR SEVEN SHUTTLE ASTRONAUTS AND OUR SHUTTLE CHALLENGER. SURELY IT HIS HAS BEEN A SET BACK FOR THE AMERICAN SPACE PROGRAM; HOWEVER, THIS ONLY STRENGTHENS MY RESOLVE TO PRESS ON. IT HAS BEEN SAID ALL THINGS EXCELLENT AS DIFFICULT AS THEY ARE RARE. MR. PRESIDENT, EVEN THOUGH WE PROBABLY DON'T NEED A STOCK BROKER IN SPACE YET, I'D GIVE EVERYTHING I OWN TO BE ON THE NEXT FLIGHT. ALTHOUGH THERE IS NO WAY TO REPLACE THE LOSS OF OUR PILOTS, WE SURELY CAN REPLACE THE SHUTTLE. I FIGURE IT WOULD ONLY COST 4 DOLLARS PER AMERICAN. I WANT TO TAKE THE FIRST STEP. I AM AT THIS TIME, FORWARDING A CHECK TO THE U.S. GOVERNMENT OF 400 DOLLARS, SPECIFICALLY FOR THE SHUTTLE PROGRAM. I HOPE OTHER AMERICANS WILL FOLLOW MY LEAD.

SINCERELY
JIM HANSEN
PORTLAND OREGON
1500 SOUTH WEST 5TH #1203
PORTLAND OR 97201

1639 EST

1-018109A028 01/28/86
ICS IPMWGWC WSH
02541 01-28 0742P EST
PMS WHITE HOUSE DC 20500

4-037737S028 01/28/86
ICS IPMBNGZ CSP
4022920724 NL TDBN BELLEVUE NE 96 01-28 0620P EST
ICS IPMMGZZ
PRESIDENT RONALD REAGAN
WHITE HOUSE
WASHINGTON DC 20500

DEAR PRESIDENT

I WAS DEEPLY MOVED BY YOUR TELEVISED SPEECH TODAY. AS A MEMBER OF THE OFFUTT CADET SQUADRON OF THE NEBRASKA WING CIVIL AIR PATROL. I APPLAUD YOUR COMMITMENT TO THE FUTURE AND THE SPACE PROGRAM. MANY OF THE CADETS IN CIVIL AIR PATROL LOOK FORWARD TO THE DAY WHEN WE CAN PARTICIPATE IN THE EXPLORATION OF OUTER SPACE AND THE EXTENSION OF OUR KNOWLEDGE IN THIS NEW FRONTIER. AND I WOULD LIKE YOU TO KNOW THAT I WILL ALWAYS STAND BY THE SPACE PROGRAM.

DAVID R TARVIN JR. C/SGT OFFUTT CADET SQUADRON
C-TSGT AFJROTC

18[illegible] EST
19[illegible] EST

19[illegible] EST

2156424563 TDMT WYNNEWOOD PA 15 01-28 0519P EST

ICS IPMMOZZ

PRESIDENT RONALD REAGAN

WHITE HOUSE DC 20500

IN NATIONAL TRIUMPH OR TRAGEDY THANK GOD FOR YOUR LEADERSHIP GOD BLESS YOU AND AMERICA

GENE REILEY
8 ENGLISH VILLAGE
WYNNEWOOD PA 19096

1720 EST

1840 EST

1859 EST

4-041408S028 01/28/86

ICS IPMBNGZ CSP

7136606224 POM TDBN BELLAIRE TX 37 01-28 0735P EST

PMS PRESIDENT RONALD REAGAN

WHITE HOUSE DC 20500

MR. PRESIDENT,

YOUR CHALLENGER STATEMENT TODAY WAS ELOQUENT. YOUR WORDS TOUCHED OUR HEARTS. HOPEFULLY THIS TRAGEDY WILL NOT SLOW OUR EFFORTS IN SPACE BUT STRENGTHEN OUR RESOLVE TO EXPAND OUR FRONTIERS. THANK YOU FOR YOUR INSIGHT AND COMFORT.

MR AND MRS WILLIAM G. MILLER
4525 MAPLE ST
BELLAIRE TX 77401

1936 EST

4-040568S028 01/28/86
ICS IPMBNGZ CSP
3133340363 PDM TDBN BLOOMFIELD HILLS MI 18 01-28 0615P CST
PMS PRESIDENT RONALD REAGAN
WHITE HOUSE DC 20500

WHERE HEROES FLY FIRST IT IS THE RESPONSIBILITY OF THOSE THEY LEAD TO FOLLOW AND SUPPORT THE DREAM.

THE MAIN FAMILY CHARLES MAIN
2143 BRENTHAVEN DR
BLOOMFIELD HILLS MI 48013

1918 EST

4-044024S028 01/28/86

ICS IPMMTZZ CSP

3056270885 POM TDMT NORTH PALM BEACH FL 29 01-28 0838P EST

PMS PRESIDENT RONALD REAGAN

WHITE HOUSE DC 20500

DEAR SIR

YOUR TALK TONIGHT GAVE US COMFORT THANK YOU OUR TEARS ARE FOR THE FAMILIES OF THE BRAVE CREW OF CHALLENGER GOD BLESS THEM ALL GOD BLESS AMERICA

MRS PETER MAKRIS
11905 LAKE SHORE PL
NORTH PALM BEACH FL 32408

2038 EST

4-037968S028 01/28/86

ICS IPMBNGZ CSP

7133583576 POM TDBN KINGWOOD TX 15 01-28 0625P EST

PMS PRESIDENT RONALD REAGAN

WHITE HOUSE DC 20500

YOUR ACTIONS RESPONDING TO CHALLENGER TRAGEDY AFFIRMS MY BELIEF THAT YOU ARE A GREAT PRESIDENT.

MRS BILLY JEAN WALTON

2118 LAKEVILLE

KINGWOOD TX 77339

1827 EST

4-042651S028 01/28/86
ICS IPMBNGZ CSP
4143721933 POM TDBN MILWAUKEE WI 13 01-28 0803P EST
PMS PRESIDENT RONALD REAGAN
WHITE HOUSE DC 20500
TUESDAY'S SPEECH MOVING, INSPIRATIONAL. YOU GIVE AMERICA COMFORT AND HOPE. MUCH CONTINUED SUCCESS.

CHERYL AND GREGORY POSNER-WEBER
2650 NORTH BREMEN ST
MILWAUKEE WI 53212

2004 EST

4-035946S028 01/28/86
ICS IPMBNGZ CSP
2058594820 POM TDBN HUNTSVILLE AL 17 01-28 0550P EST
PMS PRESIDENT RONALD REAGAN
WHITE HOUSE DC 20500
REGARDING THE CHALLENGER TRAGEDY SPEECH

THANK YOU FOR YOUR COMPASSION ESPECIALLY THE ATTENTION GIVEN TO OUR YOUTH.

MR AND MRS GEORGE MCGLONE
2208 APACHE
HUNTSVILLE AL 35810

1751 EST

4-042861S028 01/28/86

ICS IPMBNGZ CSP

2194863029 POM TDBN FT WAYNE IN 30 01-28 0808P EST

PMS PRESIDENT RONALD REAGAN

WHITE HOUSE DC 20500

THANK YOU AND BLESS YOU FOR HOLDING THE HANDS OF THIS NATION TOGETHER TODAY AS WE ALL GRIEVED. THE IMPACT OF YOUR INNER STRENGTH IS FELT BY ALL. THANK YOU.

MRS. JOYCE A. GREIG
3641 TRIER RD
FT WAYNE IN 46815

2010 EST

1-017355A028 01/28/86
ICS IPMRYNR RNO
04391 RENO NV 01-28 0400P PST RYNO
ICS IPMWHDS
1-016759A028 01/28/86
ICS IPMWGWC WSH
02321 01-28 0633P EST
PMS WHITE HOUSE DC

1-011522C028 01/28/86
ICS IPMBDGF BTN
02431 BRIDGETON MO 01-28 0516P CST BDGE
PMS WASHINGTON DC

4-034079S028 01/28/86

ICS IPMBNGZ CSP
513399516P TDBN SPRINGFIELD OH 25 01-28 0519P EST
ICS IPMBDGS
PRESIDENT RONALD REAGAN RPT DLY MGM
WHITE HOUSE
WASHINGTON DC
I AM A SCHOOL TEACHER. WHEN YOU NEED A PHILOSOPHER ON A SPACE SHUTTLE
I AM READY TO GO. THANK YOU FOR YOUR REASSURING MESSAGE.
ROBERT O LONG DEPT OF PHILOSOPHY WITTENBERG UNIVERSITY
SPRINGFIELD OHIO
2215 NORTH FOUNTAIN
SPRINGFIELD OH 45504
1722 EST
1824 EST
1827 EST

here today by the representatives of so many of the other nations of the world.

I now take great pleasure in presenting to you our distinguished Secretary of State—Mr. Dean Rusk.

NOTE: The President spoke at 5:15 p.m. in the East Room at the White House. In his opening words he referred to Secretary of State Dean Rusk, Vice President Hubert H. Humphrey, and Chief Justice Earl Warren.

In his remarks following the President's, Secretary Rusk reviewed the major steps taken since the Soviet Union launched its first Sputnik in 1957 in the quest for peace and security. "There is great satisfaction," he noted, "in being able to present this treaty within 10 years after the launching of that Sputnik."

Arthur J. Goldberg, U.S. Representative to the United Nations, then spoke briefly. He commended the members of the United Nations Committee on the Peaceful Uses of Outer Space and expressed his appreciation to the President "for initiating this effort on behalf of our country."

Ambassador Goldberg also read a message from United Nations Secretary General U Thant. The Secretary General described the outer space treaty, together with the Antarctic treaty of 1959 and the nuclear test ban treaty of 1963 as "true landmarks in man's march towards international peace and security. I fervently hope," he said in conclusion, "that these achievements will shortly be followed by similar agreements on nonproliferation of nuclear weapons and other steps towards international peace and security."

The British Ambassador, Sir Patrick Dean, and the Ambassador from the Soviet Union, Anatoly F. Dobrynin, also spoke briefly. Stating that the treaty was an important step toward the creation of a world free from the fear of war, Sir Patrick added that its signature by the United States and the Soviet Union would "give fresh encouragement and new hope to the world."

In signing the treaty on behalf of the Soviet Union Mr. Dobrynin stated: "We believe that the treaty . . . will be an important step in further development of cooperation and understanding among states and peoples, and will contribute to the settlement of other major international problems facing humanity here on this planet."

The full text of the various remarks at the signing ceremony is printed in the Weekly Compilation of Presidential Documents (vol. 3, p. 127). After signatures by Secretary Rusk and Ambassador Goldberg for the United States, Ambassador Dean for the United Kingdom, and Ambassador Dobrynin for the Soviet Union, the treaty was signed by the representatives of 57 other nations. Signing ceremonies were also held in London and Moscow.

On February 7, 1967, the President transmitted the treaty to the Senate (see Item 38). It was favorably considered by the Senate on April 25, 1967. The text of the treaty is printed in Senate Executive D (90th Cong., 1st sess.).

19 Statement by the President on the Death of Astronauts Virgil I. Grissom, Edward H. White 2d, and Roger B. Chaffee. *January* 27, 1967

THREE valiant young men have given their lives in the Nation's service. We mourn this great loss. Our hearts go out to their families.

NOTE: The three astronauts were killed on January 27 by a fire in an Apollo spacecraft mounted on a Saturn rocket at Cape Kennedy. The accident occurred in the course of a test in preparation for a flight scheduled for February 21.

A press release issued by the Manned Spacecraft Center at Houston, Texas, gave biographical sketches of the three astronauts and details concerning their burial. On January 31 the President attended the funeral of Lt. Colonel Grissom and Lt. Commander Chaffee at Arlington National Cemetery. On the same day Mrs. Johnson was present at the interment of Lt. Colonel White at the U.S. Military Academy at West Point.

The statement was made available to the press through the White House Press Office.

MEMORANDUM OF CALL

Previous editions usable

6691 x Khedouri

TO: [illegible] Tom Colleran x7045

[ ] YOU WERE CALLED BY— [ ] YOU WERE VISITED BY—

Dick Johnson

OF (Organization)

453-8364

[ ] PLEASE PHONE ▶ [ ] FTS [ ] AUTOVON

[ ] WILL CALL AGAIN [ ] IS WAITING TO SEE YOU

[ ] RETURNED YOUR CALL [ ] WISHES AN APPOINTMENT

MESSAGE

Rm 358 NASA Public

Theresa Howard

RECEIVED BY | DATE | TIME

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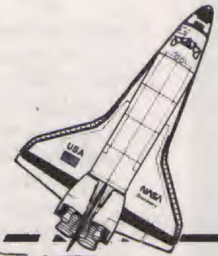
NASA
National Aeronautics and
Space Administration

Teacher in Space

Teacher in Space Project



YOUR INVITATION FROM SPACE... Come aboard for a history-making educational opportunity to instruct using the first lessons taught live from the Space Shuttle. Teacher in Space, Christa McAuliffe, will teach two lessons that will be broadcast live via satellite to the classrooms and homes of television viewers from the Shuttle Challenger. The materials in this publication have been designed to help teachers and other adults maximize the learning experiences which will grow from the lessons and other educational events scheduled on Mission 51-L's historic flight!

CONTENTS

PROJECT BACKGROUND

Plans to make a teacher the first private citizen to fly on the Space Shuttle began with President Ronald Reagan's announcement of the program on August 27, 1984. Christa McAuliffe will fulfill that decision on Shuttle Mission 51-L slated for launch in January 1986. McAuliffe's flight is a part of NASA's Space Flight Participant Program which is designed to expand Shuttle opportunities to a wider segment of private citizens. Among her challenges will be communication of the experience and flight activities to the public through educational and public information programs.

The selection of Christa McAuliffe as primary candidate and Barbara Morgan as backup culminated a search process coordinated for NASA by the Council of Chief State School Officers. Some 11,000 teachers applied for the opportunity to become the Teacher in Space. State, territorial, and agency review panels each selected two nominees for a nomination slate of 104. These nominees are continuing to serve as NASA's educational Space Ambassadors in their areas.

The ten finalists announced on July 1, 1985 traveled to NASA's Johnson Space Center in Houston, Texas and Marshall Space Flight Center in Huntsville, Alabama for briefings and testing. A NASA Evaluation Committee interviewed them in Washington, D.C., and the final selection announcement was made by Vice President George Bush on July 19, 1985. Christa McAuliffe and Barbara Morgan began their training on September 9 at the Johnson Space Center.

The remaining eight finalists are working with NASA on a one-year assignment at Headquarters and NASA research centers. In August, they worked with McAuliffe and Morgan to design the lessons which the Teacher in Space will teach live during the mission. Their continued input will create an abundance of new space-related materials for the classroom.

MISSION BACKGROUND

The Crew:

Commander—Francis R. (Dick) Scobee
Pilot—Michael J. Smith
Mission Specialist—Judith A. Resnick, Ph.D.
Mission Specialist—Ellison S. Onizuka
Mission Specialist—Ronald E. McNair, Ph.D.
Payload Specialist—Gregory Jarvis (Hughes Communications)
Space Flight Participant (Teacher-Observer)—S. Christa McAuliffe

The Flight, Payload, and Experiments:

Shuttle Mission 51-L will be a six-day mission. Launch is scheduled for January 22, 1986 from the Kennedy Space Center, and landing is scheduled for January 28 at the same site. The mission carries two major payloads, the TDRS-B (Tracking and Data Relay Satellite-B) and the Spartan-Halley carrier. On the first flight day, the crew will deploy TDRS-B; on the third flight day, the Spartan-Halley carrier, which will be retrieved on the fifth flight day. In addition, the crew will be conducting and monitoring a series of scientific experiments during the Mission. McAuliffe may describe these activities during her live lessons from space.

Payload:

The TDRS-B will join TDRS-1 in geosynchronous orbit to provide communication and data links with the Space Shuttle and satellites. TDRS-2 (WEST) will be stationed over the Pacific; TDRS-1 (EAST) is stationed over the Atlantic.

The Spartan (Shuttle Pointed Autonomous Research Tool for Astronomy) mission is designed to observe the ultraviolet spectrum of Comet Halley. Two ultraviolet spectrometers will be mounted on the Spartan carrier which will scan the tail of Halley on each of its orbits. The Spartan will be deployed and retrieved with the Remote Manipulator System (RMS) and stowed in the payload bay for the remainder of the Shuttle flight.

The Shuttle Student Involvement Program, a competition managed by the National Science Teachers Association with NASA to encourage student-designed experiments that can qualify to fly on missions, will be flying three experiments on this mission:

A. *Chicken Embryo Development in Space* by John C. Vellinger of Lafayette, Indiana.
B. *The Effects of Weightlessness on Grain Formation and Strength in Metals* by Lloyd C. Bruce of St. Louis, Missouri.
C. *Utilizing a Semi-Permeable Membrane to Direct Crystal Growth* by Richard S. Cavoli of Marlboro, New York.

PREFACE

NASA is pleased to provide this Teacher's Guide to extend the learning experiences evolving from the Teacher in Space Project. The publication is the product of a team effort by NASA, the National Science Teachers Association (NSTA), the National Council for the Social Studies (NCSS), and curriculum professionals. It is based upon ideas contributed by the Teacher in Space finalists, the Space Ambassadors, and other practicing teachers.

We have sought to publish practical and mind-stretching teaching ideas, plans, and resources for a variety of curriculum areas and grade levels — all growing from aspects of Mission 51-L. The capsules and detailed activities are concept-based and are designed to strengthen critical thinking and problem-solving skills. We hope this Guide will help all of you, the people who teach live on Earth every day.

NASA wishes to thank the following individual teachers who wrote activities for this Guide: Charles Frederick, Marilyn Kirschner, Beverly Sutton, and Howard White. We wish to acknowledge the contributions of the following: William D. Nixon, Teacher in Space Project Manager; Dr. Doris K. Grigsby and Muriel M. Thorne of NASA Headquarters Educational Affairs; Dr. Helenmarie Hofman, NSTA; Frances Haley, NCSS; and Dr. June Scobee, University of Houston–Clear Lake. We also thank Joan Baraloto Communications, Inc. for coordinating the preparation, development, and publication of this guide.

Thomas P. DeCair

Thomas P. DeCair/Associate Administrator for External Relations, NASA

DESCRIPTION OF THE LIVE LESSONS

The Ultimate Field Trip

This lesson is based on a quotation by Teacher in Space Christa McAuliffe who described her opportunity to go into space as "the ultimate field trip."

Viewer Objectives:

1. To observe the major areas of the Shuttle and describe their functions
2. To list and describe the major kinds of activities crewmembers perform aboard the Shuttle
3. To compare and contrast daily activities in microgravity with those on Earth

Video Lesson Description:

This lesson from space will begin in the flight deck area of the Challenger where Christa McAuliffe will introduce the commander and pilot and will point out the Shuttle controls, computers, and payload bay.

When she arrives at the middeck, McAuliffe will show viewers the kinds of equipment and processes which help human beings live comfortably and safely in the microgravity environment of the Shuttle.

Where We've Been, Where We're Going, Why?

Viewer Objectives:

1. To explain some advantages and disadvantages of manufacturing in a microgravity environment
2. To describe spinoffs and other benefits which have evolved from the space program
3. To list ways in which the modular Space Station would change the lives of human beings

Video Lesson Description:

As this lesson from space begins, Christa McAuliffe will refer to models of the Wright Brothers' plane and of a proposed NASA Space Station to help viewers recall that only 82 years separate that early flight and today's life in space.

McAuliffe will discuss the reasons we are living and working in space, covering astronomy, Earth observations, experiments on-board the Shuttle, satellites on the mission, materials processing, and technological advances.

TEACHING-RELATED EVENTS OF MISSION 51-L

Live Lessons:

As part of the 51-L Mission, the Teacher in Space, Christa McAuliffe, will teach two live lessons from space. These lessons are currently scheduled on the sixth day of the Mission at 11:40 a.m. and 1:40 p.m. Eastern Standard Time.

PBS Broadcast:

The Public Broadcasting Service (PBS) will carry both lessons via Westar IV. PBS will offer the programs to member stations that will be requested to preempt regular classroom programming to carry the lessons live. Specific information about the PBS transmission may be obtained from local PBS stations or by writing to Elementary and Secondary Programs, PBS, 475 L'Enfant Plaza, SW, Washington, D.C. 20024 or calling 202/488-5080.

Mission Watch (Satellite Broadcast to Schools):

NASA will make available to schools equipped with satellite dish antennas daily activities conducted aboard the 51-L Mission. This effort will be coordinated by Classroom Earth, an organization dedicated to direct satellite transmission to elementary and secondary schools. Participating schools will receive in advance educational materials, television schedule, orbital map, Shuttle Prediction and Recognition Kit (SPARK), and other information that will prepare teachers and students to follow all aspects of the 51-L Mission. Barbara Morgan, backup candidate, will act as moderator for these daily special broadcasts. Specific information related to "Mission Watch" is available by writing to Classroom Earth, Spring Valley, IL 61362 or by calling 815/664-4500. Information can also be accessed on the National Computer Bulletin Board (300 baud) 817/526-8686.

Filmed Activities:

In addition to live lessons, McAuliffe will conduct a number of demonstrations during the flight. These filmed activities will be used as part of several educational packages to be prepared and distributed after the Mission.

KEY MISSION-RELATED TERMS

Comet Halley—comet which reappears near Earth approximately every 76 years

Communication satellite—orbiting spacecraft which sends messages, connects computers, and carries radio and television programs via microwaves

EMU (Extravehicular Mobility Unit)—space suit with its own portable life-support system

51-L—number of the Mission carrying the Teacher in Space project

Flight deck—upper Shuttle deck housing the controls and computers for the commander and pilot

Geosynchronous orbit—path 35,680 km from Earth in which a satellite's speed matches exactly Earth's rotation speed, so that the satellite stays over the same location on the ground at all times

Microgravity—1/10,000 of the gravity force on Earth

Middeck—living and work area of Shuttle located below flight deck

Mission control—a room at the Johnson Space Center in Houston, Texas from which the crew's activities are directed

Mission specialist—scientist on crew responsible for experiments and deploying satellites

Mission Watch—daily satellite program transmission highlighting Mission events

NASA—National Aeronautics and Space Administration

Orbiter—reusable manned component of Space Shuttle; there are four; Mission 51-L uses Challenger

Payload—cargo; equipment

Payload bay—large section of the Shuttle where the payloads are stored

Payload specialist—scientist named for flight by a company or country sponsoring a payload; specialist is certified for flight by NASA

Principal investigator (PI)—scientist who designs and directs a mission experiment

Simulator—training equipment which gives trainees opportunities to experience flight-like activities and sensation

Space Shuttle—four-part vehicle: a reusable orbiter, an expendable liquid propellant external tank, and two recoverable and reusable solid rocket boosters

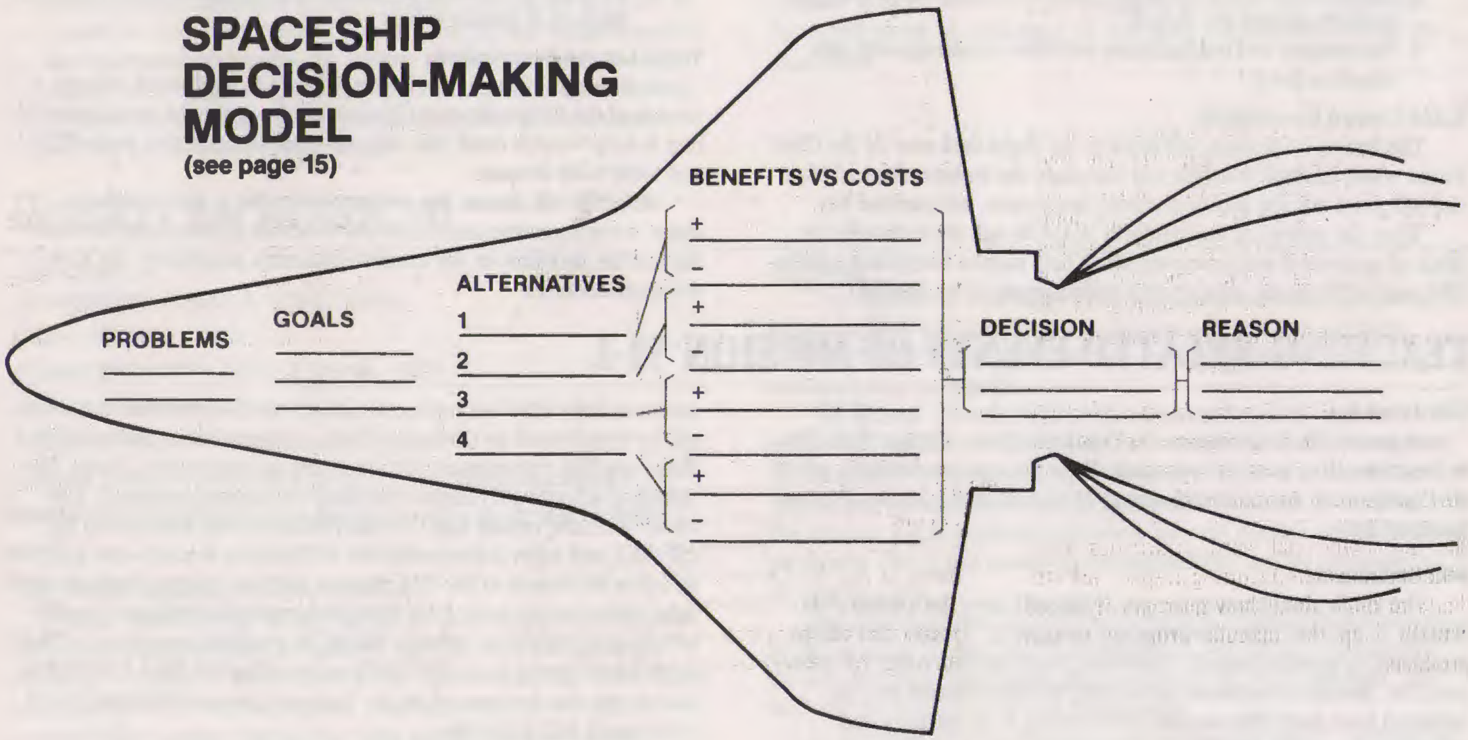
Spartan-Halley—payload designed to make observations of the ultraviolet spectrum of Comet Halley

Spinoffs—useful applications of space technologies different from their original aerospace function

TDRS (Tracking and Data Relay Satellite)—a communication satellite deployed by NASA for its communication system

SPACESHIP DECISION-MAKING MODEL

(see page 15)



PRE-VIEWING ACTIVITIES

● Provide enlargements of the illustration of the Space Shuttle from this Guide or other sources. Explain that the teacher-observer is part of a seven-person crew living in that Shuttle. Ask students to focus on "The Ultimate Field Trip" lesson, to estimate the Shuttle's size, and to describe as many details of the living space as possible.

Use a globe and model or picture of the Shuttle to demonstrate the location of the Shuttle above Earth's surface. Have students relate the distance of the spaceship above Earth to ground distances familiar to them, e.g., the Shuttle is orbiting at least 115–190 statute miles above Earth's surface—a distance between your community and ________. Talk about how Earth looks from that distance.

● Tell students that they will be seeing the teacher-observer as she speaks from the Space Shuttle. Theorize with them about how that will be possible. Introduce the idea of communication satellites and ask them to watch for information about satellites.

Focus students' thinking on the kinds of planning it may take for a mission to be successful. Discuss the roles of the ground and Shuttle crews in performing experiments. Think about applications of the experiments after 51-L.

● The Teacher in Space is the first private citizen in space. When President Reagan announced the NASA Space Flight Participant Program, he emphasized that the private citizen chosen to fly a mission would have the job of communicating the experience and flight activities to the public. Discuss why the first private citizen is a teacher. Discuss the duties and sense of responsibility placed upon her. Have students list some experiments they would like to see her demonstrate in the microgravity environment. Have them provide the rationale for their choices.

Explain that the Teacher in Space is keeping a journal of her experiences. Ask students to describe the kinds of information they think she should include in it.

● The commercial world anticipates many benefits from manufacturing in space. Ask students to think about how microgravity could actually help the manufacturing of certain products.

One of the justifications for the space program has been the many benefits of direct applications of ideas and products to life on Earth. McAuliffe will explore some of the newest experiments. Ask students to be watching for ways these experiments might help human beings on Earth.

● Brainstorm with students the titles and collections of space-related music. Collect the albums or tapes and play them as background music during the week of Mission 51-L. Possible titles: *The Planets* by Gustav Holst; *Pops in Space* and *Out of This World* by John Williams and the Boston Pops; the soundtracks from *E.T.*, *Close Encounters of the Third Kind*, the *Star Wars* trilogy, *2001*, and the PBS television series of *Spaceflight*; Handel's *Royal Fireworks Music*; and *Ionization* by Varèse.

Prepare a list of authors, stories, books, and poetry that deal with space. (See Resources.) Read selections with students each day of the Mission.

● Before reading the following passage to students, explain that it was read aloud from space by Astronaut Jeff Hoffman during his April 1985 mission. The prose was written by French writer, René Daumel, in his book, *Mount Analog: NonEuclidean Adventures in Mountain Climbing*. Discuss with students what the surrealist Daumel may have meant when he first wrote the words in the 1920s. Then discuss possible applications of the words to spaceflight. Why would an astronaut choose to carry these thoughts with him into space? "You cannot stay on the summit forever, you have to come down again. So why bother in the first place? Just this. What is above knows what is below, but what is below does not know what is above. One climbs. One sees. One descends. One sees no longer. But, one has seen. There's an art of conducting oneself in the lower regions by the memory of what one saw higher up. When one can no longer see, one can at least still know."

Obtain a SPARK KIT (Shuttle Prediction and Recognition Kit). See Resources. Step outside with your students to gaze at the first outer space classroom—the Space Shuttle, home to Teacher-Observer Christa McAuliffe. The easy-to-follow booklet will let you and your students learn how to locate the Shuttle on any of its orbits around Earth and to predict when it can be seen from your community.

● Discuss with students the special problems of meeting survival needs in space. Explain that in addition to those described by McAuliffe during the live lessons, the students may want to read about special needs and solutions for space. Assign students to research and report on the areas of needs and how they are met.

Have students prepare a list of items they might like to take on the Shuttle to use in their leisure time. Ask them to explain the importance of each item selected.

● Encourage students to imagine that they are on the crew of a future spaceflight. Have them describe a problem that arises, how the crew might resolve it, and the role of the individual in the solution. Have them write their composition in narrative style.

Set up a tent in the classroom and assign various activities that will help students experience working in a confined space.

● Ask students to think about their home kitchens and meals. Ask them to talk with families about items that were not there before the students were born. Make a class list of these items and processes. Students may like to write a time warp story about a person from the 1960s who shows up in a kitchen of the 1980s or the year 2000.

Display several items such as a digital watch, calculator, microcomputer, plastic meal pouch, or Velcro fastener. Ask students to link the items to the space program. Classify them as benefits or technological spin-offs of space technology. Emphasize that when Congress established NASA in 1958, one of the goals was to have the space agency seek to transfer space technologies to everyday life. Today's benefits are accessible through NASA's Technology Utilization Program.

● Benefits related to aerial photography via satellite are also of interest to students. Some may want to explore detecting oil slicks at sea, charting glaciers, forecasting spring runoffs for irrigation, inventorying standing timbers and grasslands, evaluating flood damage, checking environmental impact of strip mining, analyzing the gypsy moth, detecting potential earthquake zones, and mapping land and water uses.

Concept: The size of the middeck and payload bay areas of the Shuttle helps determine the crew's activities and the payload.

● Ask students to imagine that they have been chosen for a space mission. Have them list items they would take as mementoes. Then inform them that their Personal Preference Kits must be limited to 20 separate items weighing a combined total of 680 grams (1.5 pounds). Ask them to eliminate all overweight articles and list only the items they consider most important.

Have students suggest some familiar large payload objects for the cargo bay to gain an idea of comparative size, i.e., a trailer truck (18-wheeler), a railroad boxcar, a tank car, or a bowling alley.

● Obtain large discarded cardboard boxes used to ship appliances to build a model of the middeck. Let students measure, cut, tape, and build a walk-in model of the middeck. Invite other classes to see these examples of "cardboard carpentry."

Many teachers are using a process approach to writing with their students. In one of its earliest stages students prepare to write by charting words and relationships on paper. Given the topic "Everyday Life on Mission 51-L," build a "word web" or idea chart on the chalkboard. Assign students to choose the best ideas to write a paragraph on the topic.

Objectives:

1. To simulate the amount of space available to the crew on a Shuttle mission by measuring and laying out the dimensions of the middeck and payload bay

2. To physically experience the amount of space available in the middeck and payload bay areas

1. Remind students of the Teacher in Space's tour of the Shuttle. Explain that they will be laying out the size and shape of the Shuttle on a parking lot or blacktop area (chalk), playing field (lime or mowing), snowy field (dye). Middeck dimensions may be laid out in the classroom; payload bay, in the school hallway.
2. Assign groups to make specific measurements of the following interior dimensions of the Shuttle on the surface you have selected:

   a. Overall length of the middeck, 4.00 m (13.1 ft.) plus the payload bay, 19.7 m (60.00 ft.) totals a continuous length of these two working interiors of 23.7 m (73.1 ft.).

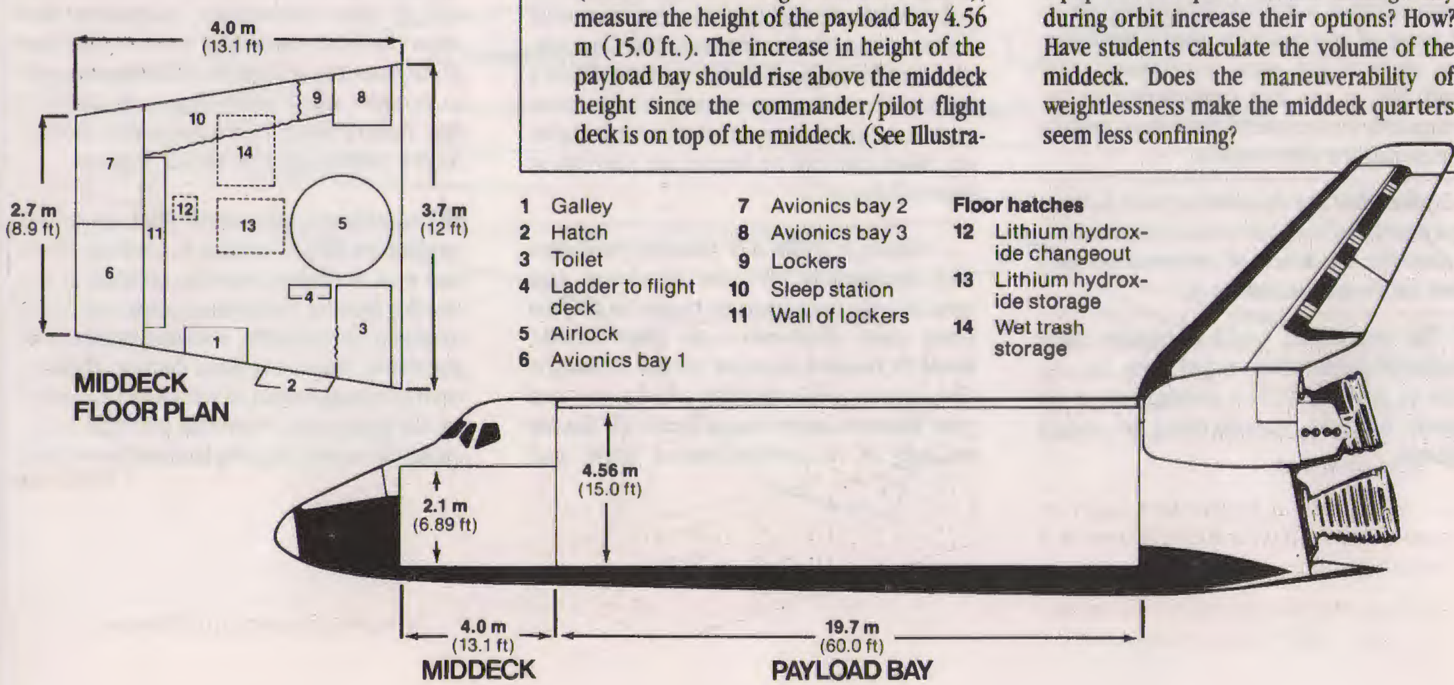
   b. At right angles to the length, beginning at the front end, mark off the height of the middeck, 2.1 m (6.89 ft.).

   c. At the terminal end of the middeck (which has an airtight structural wall), measure the height of the payload bay 4.56 m (15.0 ft.). The increase in height of the payload bay should rise above the middeck height since the commander/pilot flight deck is on top of the middeck. (See Illustration below.) Measure and mark this height, 4.56 m (15.0 ft.), at intervals along the entire length of the payload bay.

   d. Use some technique to outline the length and height of the middeck and payload bay. You now have the crew's working area (middeck) and the payload bay.

   e. To show the trapezoidal-shaped floor space available to the crew when the Shuttle is on the ground, use the same 4.00 m middeck length and mark off these widths for the floor plan: 2.7 m (8.9 ft.) at the front, expanding to 3.7 m (12 ft.) at the rear. This floor plan area is filled with hundreds of items precisely arranged to maximize efficiency and minimize discomfort for the crew. (See Illustration below.)

   f. The payload bay's floor plan is the same as that laid out in 2.c. above because the height of the bay, 4.56 m (15.0 ft.), is also its width.
3. Have seven students stand on the floor plan of the middeck and see how much area each student has. How does this area compare with rooms in a home? Tell students to imagine this middeck floor plan area also holding large equipment. (See Illustration below.) Have students now estimate the available space for crewmembers with equipment in place. Could microgravity during orbit increase their options? How? Have students calculate the volume of the middeck. Does the maneuverability of weightlessness make the middeck quarters seem less confining?



Concept: Planning for life on extended Shuttle missions or in Space Stations must consider the effects of Orbital Human Factors (OHF) on people's behavior.

● Have students work individually or in small groups to study the following questions:

a. What are the physiological effects of microgravity?

b. Why is exercise so important in microgravity?

c. What is space sickness? How might it affect the crew's performance? How is it being treated?

Circadian rhythms are another consideration when planning space missions. Circadian rhythm is the cycle of wakefulness and rest that each individual experiences. Most people operate on a 24- to 25-hour cycle with six to eight hours of sleep included in the cycle.

***a.** Have students locate general information regarding the crew's schedule in space.*

***b.** Direct students to chart their own circadian rhythm for one or two weeks. Each day, they should record their times of sleep, peak activity, and relative inactivity. Compare these charts with those schedules maintained by flight crews.*

***c.** Have students compile information about the effects of shift work on humans, the scientific explanation of "Monday morning blues," and how much sleep actually is required by most people. Invite a psychologist or medical doctor to discuss sleep.*

● Ask the class to explain why it is necessary for most people on Earth to recline in order to sleep well. Then compare this sleep behavior on Earth to sleep in microgravity. (See Illustration right.) Emphasize the changes in sleeping arrangements in microgravity where there is no need to recline.

Discuss with students the kind of psychological atmosphere among the crew that would be necessary to function for six to nine days in these small living/working quarters where every waking and sleeping hour is programmed.

***a.** What kinds of preparation might be needed in pre-flight training to ensure a smoothly working team?*

***b.** What other kinds of high performance teamwork might be as demanding on Earth?*

Have students design recreational activities which would be suitable for a microgravity environment.

● Several of the seven crew members on Mission 51-L have a strong interest in the arts. Commander Scobee enjoys oil painting and woodworking; Pilot Smith does woodworking; Mission Specialist Resnick is a classical pianist; Mission Specialist McNair is a performing jazz saxophonist; Space Flight Participant McAuliffe plays the guitar and piano and enjoys singing; and backup candidate Morgan plays the flute and violin. Ask the students how the crew might pursue their interests during flight. Discuss why it is important to have outside interests. Ask them to list some of theirs and to discuss the benefits they receive by being a member of the team, club, or group.

Have students describe their favorite at-home and at-school activities. Could they be able to enjoy them during a spaceflight? Have them consider a substitute leisure activity.

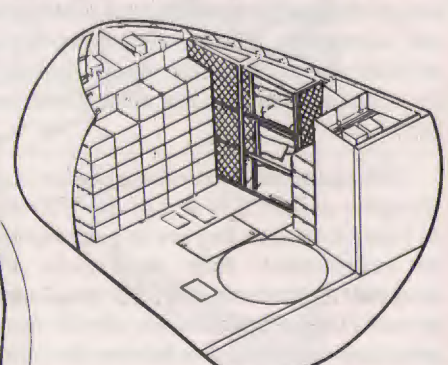
● Make a class mural that includes a self-portrait of each student doing his/her favorite leisure activity on the Shuttle. Allow students to include only those which would work in small spaces and in microgravity.

Each member of a Shuttle crew has a portable stereo cassette with earphones and may take six 60- or 90-minute tapes of music on a flight. Have students select six albums or tapes that they would take and write a paragraph explaining their choices. Ask them to listen to only that music during the 51-L Mission. At the conclusion of the flight have them write their reactions to their selections: Would they make the same choices again? Why or why not?

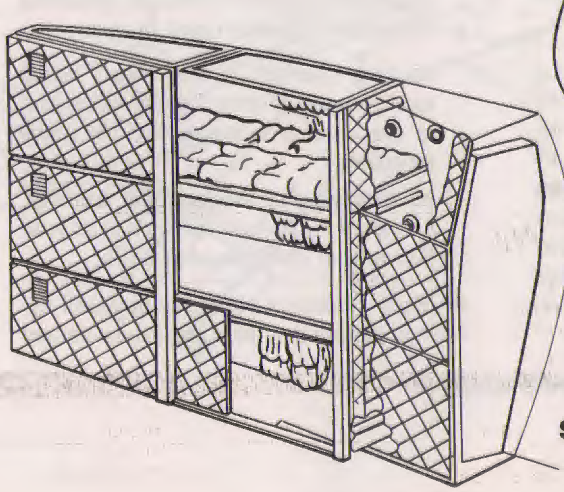
● Arctic and Antarctic explorers have kept detailed records of the influences of an isolated environment and cold on human behavior. Challenge students to research their writings and report to the class on parallels between their ideas and Orbital Human Factors. Discuss whether similar parallels might be drawn with explorers of other territories.

Ask students to interpret what Isaac Asimov meant when he said, "Throughout the history of humanity, we have been extending our range until it is now planet-wide, covering all parts of Earth's surface and reaching to the bottom of the ocean, to the top of the atmosphere, and beyond it to the Moon. We will flourish only as long as we continue that range, and although the potential range is not infinite, it is incredibly vast even by present standards. We will eventually extend our range to cover the whole of the solar system, and then we will head outward to the stars." — Isaac Asimov in "Our Future in the Cosmos — Space," NASA Conference

Have students write position papers based on this quotaton. Ask them to defend or refute the idea of limiting our exploration to Earth. Ask how they define "our world."



Middeck



Sleeping System on Shuttle

Concept: Space crews follow specific routines for meeting health and survival needs in space.

● Describe and demonstrate the small space (4 m × 3.7 m × 2.7 m) of the middeck in which the spaceflight crew lives. Have students list the basic needs they think might have to be met in order to survive a seven-day period in a microgravity environment. Ask them to explain and defend their choice.

Plan a day's menu which meets the daily food requirements. Determine how to prepare the foods for storage, how they will be stored, and how they will be prepared. Plan a five-day menu which can be stored in a child's backpack. Compare the space utilization (volume) and weight of dehydrated foods such as instant soup, orange drink, and dried apples with their rehydrated counterparts. Make a graph showing the results.

● Visit or read about a ship's galley. Compare and contrast it with the galley on the Challenger.

When people colonize space, it will be necessary for them to produce some of their own foods. Discuss the implications of food production in space.

● All clothing for the crew, except underwear, is the same for both sexes and includes cotton pants, shorts, tee shirts, flight jackets, short sleeved shirts, and slipper socks. Crew members frequently move around their Shuttle environment and they need to carry and use pens, flashlights, scissors, fork, kneeboards (for notes), and a checklist. Ask students to design clothing to accommodate movement and accessories. Have them consider both vehicular and extravehicular needs. How will their clothing differ from that which is worn on Earth?

Astronauts have recorded evidence that they grow at least 2.54 to 3.81 cm (1 to 1½ in.) very soon after they are in a microgravity environment. Their space suits are designed to accommodate this temporary growth. Discuss with students why the body grows and how the spaces between the vertebrae expand in space. Research body fluid shifts in microgravity. How does this affect clothing requirements?

● Logos are symbolic representations of the major goals of a spaceflight mission. Ask students to imagine that the class has been assigned to a spaceflight. Have them design and prepare a logo for use on their clothing to designate that mission.

Exercise is needed on a spacecraft so that bones and muscles will not deteriorate on long missions. In an apparent weightless state, bones and muscles do not experience the same resistance as in gravity. Have students compare their exercise regimens with the recommended 15 minutes per day treadmill workout on the Shuttle. Discuss why doctors have patients up and walking as soon after surgery/illness as possible.

● Have teams of students take blood pressures and pulse rates before and after three minutes of vigorous exercise, determine the time needed to return to normal pulse rate, and record all data. Invite a doctor/school nurse/instructor to help students interpret the results. What variables might effect changes in pulse rate/blood pressure during and after a spaceflight?

Ask students to prepare a list of exercises they could not do in space and the reasons why they could not be done.

● Shuttle crew members are allocated as much as 2800 calories each day of the mission. Challenge students to decide whether they think the crew would need more or fewer calories in space than on Earth. Have them explain and support their decision.

Explore the following thought questions as they relate to similar needs in space.

a. How does the Shuttle crew's health maintenance routine compare with that of the crew of a submarine on active patrol?

b. What kind of balanced diet, exercise, and sleep routine do you need to do your best in your sports/academic life?

● Show students a picture or model of the Orbiter. Explain that there are systems aboard the spaceship to help keep it functioning and to keep the crew alive. Discuss each of the six systems with the class: food supply, air, water, waste disposal, power, and communications. Assign a group to each of the six systems to begin a chart with the following headings: **a.** Name of System, **b.** Need for the System, **c.** Possible Problems if System Does Not Function, e.g. spoiled food, loss of oxygen, fire, **d.** Alternate Solutions. Have groups report their findings to the class.

Have students investigate problems encountered and resolved in earlier spaceflights. Consider, for example, Solar Max repair (STS 41-C) and the Syncom satellite repair (STS 51-D). Ask students to write expository essays explaining the problem-solving activities in space.

Objective: To compare the Shuttle crew's needs in space with those needs on Earth in terms of caloric intake, exercise, and sleep

1. Talk with students about how they maintain their health by eating, exercising, and sleeping.
   a. Develop an efficient record-keeping chart for each student to record the following data:
   1) name, day, date, and hours of sleep;
   2) each meal's items and approximate number of calories and total calories for the day
   3) type and amount of exercise all day

   b. Provide the following information on daily needs of the Shuttle crew:
   1) food/calories — (approximately 2,800 Calories)
   2) exercise — (15 minutes on treadmill or its equivalent)
   3) sleep — (8 hours)
2. Review the kinds of foods used on a space mission. Describe a typical daily menu. Compare an astronaut's menu with a student's menu. If possible, compare and contrast them as to processed or natural foods. Compare calories.
3. Compare students' records for exercise and sleep with crew's requirements in space.

Concept: A Space Station is designed to serve a variety of functions for technological study and development that will benefit all humankind.

● Ask students to recall different kinds of space stations from science fiction stories they have read or movies they have seen (Battlestar Gallactica, the Star Wars Empire, the Star Trek Federation). Emphasize that these are fictional versions of something that has never existed, but that the Space Station will soon be a reality.

The Space Station will fulfill eight major functions: living area, laboratory for science and technology, permanent observatory of Earth, servicing for spacecraft, station for space vehicles and payloads, manufacturing facility, storage depot, and staging base for future space activities. Divide the class into small groups to study each of the Space Station functions. Ask the groups to describe the possible details of their function, to compare it to a place or activity we know on Earth, and to describe how they think it will look with words and illustrations. Have the groups report and combine all illustrations into a giant collage or flow chart entitled "Our Future Home." (See Illustration below.)

● President Reagan's plans include international cooperation in the development and use of the Space Station. Discuss this potential international colony in space.

Reasons for establishing a space station may include adventure, trade, freedom, growth of new technology, commerce, transportation, and manufacturing. Have students suggest other reasons for space colonization.

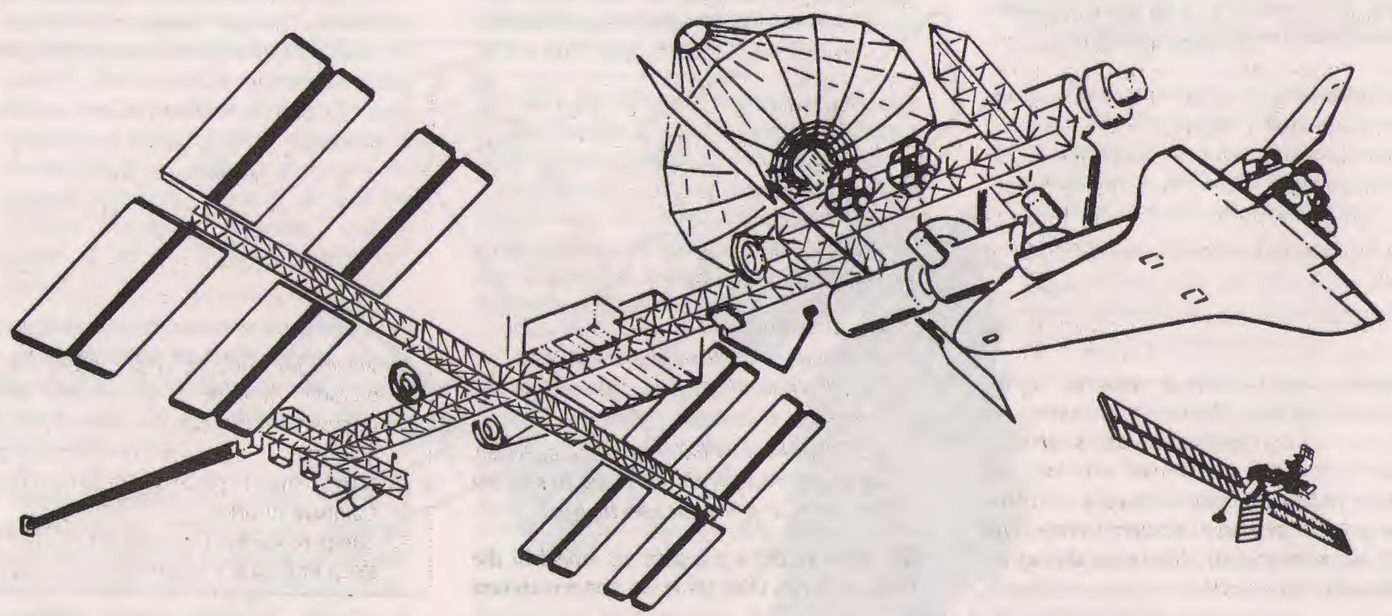
● Challenge students to predict how people from Earth will get to the Space Station, how long they will stay, and how they will return. Ask them to pretend that tickets will go on sale in the year 2000. Have them imagine what they will be doing and whether they or anyone they know will go. Predict whether the Station will admit only workers or whether visitors will be allowed.

Assign each student to write a first-person account of a new inhabitant of the Space Station. Have the students describe their trip, their new living quarters, and their work. Share the compositions.

● The Space Station concept will be reality for your students in their lifetimes. Talk with them about the kinds of activities and responsibilities which will be required on a Space Station. Ask them to pretend that they have an opportunity to apply for a job on the Station. Have them write their letter of application to the space personnel office to apply for the job of their choice.

Challenge students to consider the following question: Will migrations from Earth to Space Stations and other planets be similar to the migrations from Europe at the turn of the century? Ask students to compare our future space settlers and pioneers to the early settlers and pioneers of America. After a brainstorming session, have students organize their ideas for a composition based upon comparison/contrast.

● Hypothesize with students that they have been given the responsibility of planning a Space Station community. They may be like the planners of some of America's famous planned communities or towns. Ask them to list the institutions, services, jobs, activities, recreation, and other details their community would have. Make a large flow chart to show the relationship of the community's components.



A Space Station Concept

Concept: A diversity of jobs is required to plan, build, operate, and maintain a spacecraft.

● Distribute pages of classified advertisements to the class. Divide the class into small groups to write want ads for each of the jobs on the crew of 51-L. Post the ads. Discuss whether they know of individuals who could meet the qualifications they set.

Philip Morrison, Professor of Physics at the Massachusetts Institute of Technology, speaking at a NASA symposium in 1976, said, "...it seems to me the imagination has not yet succeeded in conveying to people in general what kind of role one can have in today's complex exploraton. Very many are the indispensable porters, and only very few are the intrepid mountaineers." Have students apply this to Mission 51-L and the space program.

● Ask students to think about their interests and to choose two jobs related to space that they think they would like to do; research the skills and training necessary to fulfill the jobs; draw up job applications; apply for jobs in space; and go through a preliminary screening and interviewing process to select two candidates for each job.

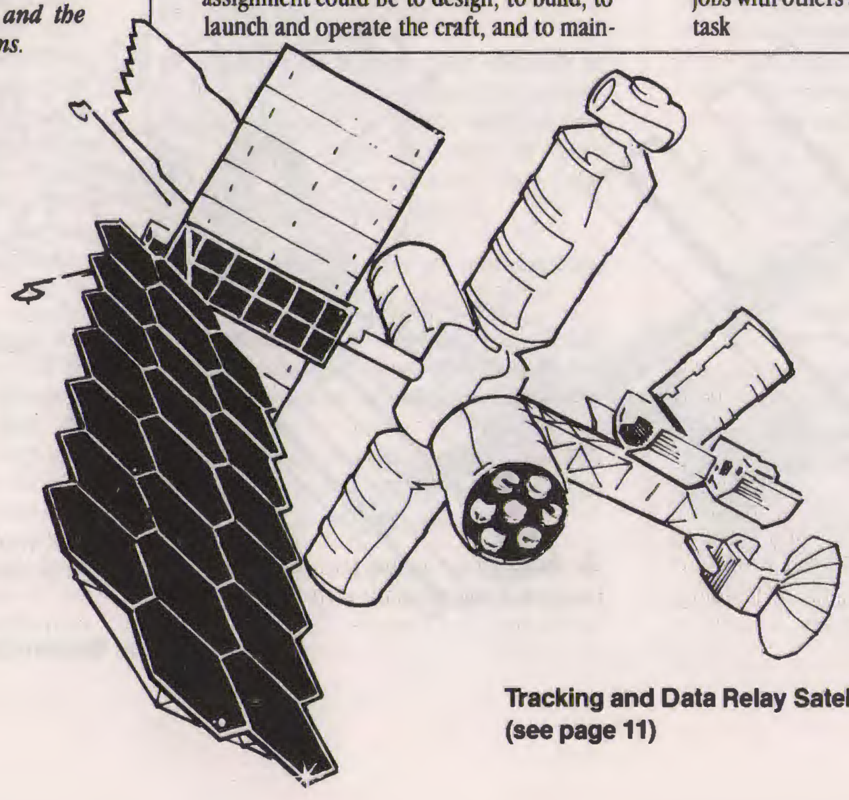
Interpersonal cooperation is a critical element in a successful mission. Discuss the kinds of personal qualities that individuals chosen for a mission must have and the qualities which might cause problems.

Objectives:

1. To identify job opportunities in the space industry
2. To apply decision-making skills in small groups
3. To discuss the interdependence of personnel in completing a project

1. Introduce the concept of jobs by displaying pictures of a Shuttle, Space Station, or satellite. Have students list the kinds of jobs it takes to design, build, operate, and maintain a Shuttle, Space Station, or satellite. Discuss a misconception that the only space-related jobs are for astronauts. Divide the students into small groups to list as many jobs as they can think of under each category. Have each group appoint a recorder.
2. Copy each job onto an index card. On the bottom of the card, identify the job according to one of the four categories and have each student select a card to research.
3. Have students make oral, first-person reports on the jobs, including the job qualifications and training.
4. Divide students into groups according to their job category on the spacecraft. Give each group an assignment that will require cooperation and interdependence. The assignment could be to design, to build, to launch and operate the craft, and to maintain it before and after launch. Note that groups will have to choose leaders and individuals to meet with other groups to keep the groups coordinated. Assign two students to observe the activities of all four groups and to comment on the following:
   - How the students made decisions within their own groups
   - How the groups communicated with other groups
   - Whether the completed plans and work reflected cooperation and organization
   - Whether individuals performed the work required by their assigned jobs

   The groups should keep written records of their ideas and decisions, list assignments on chart paper, and sketch plans and designs to be displayed and shared.
5. Have each group present its work to the entire class. Ask the two student observers to present their comments and to accept explanations and rebuttals from the groups. Have students prepare oral or written statements on the following topics:
   - The importance of any job in completing tasks
   - How decisions are made in completing a task
   - How individual workers perform their jobs with others as they try to complete a task



Tracking and Data Relay Satellite (TDRS)
(see page 11)

Concept: The space program has had both benefits and costs for Earth's inhabitants.

● Give some examples of recent spinoffs of the space program, including microminiaturization of electronics, lightweight materials, solar panels, computerized scanning medical devices, portable x-ray machines, automatic utility meter reading devices, compact water filters, automatic inventory cash registers, high intensity lights, water-cooled headbands, fabrics made of strong chemical bonds, and microcomputer software. Have students research their own list. Have teams of students report on an item, whether the work it does was possible before its space application, and how the work it does changes lifestyles on Earth. Have the students illustrate their reports.

Have students pursue spinoff technologies in more detail. Teachers can locate materials through NASA Teacher Resource Centers.

a. Assign a group of students to develop a catalog of spinoff products.

b. Have students locate information on specific products and report how they are linked to the space program, e.g., fabric used for the Pontiac (Detroit) Silverdome, heat absorbing clothes for athletes, NASTRAN computer structural analysis program, and plastic welding.

c. Challenge students to create a "Technological/Economic Impact" statement highlighting and analyzing the impact of spinoffs. This could be reported in traditional oral or written formats or as a video news report format. Challenge a second group of students to create the opposite scenario, "What If We Had Not Pursued the Space Program" and to report it in a "Point-Counterpoint" format.

Although the spinoffs seem to have improved life on Earth, some individuals and groups believe that the technology has also brought increased costs. Do a cost-benefit analysis and debate the issue.

● Weather satellites are another benefit of space technology. Students may wish to research and report the following areas: forecasting, television reporting, the meteorological satellite system, economic impacts of weather satellites, and the potential issue of controlling the weather. Students could prepare video news reports or "white papers" on controversial aspects of the topic.

Present a hypothetical situation in which you are NASA and want to hire a contractor—four students—to manufacture certain parts for the Space Shuttle. Give the four students a sum of play money and a period of time to "manufacture" some meal packs for the Shuttle. Then have them dispose of their money in the economic community—the rest of the class. Use this activity to lead into the concept of circular flow of goods and services. Have students generalize about the impact of NASA spending.

● Many of the economic impacts of NASA are first felt on a local level. The areas surrounding the Johnson Space Center in Texas and the Kennedy Space Center in Florida are obvious examples. Students may want to generalize about the potential impact of a NASA facility on a community, discussing increased retail sales, employment, increased per capita income, and accelerated road and building construction.

Have students speculate about the future economic impact of space travel and colonization. They may want to use a decision-making model to decide a hypothetical issue, such as whether a space colony should be established. The key concept would be the economic impact of the colony.

● Offer the following research opportunity: In past decades, "urban renewal" has been a highly controversial topic. The current trend of "revitalization," a mix of refurbished and new construction, is a parallel. Direct students to locate information on the impacts of this trend and to compare it with renewal. Discuss the implications for life in space.

Challenge students to investigate the regulation of communications satellites (orbits and relay frequencies). They may approach it in an international economic or legal context at the present time or at some future age.

● Although the Shuttle itself is reusable, the equipment and items for crew life aboard the Shuttle may be disposable. Have students list items used aboard the Shuttle and indicate whether they are reusable or disposable. Discuss the difference between the terms "reusable" and "recyclable." Have students determine whether any disposable items could be recycled and discuss the feasibility of such an idea.

Discuss advantages and disadvantages of robotics in space and on Earth.

● The TDRSS (Tracking and Data Relay Satellite System) is an example of the potential benefits of the current flight. Mission 51-L will deploy TDRS-B, the second of three communication satellites that will allow almost full-time coverage of the Shuttle and up to 26 other satellites. Present several scenarios that involve communications satellites such as an important news story breaking in Europe, a long-lost relative calling from Latvia, or worldwide viewing of the Olympic games. Discuss how communications satellites are involved in each example and how the quality, speed, and reliability of the communications would be affected without the use of satellites.

Have students address the questions that follow in small groups, debates, written essays, or discussions.

a. Why were previous spacecraft not designed to be reusable? (technological limitations, changes in budgetary policies, and cost increases)

b. What advantages are provided by this Space Shuttle design? (more economical in terms of dollars per payload, resource conservation, ability to repair inoperable satellites, two-way transportation)

c. What considerations in terms of reuse are involved with the Space Station or other "permanent" space facilities? (similar economic considerations)

d. Consider products and packaging involved in your everyday life that could and should be recycled.

● Have a group of students prepare a collage of magazine pictures or a mural showing space technology at work in their community. Communities may allow these murals to be painted on or displayed in shop windows.

Concept: The space program generates experimentation in a variety of scientific fields.

● Provide students some background on the use of crystals in communications. Explain that the space program has extended the opportunities for scientists to study and grow useful crystals. Discuss the potential benefits of growing a crystal in a microgravity environment.

Ask students to defend or refute Isaac Asimov's idea: "Another kind of structure in outer space is factories. There is no reason why a good proportion of our industrial factories couldn't be placed in orbit. Pollution that it produces can be discharged into space."

Explore the following thought questions:

a. How does the process of growing a crystal of germanium or silicon differ from growing crystals of sugar or salt?

b. How would microgravity make purifying metals easier?

c. What is the advantage of containerless processing of materials over heating them in ceramic containers on Earth?

d. Why do some materials form crystals and others do not?

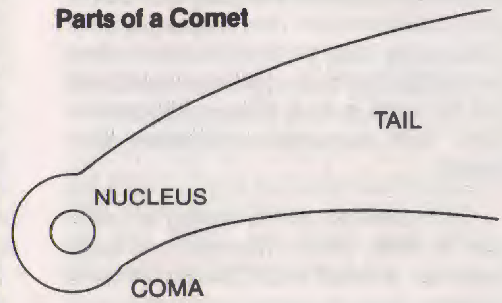
● Ask students to prepare two advertisements that would convince manufacturers to conduct experiments aboard the Shuttle. One group could do a magazine advertisement; the second, a radio or television advertisement. Generate ideas in a brainstorming session.

Objectives:

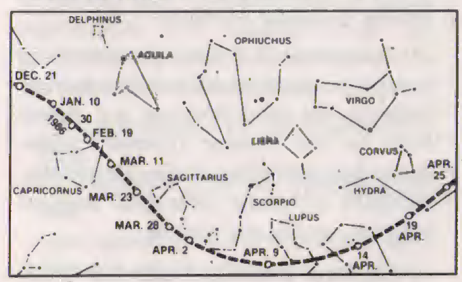
1. To describe the structure and behavior of the Comet Halley
2. To draw a comet and label its parts
3. To explain that light radiation exerts pressure
4. To place ultraviolet radiation in the electromagnetic spectrum correctly and compare its wave lengths to that of light

1. Explain to students that on Flight Day 3, the Spartan astronomical instrument was deployed from the payload bay to examine the tail of Comet Halley. At this time, radiation pressure from the Sun will make the sublimation of materials from the head of the Comet the greatest. The ultraviolet spectrometers on the Spartan will tape record Comet radiation invisible to the human eye. The Spartan unit was retrieved by the Shuttle on Flight Day 5. When returned to Earth, the data will be analyzed and compared to other ultraviolet data gathered by Spacelabs and satellites to help us understand the Universe.
2. Ask students who have recently observed Comet Halley to describe their sightings to class members. List pertinent facts on the chalkboard. Show a chart or diagram of the Comet's structure and orbit. Have students use the chart to locate the Comet's position in reference to the Sun–Earth orbit on the day of sighting.
3. Have students draw and label the parts of the Comet.
4. Have students discuss why the tail is visible only when the Comet is close to the Sun. Use dry ice to represent the Comet, a flashlight to represent the Sun's light, and a vacuum cleaner's blower-end attached to the flashlight to represent the solar pressure of light. Darken the room. Have a student circle close to the "Sun" carrying the tray of dry ice while the blower directs the sublimating gas away from the coma. Observe that the gaseous tail is always streaming away from the Sun. Question students as to which parts of the demonstration are similar to Comet Halley's trip close to the Sun. Explain that the pressure of light is due to tiny particles called photons. Light can exist in fact as both wave and particles. The pressure of our Sun's light is called the solar wind in space.
5. Exhibit a "dirty snowball" with a rock core. Explain that in the vacuum of space, ice changes to gas without melting (sublimation). The dirt becomes the dust of the tail, and the particles in the rocky core eventually disintegrate to dust. We see them as meteors in our upper atmosphere.
6. Darken the room and demonstrate one property of ultraviolet light by shining an ultraviolet (UV) light source on "glow in the dark" materials. Clap erasers near the beam of the UV source to see if eraser dust appears different under UV than in normal light. WARNING: *Do not allow students to look directly at the bulb. The light could burn the eye's retina.*
7. Show where UV radiation is located on the electromagnetic spectrum chart. It has shorter wavelengths than visible light, but not as short as x-rays. Explain that astronomers have used space-orbiting spectrometers sensitive to UV to study dust clouds, our Milky Way, and other galaxies. They want to compare the effect of our Sun's UV on Halley's dust.

Parts of a Comet



MOVEMENT OF COMET HALLEY



Late Jan. to Feb., '86	Comet at its brightest but cannot be seen from Earth as it circles the Sun.
Feb. 24, '86	Comet reappears in early morning sky, just before sunrise, a few degrees above the eastern horizon.
Mar. 8, '86	Comet visible, perhaps with a small tail, 5 degrees above the eastern horizon during dawn twilight.
Mar. 26, '86	Comet 10 degrees above southeast horizon in pre-dawn morning. Its tail may reach up to 20 degrees or more.
April 10, '86	Comet 10 degrees above southern horizon at the crack of dawn. Comet should be at its brightest.
April 11, '86	Comet begins its journey outbound.
April 12, '86	Comet visible before dawn in the southwest and after sunset in the southeast.
April 17, '86	Comet 7 degrees above the horizon after sunset in the southern sky.
Late April, '86	Comet fades from unaided vision.

Concept: The space environment is a catalyst for creative expression in art, music, and literature.

● Review with students the music that throughout history has resulted from exploration, migration, and conquest: the sea chanty, Appalachian folk songs, Negro spirituals, Western ballads. Trace the development of each from their sources to 20th-century interpretations. Then challenge students to create a comparable musical form and expression for space. Have them write a paragraph about their reasons for choosing the style, instrumentation, and lyrics.

Challenge music students to imagine that they have been named to compose the theme music for a space mission. Ask them to identify their musical style. Then ask them to identify the moment their composition would begin—launch, orbit, sleep, space walk. Next, ask them to identify the mood or feeling of a piece that best shows the kind of work they would compose. Ask them to compose a given number of measures.

● To commemorate the 50th anniversary of the National Society of Professional Engineers, Richard Bales composed *The Spirit of Engineering* for orchestra. Have students consider what kind of music would capture the Spirit of Exploration, of Science, of Learning, or of Mission 51-L (chamber music, a march, a chorale).

Have students research and report on "What effect has space exploration had on music?" including a discussion of improved recording techniques as a function of advanced electronic technology and the use of electronics in music composition and performance.

● Read the story of Gian Carlo Menotti's opera, *Help, Help, The Globolinks!*, to students and discuss with them the qualities that make it a space-age opera. High school students might consult with a local opera association about producing it.

Challenge students to agree or disagree with novelist James Michener's comments at a NASA symposium on "Why Man Explores." "I have always believed that an event has not happened until it has passed through the mind of a creative artist able to explain its significance." Have them put their ideas into a piece of persuasive composition.

● After discussing the modules of a space station, have students draw their own concepts and develop their ideas from preliminary sketches to detailed drawings to finished paintings or prints.

Have students depict a Space Station in different pictorial styles (e.g., realism, expressionism, abstract). Have them paint two views: (1) the Space Station seen from the Shuttle and (2) the view from the Space Station. Then have them select one of the compositions to explore a variety of techniques—water color, oil, tempera, and collage.

● Have teams of five to eight (the numbers of the Shuttle crew) students draw cross sections of the interior of the middeck area of the Space Shuttle. Challenge each team to choose a color and decorating motif to use in their drawing. The interior of the Shuttle orbiter is white. Discuss color likes/dislikes of individuals, and how various colors affect moods and sense of space. Have the students compare the colors of their classroom, the cafeteria, gymnasium, and a room at home and discuss the reasons why specific colors are selected. Have each student describe his/her personal preference for the interior design of the orbiter and then, what modifications might have to be made to accommodate the tastes of other crew members.

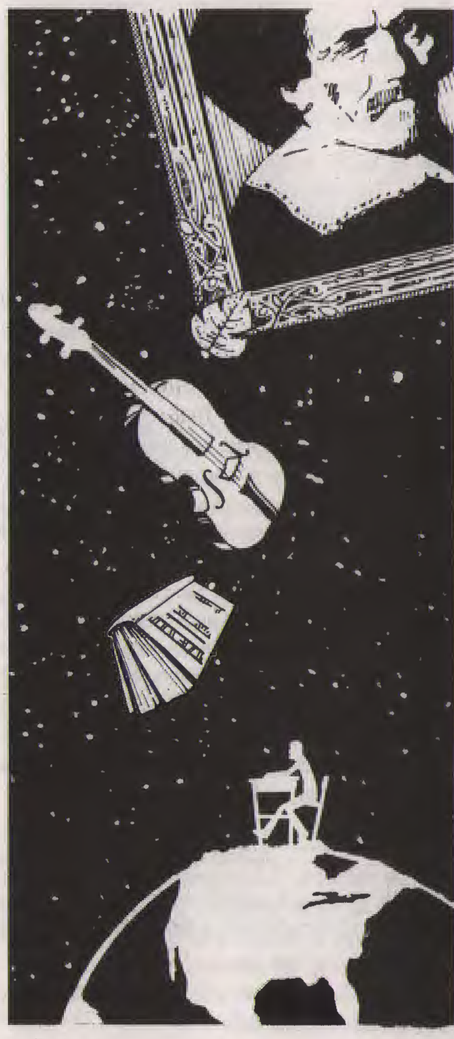
Discuss how artists interpret their awareness of the world: some paint directly from nature, some from experience and memory, some from sketches of nature, and some from imagination. Have students think about how an artist would work during a spaceflight.

● Read poems that mention heavenly bodies, aerospace personalities, and space objects—from nursery rhymes to modern poets—and compare fanciful literature with fact.

Read Gore Vidal's Visit to a Small Planet *and discuss how the alien visitor is like/unlike Earthlings. Read Edmond Rostand's* Cyrano de Bergerac *—are any of the means of spaceflight devised by Cyrano plausible?*

● Talk with students about science fiction authors—Isaac Asimov, C.S. Lewis, Jules Verne, H.G. Wells, Arthur C. Clarke. Read passages from some of their works and assign their books for reports. Discuss with students whether any of the ideas predicted by the authors already may have come to pass.

Astronaut Jeff Hoffman is an astronomer. Ask students to listen to his description of space and to discuss his word choice and sequence of details which enrich his narration. "The sight of the ice particles in front of the Shuttle is like...fireflies... They're different colors. Some of those sparkles out there are red...most of them are white ...some really bright ones out there.... And as the Sun sets on the orbiter, the ice crystals go out. The last few of them turn red. Then they're red. Then they're gone." Later he says, "When you look outside and see the black of space and the ice crystals following us around and the sunrise and sunset every hour and a half, look out and see the lightning storms flashing, the cities making their light patterns beneath the clouds, the patterns in the ocean, flying over the Himalayas as we do the last two orbits tonight, then I know I'm really in space."



Concept: The space program engenders diverse reports, stories, and other forms of communication.

● Have students role-play a news correspondent assigned to cover the flight of the Teacher in Space. Ask them to write the news story and a feature story based upon one phase of the event.

Astronaut Jeff Hoffman kept an audio diary of his April 1985 mission. Discuss how this is an example of oral history. Talk with students about the function of oral history. Order a copy of his tape from the National Public Radio Catalog. (See Resources.) After listening to it, discuss if it is more moving to hear rather than to read his words.

● Oral communication is a vital function of the space effort. Have your students help you make a flow chart of the kinds of roles and functions of oral communications during the launch, orbiting, and reentry of the Shuttle. Help them to understand that for each speaking role, there is also a listening role.

Brainstorm the ways in which communication skills of reading, writing, listening, and speaking are used in training for and during a mission.

● McAuliffe is keeping a journal of her experiences. List individuals in history who have kept diaries. Discuss why diaries have been important to later generations.

The second Space Flight Participant will be a journalist. Have students consider the reasons why one of the writing professions was selected and what other writers might like to make a Shuttle flight (poets, science fiction authors). Ask students what other communications professions will probably be represented in the Space Flight Participant Program and list them in order of importance.

● The Mission launch and its ongoing coverage expose students to the jargon of space. With your students, begin to make a list of all terms which have been "coined" by the space program. Place each term or acronym with its definition on a file card. Begin to post them around the room, adding new ones in alphabetical order.

As Mission 51-L progresses, have students collect all news articles, pictures, and any other graphic details which they find. At the conclusion of the Mission, make a class collage, emphasizing the details which the class votes most significant.

● Ask each student to choose a favorite part of the mission which was shown on the live lesson. Allow the student to choose his/her best way of communicating information about that part: oral report, written paragraph, news report, dramatization, role playing, etc.

Identify key events in the history of spaceflight and express them in a workable chronology. Speculate about future events in space.

● Use Comet Halley as a springboard for historical investigation. The reference dates for its returns are 1652, 1758, 1835–1836, 1910, 1986, and 2062. Key question: What has life been like during past returns of Comet Halley? What do you think life might be like during the next appearance in 2062?

Possible projects:

***a.** Time capsule approach. Have students create a time capsule that depicts life in the United States in 1986. Have them compare the contents of their capsule with the expected contents of other reference years using inventory lists of facsimile artifacts.*

***b.** Time frame approach. Have students imagine that a video is being made entitled "History of the World, Part I." It will include everything from the beginning until now. Their task is to prepare — either visually, orally, in writing, in skits, or in video-vignettes — the frames or scenes from those reference years in which Comet Halley was present. Themes in their time frames can include styles, housing, technology, food and agriculture, currency, manufacturing, important people and events, types of governments, medical science, social and economic conditions, music, dance, and entertainment.*

● Discuss the relationship of the following events to historical themes:

a. Do you think there is a space race? Why and how did it develop?

b. What other themes and events paralleled the space race?

c. What social themes are linked to space history?

d. What evidence is there that international competition was replaced by cooperation?

e. How have economic themes affected the space activities?

Objectives:

1. To write articles that can be submitted to a student newspaper

2. To publish a student newspaper about space and the Teacher in Space

1. Technological improvements in satellite communication have enabled publishers to print newspapers with national appeal. Television and radio news receive and send their messages via satellite and microwaves, enabling us to follow news-making events. The Teacher in Space project will be no exception. While the commercial media carry the event, students can track the mission from their own perspective, in their own newspaper.

2. Distribute current newspapers to groups of students. Discuss the functions of different kinds of stories and help the students identify the parts of the newspaper: news articles, features, editorials, comics, and advertisements, etc. How might newspapers be similar or different in the future?

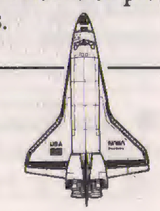
   a. Identify information about Mission 51-L which would make a good news or feature story. Divide the class into small groups to write news stories.

   b. Discuss Mission 51-L. List the kinds of products which could be the subject of advertisements. Ask students to divide into groups. Have each group select a product to advertise in the newspaper, e.g., a space suit, a space meal, or a trip. Challenge each group to design an advertisement for the newspaper, complete with illustration, prices, and details likely to attract sales.

   c. Divide the class into three groups to express their opinions on the Teacher in Space project. One group will write editorials, one the letters to the editor, and the third the cartoon.

3. Using the students' articles, publish a class or school newspaper which records events about Mission 51-L and space in general.

4. To complement the student-produced newspaper on the present mission, challenge students to prepare editions on past and future space missions.



Concept: As humanity's presence in space grows, so does the future need for laws and decision making.

● List potential problems of law and governance in space: rights of space travelers, repatriation of downed astronauts, liability problems, ownership or control of heavenly bodies or areas. Investigate the current status of law in space. To introduce the topic, present the following problem:

> Geosynchronous satellites orbit above Earth. Who determines right of way for these orbits and who assigns transmission frequencies? (The United Nations. The International Telegraph Union, ITU, has a special arm, the World Administrative Radio Conference, WARC, to make such allocations.)

Assign students to research the network of U.N. and intergovernmental space agencies which establish and enforce space laws.

Have students research existing guidelines and principles for space government. Provide copies of the provisions of the Treaty on Principles Governing the Activities of States in the Exploration of Outer Space, Including the Moon and Other Celestial Bodies *opened for signature by the U.N. General Assembly in 1967. Discuss with students why it is called the Magna Charta for space. (See Illustration below.)*

● Give specific examples of circumstances that the students could classify by the appropriate treaty provision. For example, "A country cannot claim territory in space." "A country should regulate the space activities of its citizens." (See Illustration below.)

Encourage students to create editorial cartoons or vignettes involving the special problems of space law.

● Have students design an outer space regime as they believe it should function. The Star Trek Federation is a good hypothetical example. Some issues surrounding the creation of the regime may be one nation–one vote versus votes based on contribution, enforcement, jurisdiction, and courts.

> *"Tonight I am directing NASA to develop a permanently manned space station — and to do it within a decade."*
>
> *—Ronald Reagan, State of the Union Address, January 25, 1984*

Ask students why the President made that decision, committing vast amounts of national resources at a time when budget deficits were rising.

Introduce the concept of a decision-making model or process. Use examples of other pivotal space decisions, such as the lunar landing, or ask students for their ideas of other historical decisions. Reinforce the concepts of goals, alternatives, and expected outcomes.

● Use the Spaceship Decision-Making Model (See Illustration p. 4.) to "walk through" the Space Station decision with the class. Apply the Model to a variety of space-oriented problems. Historical decisions may be researched and evaluated in terms of "accuracy." Present decisions may be followed closely, while future decisions may be considered. These may be done individually, in small groups, or as a whole class.

a. Historical Decisions
  1) Creation of NASA
  2) Kennedy's goal of reaching the Moon before 1970
  3) Participation of other countries in early space efforts
  4) Continuation of Apollo after 1967 deaths
  5) Inclusion of women as astronauts
  6) Apollo/Soyuz joint mission

b. Current Decisions
  1) Sharing scientific data with other nations
  2) Use of Earth observation satellite data by governments
  3) Cost factors
  4) Manned vs unmanned space missions

c. Future Decisions
  1) Space colonization
  2) Space manufacturing or mining facilities
  3) International space ventures
  4) Landing on other planets

A Treaty of Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies. The Treaty was opened for signature on January 27, 1967. This "Outer Space Treaty" or "Space Charter" has been characterized by some as a Magna Charta for space. Treaty provisions declare that:

(1) International law and the Charter of the United Nations shall apply to space activities.

(2) Outer space and celestial bodies are the province of mankind and shall be used only for peaceful purposes and for the benefit of all mankind.

(3) Nuclear weapons, weapons of mass destruction, military bases, and military maneuvers are banned from space.

(4) Outer space shall be free for exploration, use, and scientific investigation.

(5) There can be no claims of sovereignty or territory by nations over locations in space, "by means of use or occupation or by any other means."

(6) Jurisdiction over space objects launched from Earth shall be retained by the launching state.

(7) Private interests are recognized as having freedom of action in space, so long as a government or group of governments on Earth authorize and exercise continuing supervision over their activities. Signatory nations (seventy-eight at last count, including the United States and the Soviet Union) are therefore under a duty to oversee the activities of their citizens and commercial ventures in space.

(8) Governments are liable for damage caused on Earth by their space objects.

(9) Astronauts are "Envoys of Mankind" and are entitled to noninterference and all necessary assistance in distress.

(10) The natural environments of celestial bodies should not be seriously disrupted, and Earth must not be contaminated by extraterrestrial organisms.

NASA Teacher Resource Centers

Teacher Resource Centers at major NASA installations provide easy access to NASA-related materials that can be incorporated into the classroom at all levels. The materials reflect NASA research, technology and development in a variety of curriculum and subject areas. Resources available include NASA videotapes, 16mm films, 35mm slides, NASA publications, audio cassettes, computer software, laser discs, teacher's guides, and classroom activities. Educators can review the material and request copies for use in their classrooms. The only charge is the cost of reproduction and mailing. Visit or contact the Teacher Resource Center nearest you for information about services and materials:

ALABAMA SPACE AND ROCKET CENTER
Attn: NASA Teacher Resource Room
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Huntsville, AL 35807
(205) 837-3400, Ext. 36

NASA AMES RESEARCH CENTER
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Moffett Field, CA 94035
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NASA GODDARD SPACE FLIGHT CENTER
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NASA JOHN F. KENNEDY SPACE CENTER
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Kennedy Space Center, FL 32899
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NASA LANGLEY RESEARCH CENTER
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Cleveland, OH 44135
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NASA National Aeronautics and Space Administration

Crew of Space Shuttle Mission 51-L

National Aeronautics and
Space Administration

Space Shuttle Orbiter Crew Members for 51-L

The seven members of the Space Shuttle 51-L flight are: (back row, left to right) Mission Specialist El Onizuka, Teacher in Space Participant, S. Christa McAuliffe, Payload Specialist Greg Jarvis, and Mission Specialist Judy Resnik; (front row, left to right) Pilot Mike Smith, Commander Dick Scobee, and Mission Specialist Ron McNair.