

MANNED SPACECRAFT CENTER

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GEMINI X

Fact Sheet 291-G
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MULTIPLE RENDEZVOUS, EVA MISSION

Gemini X was described prior to its scheduled lift-off as the most ambitious manned space flight ever attempted by the United States. Results of the flight indicate just how appropriate this description was.

The prime crew consisted of Astronauts John W. Young and Michael Collins who served as command pilot and pilot, respectively; the backup command pilot was Alan L. Bean and Clifton C. Williams, Jr., was the backup pilot.

Speaking of the flight activities during the post-flight news conference, John Young said in part, ". . . It was an ambitious flight plan and we knew that. I've always thought that the probability, sta-

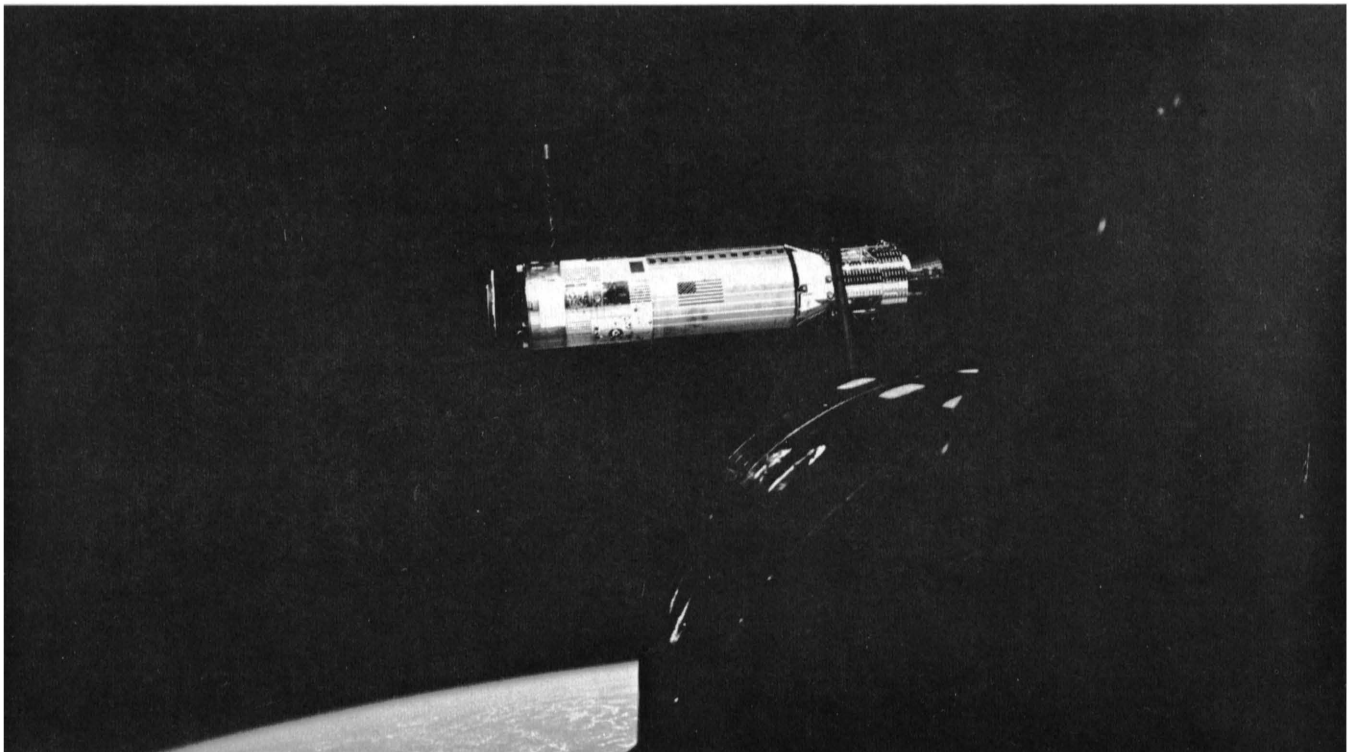
tistically speaking, of doing everything we had in the mission plan was low . . . But on the 18th of July the boosters, the Agena, the Gemini, the launch crews, the flight operations division, and even the one thing we couldn't do anything about — the weather — were all on our side."

Most of the goals of the mission were successfully accomplished.

- The primary mission objective was to rendezvous and dock (achieved).

Six secondary objectives were also assigned to the Gemini X mission. They were:

- To rendezvous and dock during the fourth revolution (achieved).



THE GEMINI X AGENA TARGET as seen from the command pilot's window after the rendezvous was accomplished. This was the first target on which the American flag was painted.

- To use large propulsion systems in space by attempting dual rendezvous maneuvers using the Gemini Agena target vehicle's primary and secondary propulsion systems (achieved).
- To conduct extravehicular activity operations (achieved).
- To conduct docking practice (not achieved).
- To conduct experiments (partly achieved).
- To conduct the following systems evaluations: bending mode, docked spacecraft — Gemini Agena target vehicle maneuvers, static discharge monitoring, post-docked spacecraft-Agena target vehicle maneuvers, and parking the Agena target vehicle (all achieved).

LAUNCH DAY ACTIVITIES

The prime crew went to bed about 2 a.m., EST (all times used in this fact sheet are Eastern Standard Time) July 18, 1966, and slept until shortly after noon. At 1:15 p.m., the final physical examination had been completed and Young and Collins had brunch with Astronauts Eugene A. Cernan, James A. Lovell, and Donald K. Slayton.

The multiple countdown (conducted simultaneously on the Agena and its Atlas standardized launch vehicle at Launch Complex 14 and on the

Gemini spacecraft and its launch vehicle at Launch Complex 19) continued smoothly during the late morning and early afternoon of that day.

At about two hours and 50 minutes before the scheduled launch of the Atlas-Agena (3:39:44 p.m.) Young and Collins arrived at the Ready Room on Pad 16 at Cape Kennedy and started donning their spacesuits. The crew continued suiting-up and was briefed on the status of the countdown, the mission and the weather. At about 3:20 p.m., they arrived at the White Room at the 100-foot level at Pad 19. This was two hours before their scheduled lift-off at 5:20:30 p.m. Prior to being inserted into their spacecraft, they were brought up to date on the spacecraft countdown status by the backup crew which had been in the spacecraft and participating in the countdown activities about five hours.

The Atlas-Agena lift-off occurred at 3:39:46 p.m., just two seconds later than planned. The Gemini X flight crew, already in place and with their hatches closed, followed the progress of the early phases of the Agena flight closely, and expressed their happiness when told that the Agena had achieved its prescribed orbit.

The countdown on the Gemini X spacecraft and its launch vehicle continued on schedule and at the



THE GEMINI X astronauts—John W. Young, left, and Michael Collins—are pictured as they study the flight plan several days prior to the mission.

T minus three-minute mark, a built-in hold was entered. This hold has been programmed into all Gemini rendezvous flights to allow the flight controllers to set up the precise launch conditions of time and launch azimuth. In the case of the Gemini X, the hold was scheduled to last five minutes and 34 seconds, aiming for an ignition time of 5:20:23 p.m., and a lift-off slightly less than four seconds later. Ignition had to be effected within a 37-second launch window period to attain the desired objectives of the mission.

Gemini X lifted off exactly as planned at 5:20:27 p.m., EST and was inserted into orbit with a perigee of 87 miles and an apogee of 146 miles. (All mileage figures quoted in this fact sheet are nautical miles. A nautical mile is equal to 1.15 statute miles.) A half-hour after lift-off the Gemini X spacecraft

trailed the Agena X by 850 miles and the Agena VIII trailed the Gemini X spacecraft by 500 miles.

MANEUVERS FOR RENDEZVOUS

A series of five major maneuvers were performed by the Gemini X crew in preparation for the rendezvous with the Agena X target scheduled for the fourth revolution. Those maneuvers were completed and, after five hours and 21 minutes of flight the crew reported through the Tananarive, Malagasy, tracking station that they were 40 feet from the Agena X. Later, while the spacecraft was over the *Coastal Sentry* tracking ship, Young and Collins were given a "go" for docking and that phase of the mission was completed after five hours and 53 minutes of elapsed flight time.

During the early phases of the flight, before ren-



A SCENE AT THE FLIGHT DIRECTOR'S CONSOLE during the second day of the Gemini X flight—Flight Director Glynn Lunney, left, monitors the progress of the mission while Christopher C. Kraft Jr., Assistant Director of Manned Spacecraft Center for Flight Operations, seated at Lunney's right, and William C. Schneider, Deputy Director for Mission Operations, Office of Manned Space Flight, NASA Headquarters, observe the activities.

dezvous, the crew accomplished sextant readings and performed other activities to attempt rendezvous without using ground-computed data. Although the computations were made, the crew decided to use the ground-computed data to accomplish the rendezvous. Fuel usage was high during the terminal phase of the first rendezvous.

The resultant shortage of fuel placed an additional constraint on most phases of the planned flight activities from that point. The flight controllers did, however, greatly alleviate the situation by determining that the Gemini X spacecraft should stay docked with the Agena X for almost 39 hours in order to get the maximum benefit out of the propulsion system of the target vehicle. By using the spacecraft-target vehicle combination, most of the mission objectives were able to be recorded as "achieved."

DOCKED MANEUVERS

During this time period there were six major maneuvers of the docked Gemini-Agena vehicles, three which used the primary propulsion system of the Agena X and three which used the Agena's secondary propulsion system. The first maneuver resulted in an orbit with an apogee of 412.2 miles and a perigee of 158.5 miles.

Speaking of this at the news conference, Young said, ". . . Mike threw the switch and a minute and 24 seconds later . . . it was really something. We had a negative 1-g and were driven forward in the cockpit . . . we got a tremendous thrill . . . on our way out to apogee and a new world's record for altitude . . ."

This maneuver was followed by one which adjusted the height and resulted in an orbit with an apogee of 205.8 miles and a perigee of 158.4 miles. The next maneuver was for circularization and was completed with an orbit which had an apogee of 208.7 miles and a perigee of 203.9 miles. The three smaller maneuvers, all performed by use of the secondary propulsion system of the Agena X, ended with the Gemini X spacecraft and the Agena X still docked and in an orbit with an apogee of 208.5 miles and a perigee of 205.5 miles.

RENDEZVOUS WITH THE AGENA VIII

The crew undocked the spacecraft from the

Agena X after 44 hours and 40 minutes of flight. The undocking was uneventful and a maneuver shortly thereafter was performed to permit the spacecraft to rendezvous with the Gemini VIII Agena which has been in orbit since March 16.

About three hours later Young and Collins reported they were closing in on the Gemini VIII target vehicle. After station-keeping for more than three hours, the crew performed a maneuver which separated them from their passive target at a rate of about one and one-half feet per second. An orbit shaping maneuver was performed shortly after that.

Retrofire was initiated after 70 hours, 10 minutes, and 27 seconds of the mission had elapsed, in order to bring the spacecraft down in the primary landing area during the 44th revolution.

The spacecraft landed at the beginning of that revolution in the west Atlantic landing zone. The landing occurred at 4:07:06 p.m., EST, July 21, 1966. The landing point was 3.4 miles east-northeast of the planned landing point, and the spacecraft retrieval by the prime recovery ship, the USS *Guadalcanal*, some 54 minutes later, was at a point 3.2 miles east-northeast of the planned spacecraft touchdown.

The rescue helicopter arrived at the impact point as the spacecraft landed and the swimmers and the flotation collar were deployed. The flotation collar was attached and inflated within five minutes. Young and Collins were picked up by the helicopter and arrived on board the *Guadalcanal* 27 minutes after their landing. The spacecraft was brought on board 27 minutes after the crew.

AGENA X MANEUVERS

Three Agena X maneuvers were performed by command of ground controllers during a 12-hour period following the spacecraft landing. These included one primary propulsion system burn which placed the Agena in an orbit with an apogee of 750.0 miles and a perigee of 208.2 miles; another primary propulsion system burn which resulted in an orbit with an apogee of 208.7 miles and a perigee of 190.2 miles; and a secondary propulsion system circularization maneuver which placed the Agena X in an orbit with an apogee of 190.3 miles and a perigee of 187.6 miles.



A **STORM CENTER** near the Straits of Gibraltar as viewed by the flight crew of the Gemini X spacecraft.

Following this last maneuver, control was turned over to the Hawaii tracking station. This station monitored the vehicle until its power was depleted about seven days after lift-off. The Agena X vehicle was permitted to remain in this orbit and may be a passive target on a future mission.

EXTRAVEHICULAR ACTIVITIES

The Gemini X crew established another record as they depressurized their spacecraft and opened the hatch on three different occasions during the flight.

The standup Extravehicular Activity (EVA) started after about 23 hours and 23 minutes of the flight had elapsed. Approximately 50 minutes later this phase of the activity was terminated because both crew members experienced eye irritation. Collins said the irritation was accompanied by an odor which reminded him of lithium hydroxide, a substance which is used in the environmental control system to remove carbon dioxide.

The umbilical or tethered EVA period started after 48 hours and 41 minutes of elapsed flight time and continued about 39 minutes. During this period Collins accomplished the majority of the planned activities. Evaluation of the hand-held maneuvering unit was not completed because the EVA period was terminated early to conserve fuel for maneuvers in preparation for their return to earth. The maneuver-

ing unit was used successfully, however, to conduct Collins' transfer in both directions between the spacecraft and the Agena VIII target vehicle, a distance of about 15 feet. Also, during this EVA, Collins retrieved an experiment package which had been attached to the Agena VIII since March 16.

The crew opened the spacecraft for a third time after approximately 50 hours and 32 minutes of the flight had been completed. This time they jettisoned the EVA equipment.

AWARDS CEREMONY

An Awards Ceremony and the Pilots' Postflight News Conference was held at Manned Spacecraft Center, Houston, Texas, August 1, 1966. The MSC Director, Dr. Robert R. Gilruth made a brief opening statement, then introduced Dr. Robert C. Seamans, Jr., Deputy Administrator of NASA.

Dr. Seamans briefly discussed the results of the Gemini X mission and the total Gemini Program to date, then presented the NASA Exceptional Service Medal to both Young and Collins.

During the discussion, Dr. Seamans said, ". . . We've done a great deal more with Gemini than originally intended. We've made Gemini much more than an improved two-man Mercury. Gemini has done much more to open the way to the moon than we could have hoped for five years ago . . . With Gemini, we've developed our ability to maneuver in space, to change orbits, to inspect other objects in space, to rendezvous and dock, and to use the power of an orbiting rocket as a switch engine in space . . ."

In talking about the various phases of the flight, both Young and Collins described the activities in great detail.

At one point, Young said, ". . . During the first five hours of the mission, Mike and I were extremely busy evaluating orbit navigation and orbit determination, and the primary rendezvous. The primary rendezvous was characterized, I think, by a large out-of-plane error. When we realized this was taking place, we could no longer let orbital mechanics work for us . . . We were working for it. We had to use what I call a brute force method of rendezvous, and it takes a lot of fuel."

Later Young said, "It was on this Agena that we painted the United States flag for the first time. I



THE GEMINI X SPACECRAFT near the end of its journey as it approached the landing point about 460 miles southeast of Cape Canaveral, Florida, on the third day of the flight. The photo was taken from a helicopter.

was very pleased to see it when we got there. That is a beautiful vehicle. It took tremendous engineering skill . . . to get those two vehicles up there at the same time.”

In discussing the docking, Collins said, “This docking is an extremely precise maneuver. The alignment must be nearly perfect, in order to bring the two vehicles together successfully. John really

made it look easy — as a matter of fact, he lined right up on the first try, we glided right into the center of the docking cone and at that point the Agena took over and literally engaged the forward nose of the Gemini and pulled it in until the Gemini was tight against the front end of the Agena. We were really glad to be there . . .”

Young said, “We burned the Agena main engine three times — the first time, 14 seconds; the second time, 11 seconds; and finally a short burn of four seconds, and in all cases the Agena performed magnificently, a flawless performance.”

Pilot Collins talked about his standup extravehicular activity. He said, “. . . I opened up the right hatch with John’s help and it opened very easily. I stood up part of the way and turned to the left and actually got my legs up under the instrument panel which . . . was a very comfortable position . . . during the standup EVA it’s almost like standing with your head up through the roof of a car going sideways across the world. It was a very pleasant sensation.”

EXPERIMENTS

A total of 14 experiments were scheduled as activities of the Gemini X crew. Following is a brief description of those experiments and results.

- The star occultation navigation experiment is designed to determine the feasibility and operational value of star occulting measurements in the development of a simple, accurate, and self-contained orbital navigational capability. On Gemini X, this experiment was accomplished with the Gemini Agena target vehicle control system because of the constraint to remain docked. This experiment was terminated early because of concern over excessive use of propellant but the crew obtained good data.
- The flight crew performed the ion-sensing attitude control experiment in an excellent manner, and, in addition to performing required operations, they obtained photographs of the attitude indicators while maneuvering. The purpose of this experiment is to develop a navigation system which can sense vehicle attitude by using flow variations on a specially designed system.
- The color patch photography experiment was terminated before completion when the eye irritation problem caused termination of the standup

EVA; however, one of the three planned series of exposures was obtained. The purpose of this experiment was to determine if existing photographic materials could accurately reproduce the color of objects photographed under the environmental conditions which exist in space.

- The fact that any data were obtained on the zodiacal light photography experiment is attributed to the crew's decision to combine this experiment with the ion-sensing attitude control experiment.
- No fuel was allocated for the synoptic terrain and synoptic weather photography experiments, but the crew obtained good photographic data while in drifting flight.
- The micrometeorite collection package was retrieved from the Gemini VIII Agena target vehicle, but the new micrometeorite collection package was not in place as planned because of hand-hold problems encountered by the pilot.

The crew performed the micrometeorite collection experiment later than originally planned because of the early termination of the first EVA. The package was retrieved during the second EVA and handed into the spacecraft, but subsequently floated out of the spacecraft and was lost in orbit.

- The decision to remain docked to the Agena target vehicle after the initial rendezvous placed a major constraint on the experiment concerning the ultraviolet astronomical camera. However, several exposures more than planned were obtained.
- The quantity of ion-wake measurement was decreased because of the deletion of docking practice. The crew performed all required operations for the completion of this experiment.

Three other experiments were conducted according to the flight plan. They concerned a Tri-Axis Magnetometer, a Beta Spectrometer, and a Bermsstrahlung Spectrometer.

THE PILOTS

John W. Young

Astronaut John W. Young was named the command pilot of the Gemini X spacecraft. He was born in San Francisco, Calif., September 24, 1930, and was one of the nine astronauts selected by NASA in September 1962. Young was pilot of the first manned Gemini flight on March 23, 1965, a

three-orbit mission on which Virgil I. Grissom was the command pilot.

He attended Georgia Institute of Technology and was graduated in 1952 with a bachelor of science degree in aeronautical engineering. He joined the Navy after graduation and completed flight training. From 1959 until 1962 he served as a test pilot and as program manager of the F4H weapons system project.

In 1962, Young set world time-to-climb records in the 3,000-meter and 25,000-meter altitude events in the F4B Navy fighter plane.

In addition to the two space flights made by Young, he was also pilot on the backup crew for the Gemini VI mission. Prior to his selection as an astronaut, he served as maintenance officer for All-Weather Fighter Squadron 143, at the Naval Air Station, Miramar, Calif. He has logged more than 3,400 hours flying time, including more than 2,900 hours in jet aircraft. Young was awarded the NASA Exceptional Service Medal in 1965 and in 1966.

He is married to the former Barbara V. White of Savannah, Georgia. They have two children: Sandy, born April 30, 1957; and John, born January 17, 1959.

Michael Collins

Michael Collins, pilot of Gemini X was born in Rome, Italy, October 31, 1930. He was selected as a NASA astronaut in October 1963.

Collins was graduated from the United States Military Academy at West Point. He chose an Air Force career upon graduation and, after receiving flight training and test pilot training, he served as an experimental flight test officer at the Air Force Flight Test Center, Edwards Air Force Base, Calif. While there he tested performance, stability and control characteristics of Air Force aircraft, primarily jet fighters.

He was backup pilot for the Gemini VII mission and received the NASA Exceptional Service Medal for his accomplishments on the Gemini X flight. Collins has logged more than 3,500 hours flying time, including more than 3,000 hours in jet aircraft.

Collins is married to the former Patricia M. Finnegan of Boston, Mass. They have three children: Kathleen, born May 6, 1959; Ann, born October 31, 1961; and Michael, born February 23, 1963.

UNITED STATES SPACE FLIGHT LOG

MISSION	PILOTS	DATE(S)	MISSION ELAPSED TIME	TOTAL U.S. MANNED HOURS IN SPACE
Mercury-Redstone 3	Shepard	May 5, '61	00:15:22	00:15:22
Mercury-Redstone 4	Grissom	July 21, '61	00:15:37	00:30:59
Mercury-Atlas 6	Glenn	Feb. 20, '62	04:55:23	05:26:22
Mercury-Atlas 7	Carpenter	May 24, '62	04:56:05	10:22:27
Mercury-Atlas 8	Schirra	Oct. 3, '62	09:13:11	19:35:38
Mercury-Atlas 9	Cooper	May 15-16, '63	34:19:49	53:55:27
Gemini-Titan III	Grissom-Young	Mar. 23, '65	04:53:00	63:41:27
Gemini-Titan IV	McDivitt-White	June 3-7, '65	97:56:11	259:33:49
Gemini-Titan V	Cooper-Conrad	Aug. 21-29, '65	190:55:14	641:24:17
Gemini-Titan VII	Borman-Lovell	Dec. 4-18, '65	330:35:31	1302:35:19
Gemini-Titan VI-A	Schirra-Stafford	Dec. 15-16, '65	25:51:24	1354:18:07
Gemini-Titan VIII	Armstrong-Scott	Mar. 16, '66	10:41:26	1375:40:59
Gemini-Titan IX-A	Stafford-Cernan	June 3-6, '66	72:21:00	1520:22:59
Gemini-Titan X	Young-Collins	July 18-21, '66	70:46:39	1661:56:17



THE GEMINI X FLIGHT CREW: Pilot Michael Collins, left, and command pilot John W. Young.