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For Release:

Nicholas Panagakos
Headquarters, Washington, D.C.
(Phone: 202/755-3680)

IMMEDIATE

Victor Seigel
Headquarters, Washington, D.C.
(Phone: 202/755-3352)

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PLANETARY EXPLORATION BY NASA SPACECRAFT

The attached summarizes chronologically by launch date NASA's planetary exploration program. It lists the planet, the spacecraft, launch and encounter dates and briefly summarizes scientific findings. This summary is provided for information and reference.

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PLANETARY EXPLORATION BY NASA SPACECRAFT

(March 1979)

<u>Planet</u>	<u>Spacecraft</u>	<u>Launch Date</u>	<u>Encounter</u>	<u>Major Findings or Goals</u>
Venus	Mariner 2	Aug. 27, 1962	Flyby: Dec. 14, 1962	Heavy atmosphere, 100 times the pressure of Earth's, mostly carbon dioxide; scorching (more than 800 degrees F) surface, no magnetic field.
Mars	Mariner 4	Nov. 28, 1964	Flyby: July 14, 1965	Cratered Moon-like surface revealed in 21 close-up pictures from distance of about 9,656 kilometers (6,000 miles). No evidence of artificial canals or of flowing water. Atmospheric pressure about a hundredth that of Earth, mostly carbon dioxide.
Venus	Mariner 5	June 14, 1967	Flyby: Oct. 19, 1967	Confirmed and refined Mariner 2 findings. Found exosphere of Venus is made up of hydrogen as is that of Earth. Detected Venusian ionosphere.
Mars	Mariner 6	Feb. 25, 1969	Flyby: July 31, 1969	Mariners 6 and 7 took about 200 close-up pictures of Mars that showed smooth, cratered and chaotic surfaces. Confirmed and refined atmospheric data. Came as close as 3,219 km (2,000 mi.) to Mars.
Mars	Mariner 7	March 27, 1969	Flyby Aug. 5, 1969	
Mars	Mariner 9	May 30, 1971	Orbited and studied Mars from Nov. 13, 1971 to Oct. 27, 1972.	More than 7,000 closeup photographs revealed exciting new Martian features: volcanic mountains including one taller and broader than any on Earth; a canyon long enough to stretch from San Francisco to New York City; signs that rivers and possibly seas could have existed on Mars in times past; and dust storms that enveloped the whole planet.
Jupiter	Pioneer 10	March 3, 1972	Flyby: Dec. 4, 1973	Pioneer 10 provided world's first close-up pictures of Jupiter. Analyses of photographs and data from Pioneers 10 and 11 indicated that below its deep atmosphere, Jupiter may be composed mostly of liquid hydrogen with no solid surface; that the Great Red Spot may be a hurricane-like storm; that the colorful cloud bands are rising and falling air masses; that the Jovian magnetic field is much larger and more complex and its trapped radiation far more intense than previously assumed; and that Jupiter may be the only Solar System body other than the Sun to emit particle radiation. New knowledge also was gained about the satellites Io, Europa, Ganymede and Callisto.
Jupiter	Pioneer 11	April 6, 1973	Flyby: Dec. 5, 1974	

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Saturn	Pioneer 11	April 6, 1973	Flyby: Sept. 1, 1979	To take close-up color pictures of Saturn and its rings and gather data on the atmosphere, magnetic field and other features.
Venus	Mariner 10	Nov. 3, 1973	Flyby: Feb. 5, 1974	Picture-taking spacecraft failed to find holes in clouds shrouding Venus. In ultraviolet, however, pictures revealed topmost clouds circle planet 60 times faster than planet rotates. Other instruments indicated the ionosphere results from interaction of Venus' atmosphere and solar wind and confirmed that the atmosphere is 95 per cent carbon dioxide, surface air pressure is about 100 times Earth's and surface temperature is about 450 degrees C (900 degrees F), hot enough to melt lead or zinc.
Mercury	Mariner 10	Nov. 3, 1973	Flybys: March 29, 1974 Sept. 21, 1974 March 16, 1975	First close-ups of Mercury reveal an ancient surface still bearing the scars of meteorite impacts that occurred billions of years ago and huge scarps (cliffs), apparently caused by crustal compression as the planet's interior cooled. A Mercurian magnetic field about a hundredth the magnitude of Earth's was detected as was a thin atmosphere of argon, neon and helium, with a trillionth the density of Earth's. Temperatures were measured from 510 degrees C (950 degrees F) on the sunlit side to -210 degrees C (350 degrees F) on the dark side.
Mars	Viking 1	Aug. 20, 1975	July 20, 1976 Lander 1 Touchdown	Studied Mars from orbit and from two different locations on the surface. Pictures of Martian surface from Landers show it as resembling deserts on Earth. However, analyses of surface show it to be drier than Earth's driest deserts. Martian atmosphere, about a hundredth the density of Earth's, otherwise has all of the elements needed to support life: nitrogen, carbon, oxygen and water vapor. Considerable quantities of water locked in polar ice caps were detected from orbiters. No organic molecules detected in soil by Lander. Lander analyses of soil samples gave puzzling results that neither proved nor disproved existence of microbial life on Mars.
Mars	Viking 2	Sept. 9, 1975	Sept. 3, 1976 Lander 2 Touchdown	

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Jupiter	Voyager 2	Aug. 20, 1977	Flyby: July 1979	To conduct close-up studies of Jupiter, its ring discovered by Voyager 1 and its major moons: Io, Europa, Callisto, Ganymede and Amalthea.
Jupiter	Voyager 1	Sept. 5, 1977*	Flyby: March 3-6, 1979	Provided the first detailed views of the surfaces of Io, Ganymede and Callisto. Io was discovered to have active volcanoes and greater volcanic activity than Earth. Ganymede and Callisto showed the scars of ancient meteorite bombardment; other surface relief shown is attributed to their assumed mantles of liquid water. A particles ring only 29-32 km (18-20 mi.) thick was discovered around Jupiter. Amalthea, the tiny innermost satellite, was found to be elongated in shape and reddish. Voyager pictures revealed surface details as small as about .37 km (.23 mi.) across on Io, 2.1 km (1.3 mi.) on Ganymede and 2.2 km (1.4 mi.) on Callisto and cloud features as small as 5.1 km (3.2 mi.) on Jupiter.
Saturn	Voyagers 1 and 2		Flybys: Voyager 1, Nov. 1980; Voyager 2, Aug. 1981.	To conduct close-up studies of Saturn, its rings and its moons, particularly Titan, which has an atmosphere.
Uranus**	Voyager 2		Flyby: Jan. 1986	To conduct close-up studies of Uranus, its rings and its moons.

* Although launched later, Voyager 1 had a trajectory that took it to Jupiter faster than Voyager 2.

** Optional.

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Venus	Pioneer Venus 1	May 20, 1978	Placed into orbit Dec. 4, 1978.	Discovered that an isotope of the rare gas argon exists in a much greater abundance on Venus than on Earth. The discovery contradicts theories on planetary formation that the closer a planet is to the Sun the more it should be depleted of its original gases. Provided new support for theory that intense heat on Venus is due to runaway greenhouse effect. Venus' overall atmosphere was shown to be about 97 per cent carbon dioxide, 1-3 per cent nitrogen and 0.1-0.4 per cent water vapor with traces of other gases. Clouds are composed mainly of oxygen, water vapor and sulphur dioxide. The sky of Venus is clear of particles below the clouds, which are separated into three distinct layers. Radar mapping from orbit indicates the Venus topography resembles Earth's.
Venus	Pioneer Venus 2	Aug. 8, 1978	Dec. 9, 1978. Separated into five probes that measured the Venus atmosphere as they descended to the surface. Although not designed to survive after landing, one probe transmitted information for 67 minutes after impact.	