NASA

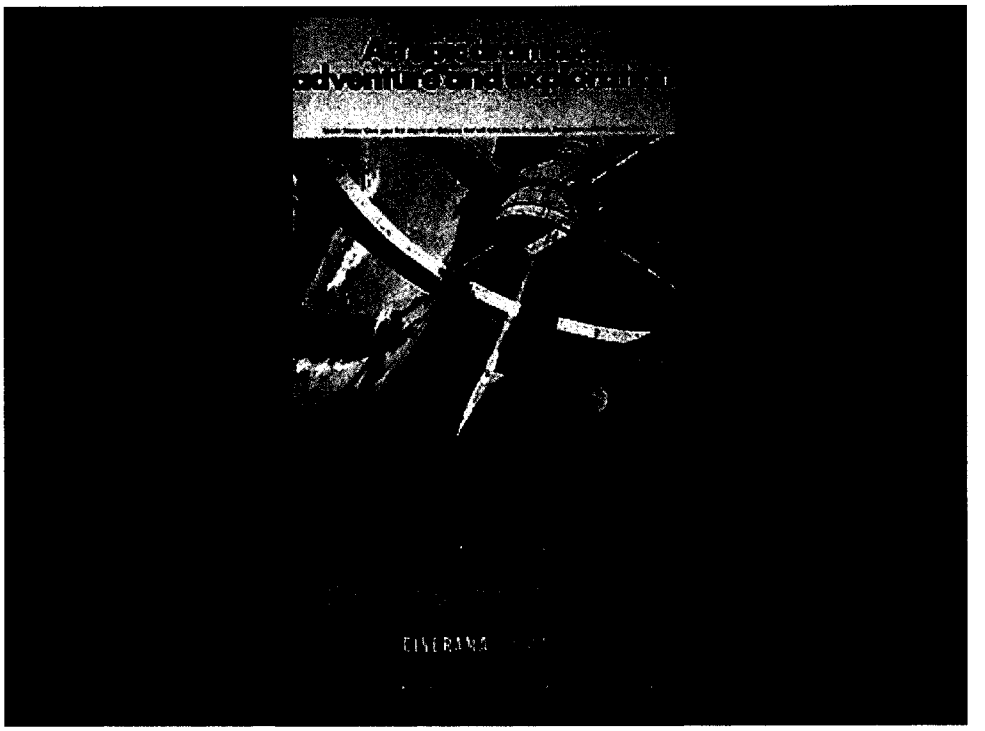
The Search for Extraterrestrial Life

Patricia M. Beauchamp

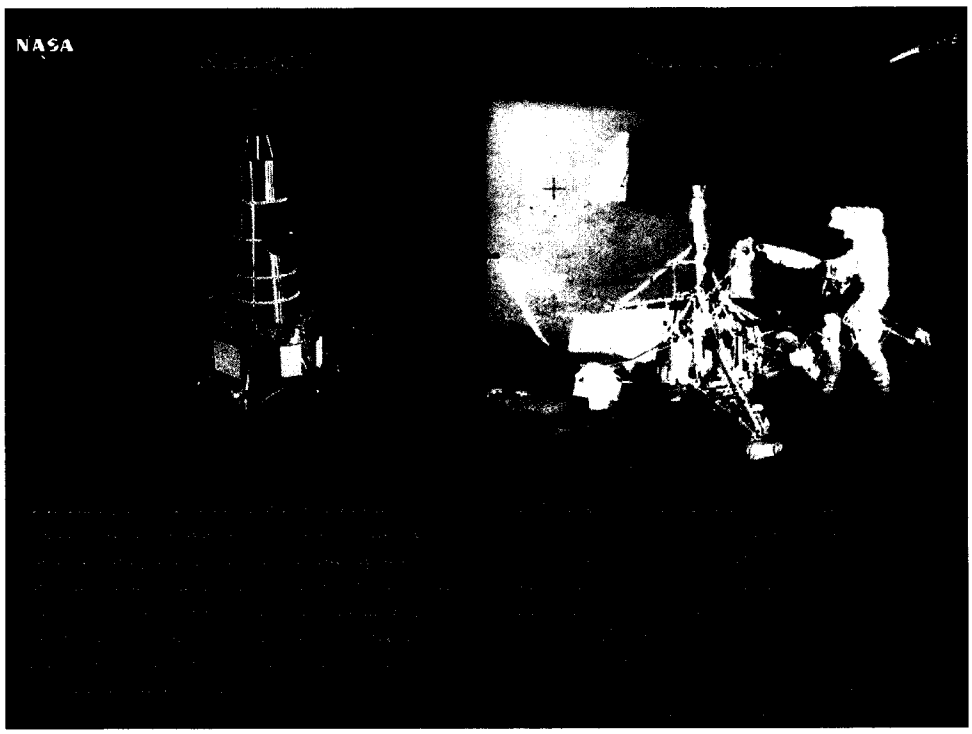
Center for In Situ Exploration and Sample Return
Jet Propulsion Laboratory/California Institute of Technology

November 6, 2000

2001
a space
odyssey




2001: a space odyssey
CINERAMA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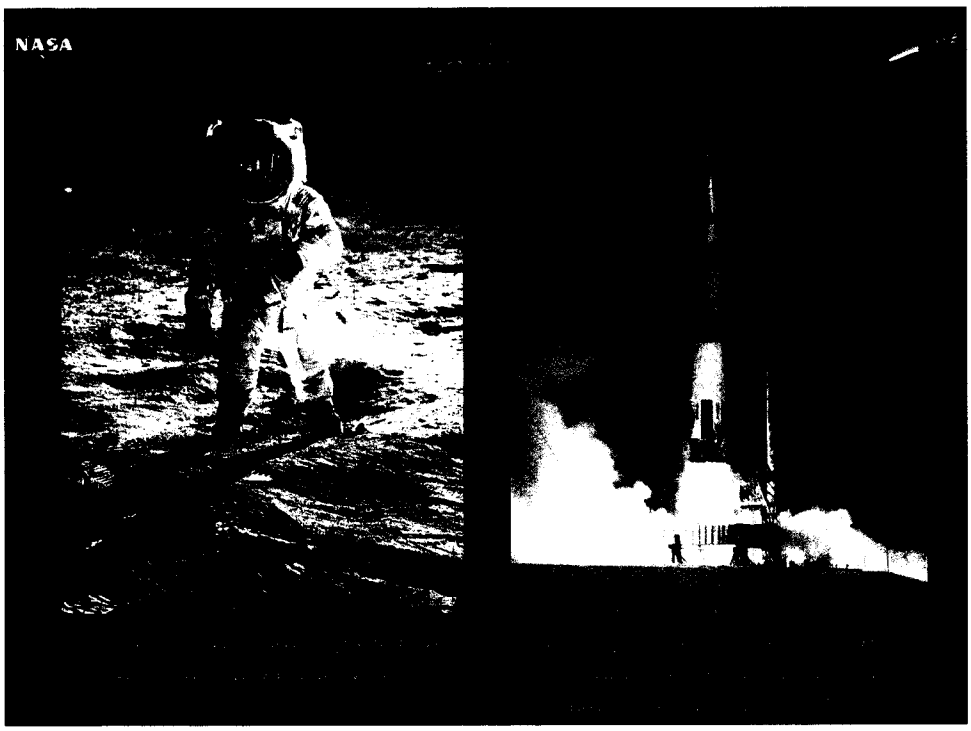
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Viking

Mission to Mars

The Viking mission sent twin spacecraft to the "Red Planet." Each spacecraft consisted of two parts: an orbiter and a lander. The orbiter's initial job was to survey the planet for a suitable landing site. Later the orbiter's instruments studied the planet and its atmosphere, while the orbiter acted as a radio relay station for transmitting Lander data. Once on the surface of Mars, the lander surveyed the soil, wind, and atmosphere and conducted numerous experiments to determine the existence of past or present life.

On the Surface of Mars

A model of the Viking lander on a simulated Martian surface. The first of two landers arrived on the surface of Mars on July 20, 1976. The second touched down September 3, 1976. Each lander housed instruments that examined the physical and magnetic properties of the soil and analyzed the atmosphere and weather patterns of Mars.

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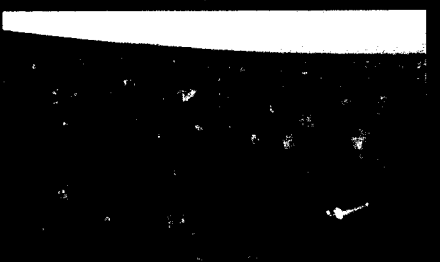
Viking 1

View of Chryse Planitia
Looking over Viking 1 Lander

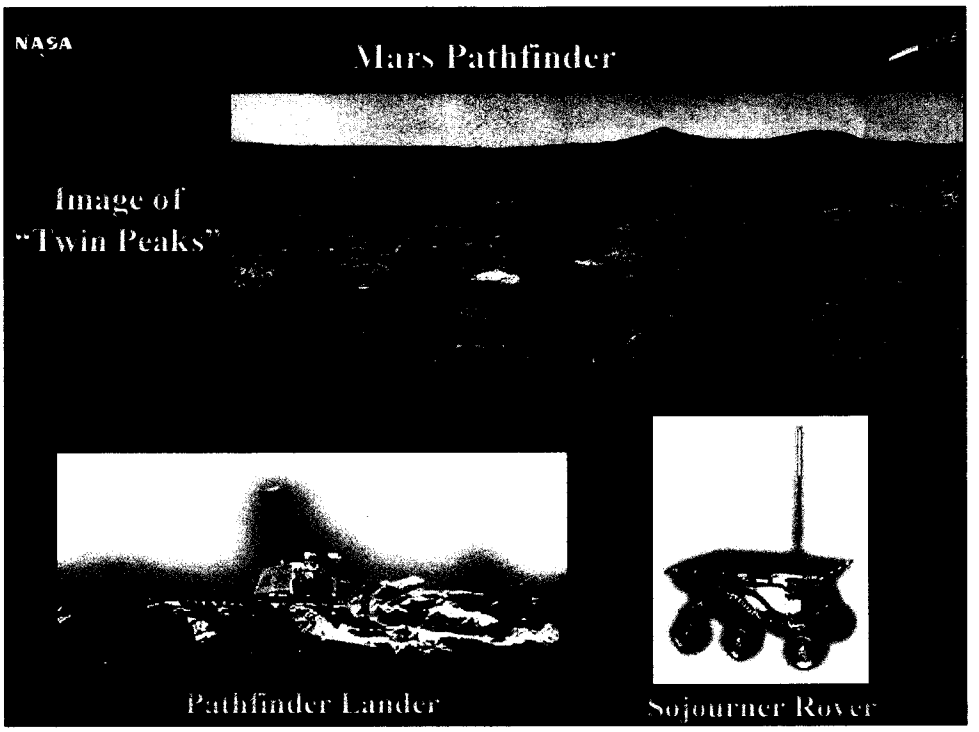
Experiments

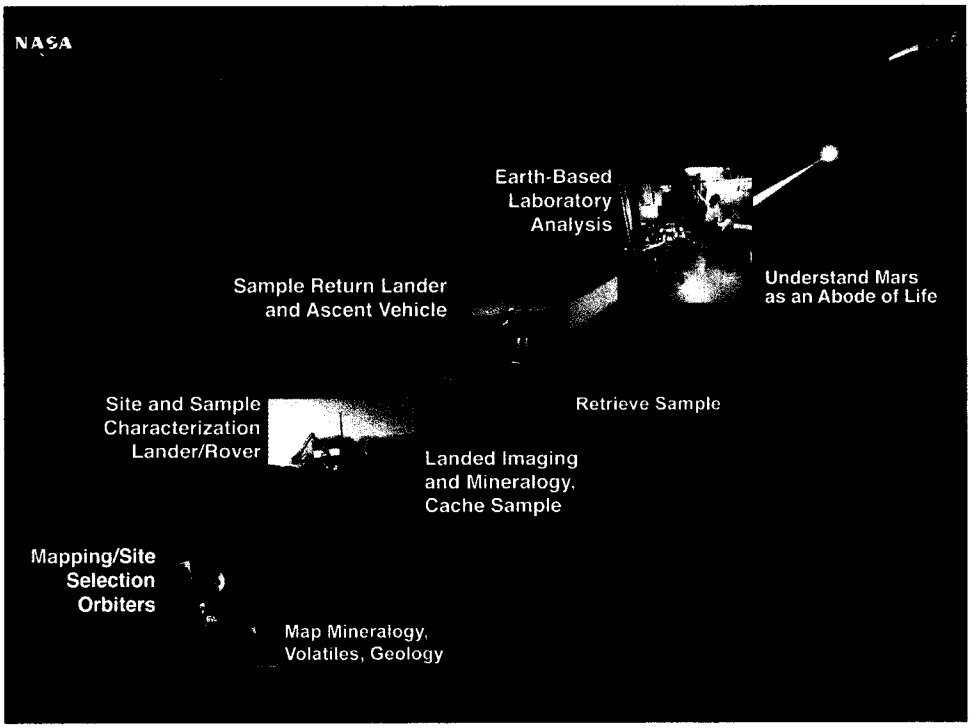
Physical Properties	(PI: Shorthill)
Atmospheric Structure	(PI: Seiff)
Biology (GEX/LR/PR)	(PI: Klein)
Gas Chromatograph Mass Spectrometer	(PI: Biemann)
Lander Imaging	(PI: Arvidson)
Meteorology	(PI: Ellman)
Seismology	(PI: Anderson)
Magnetic Properties	(PI: Hargraves)
Lander Radio Science	(PI: Michael)
Neutral Mass Spectrometer (NMS)	(PI: Nier)
X-Ray Fluorescence Spectrometer (XRFS)	(PI: Toulmin)
Retarding Potential Analyzer (RPA)	(PI: Nier)

Viking 2



Lander close up of the surface of Mars. The metal cylinder at right is the shroud for the surface sampler instrument, which was ejected after landing. To the left of it are trenches dug by the sampling arm, and part of a footpad can be seen at the lower right. Note the holes in the rocks, which appear to be vesicles produced by gas bubbles when the rocks first solidified from lava.


NASA
Mars Pathfinder
Image of
"Twin Peaks"
Pathfinder Lander
Sojourner Rover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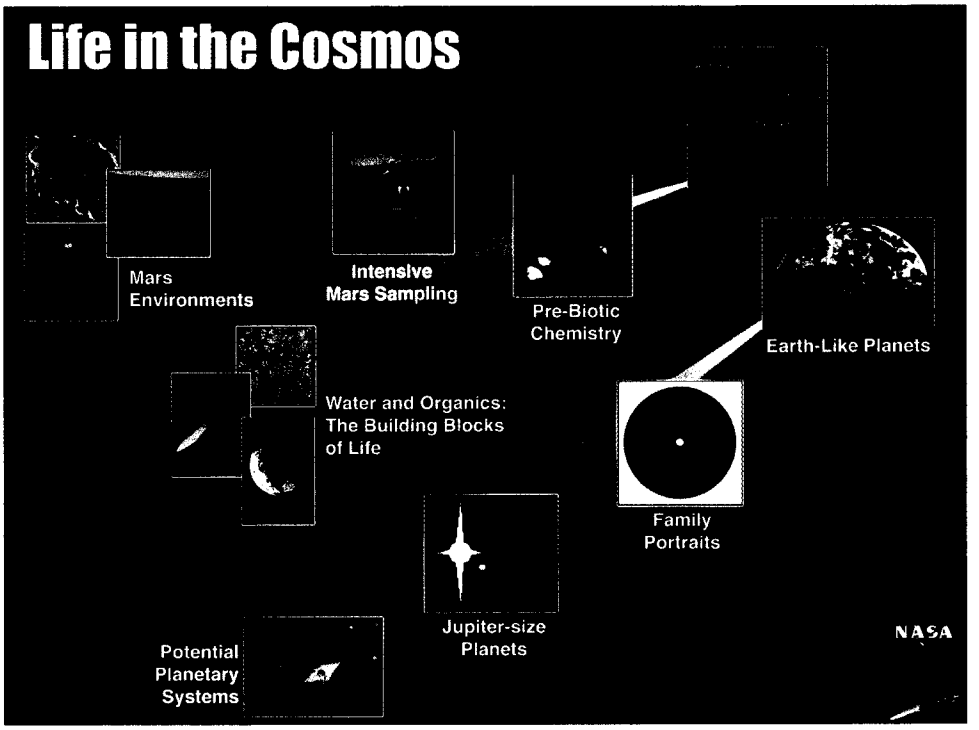
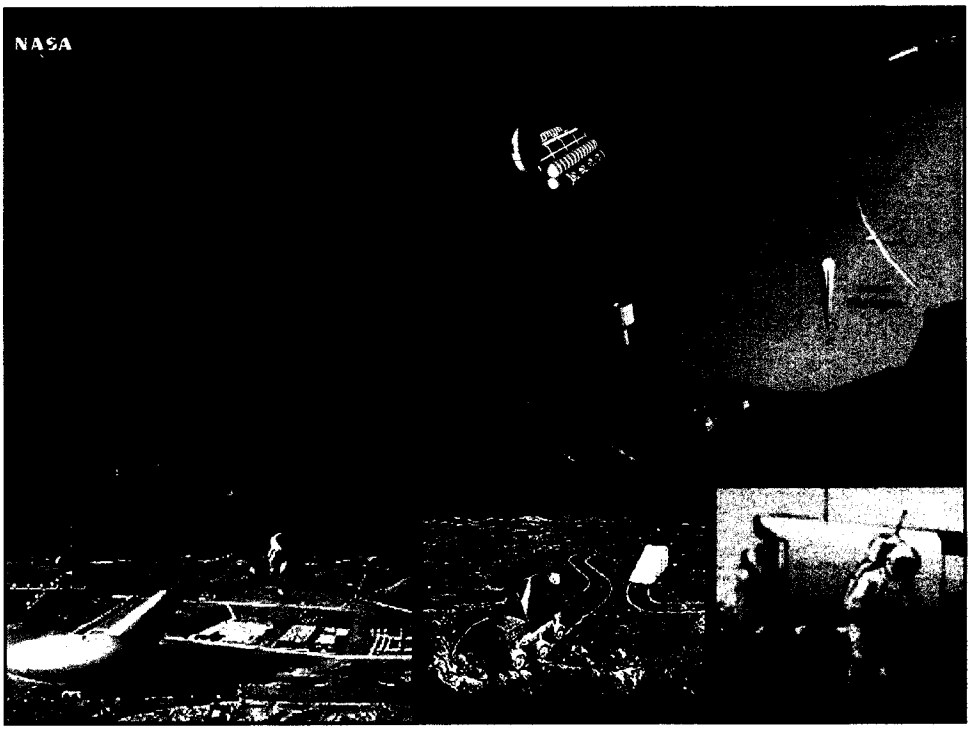
Earth-Based
Laboratory
Analysis
Sample Return Lander
and Ascent Vehicle
Understand Mars
as an Abode of Life
Site and Sample
Characterization
Lander/Rover
Retrieve Sample
Landed Imaging
and Mineralogy,
Cache Sample
Mapping/Site
Selection
Orbiters
Map Mineralogy,
Volatiles, Geology


Life in the Cosmos
Mars Environments
Intensive Mars Sampling
Pre-Biotic Chemistry
Earth-Like Planets
Water and Organics: The Building Blocks of Life
Family Portraits
Jupiter-size Planets
Potential Planetary Systems
NASA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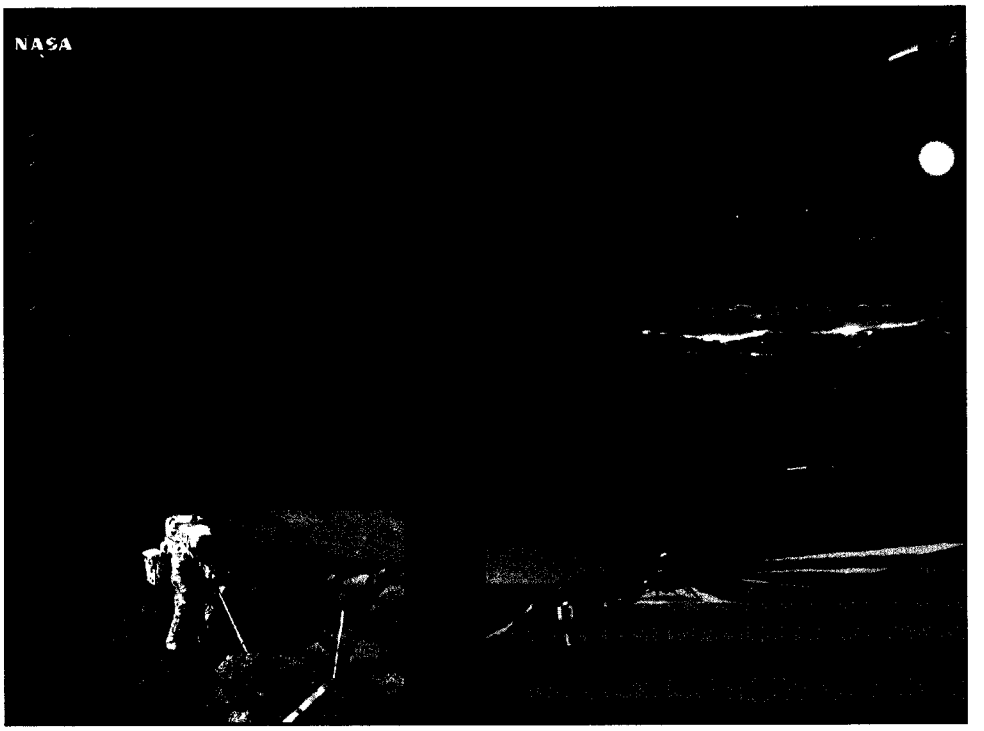
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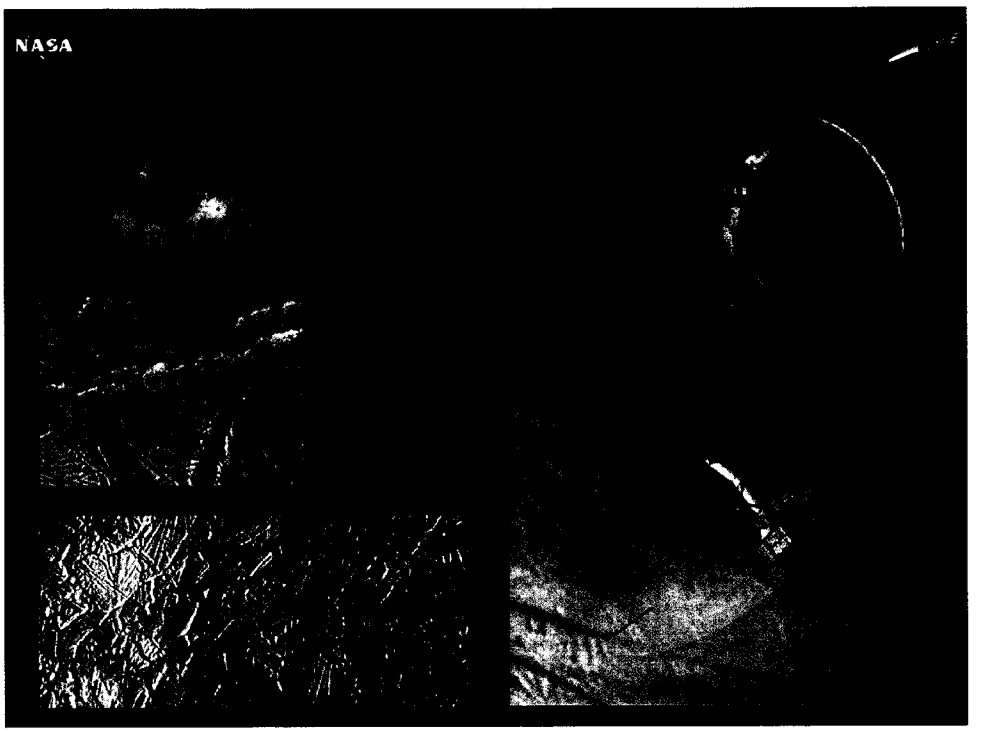
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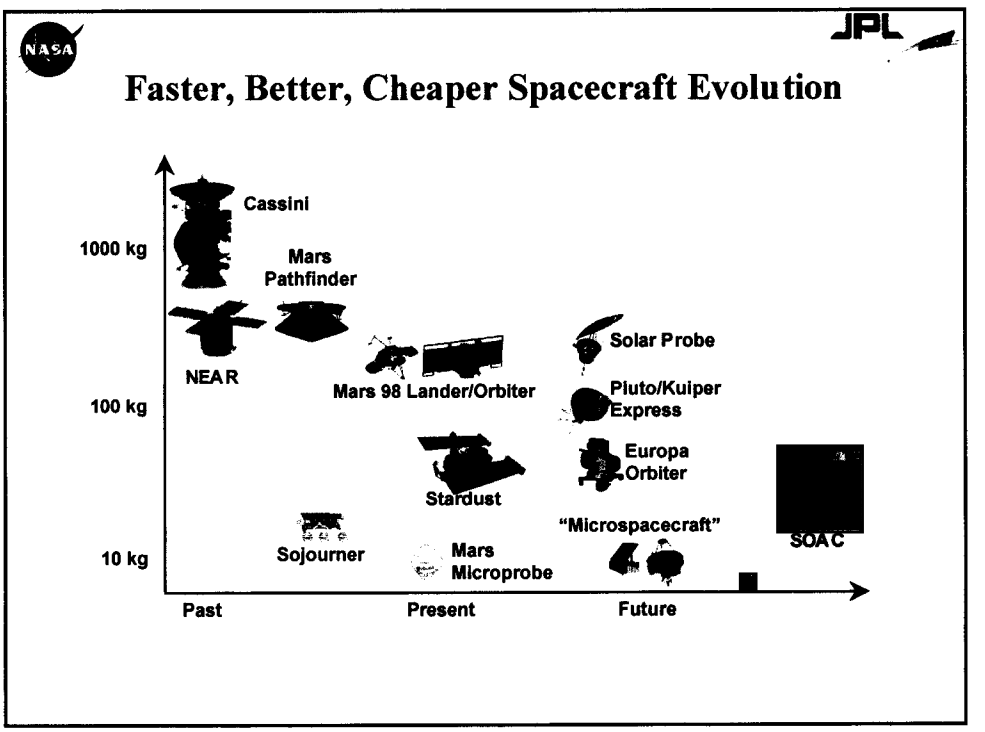
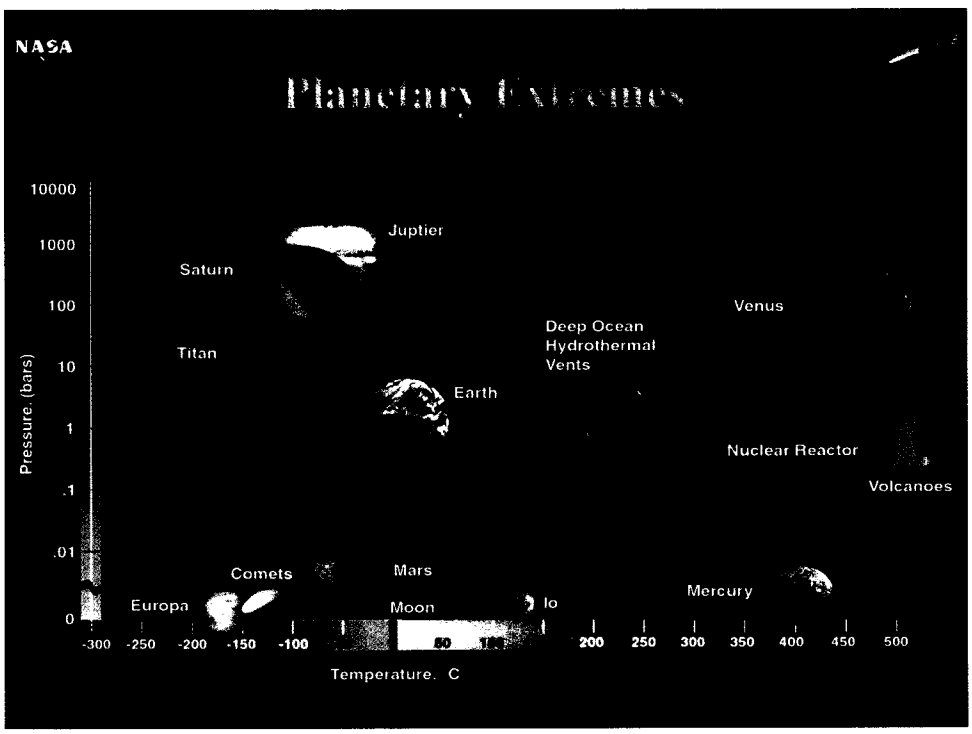
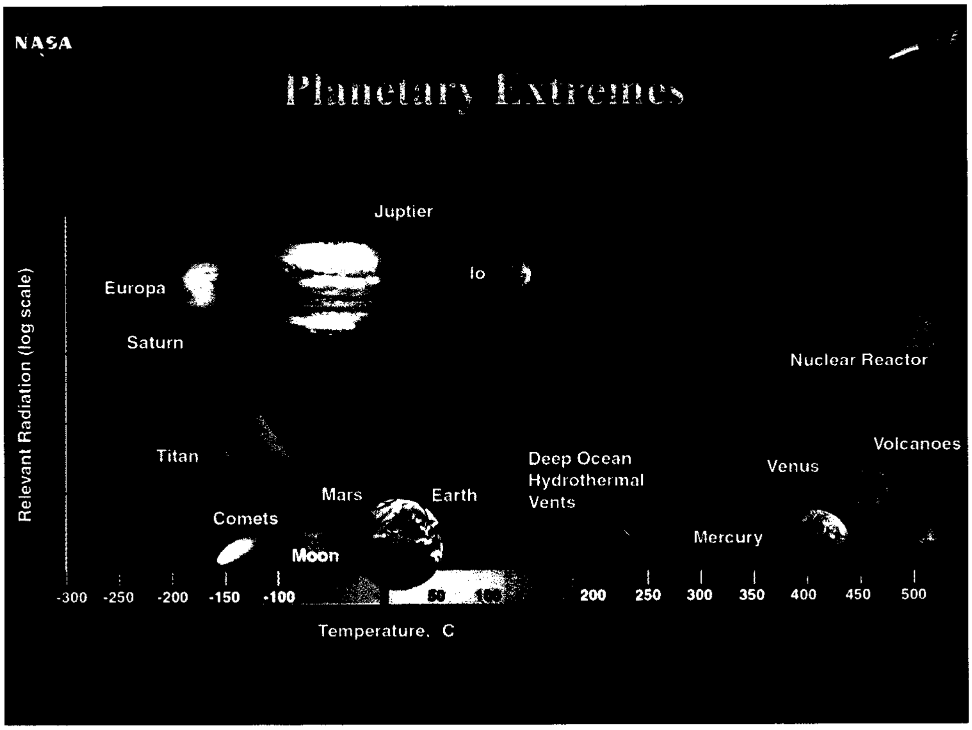
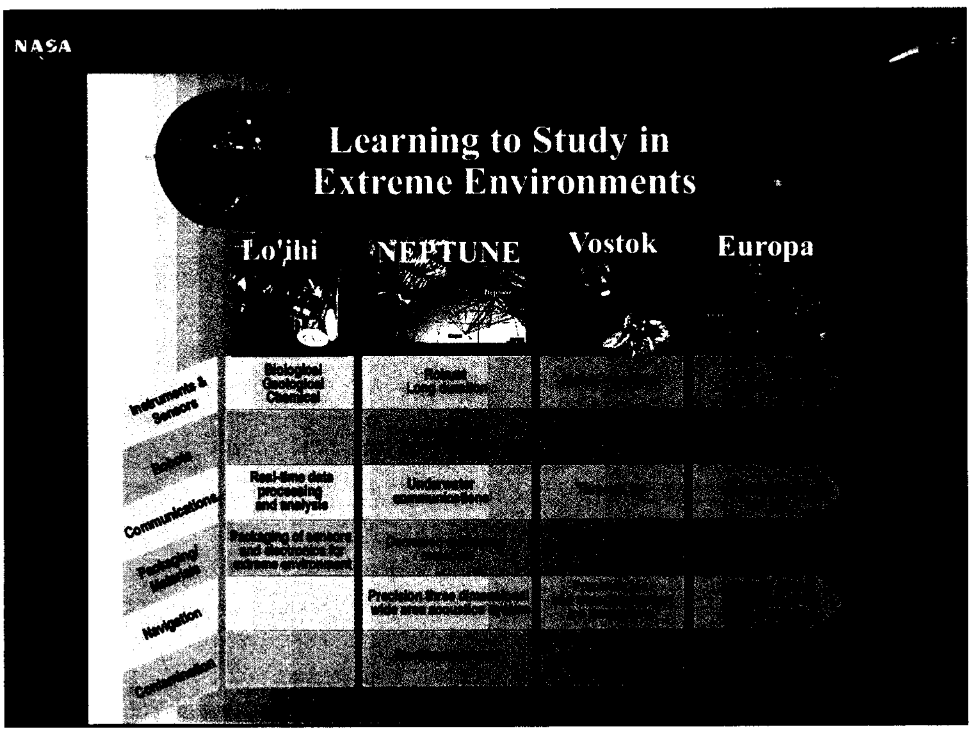

NASA
JPL
Faster, Better, Cheaper Spacecraft Evolution
1000 kg
100 kg
10 kg
Cassini
Mars Pathfinder
NEAR
Mars 98 Lander/Orbiter
Solar Probe
Pluto/Kuiper Express
Europa Orbiter
Stardust
"Microspacecraft"
SOAC
Sojourner
Mars Microprobe
Past
Present
Future

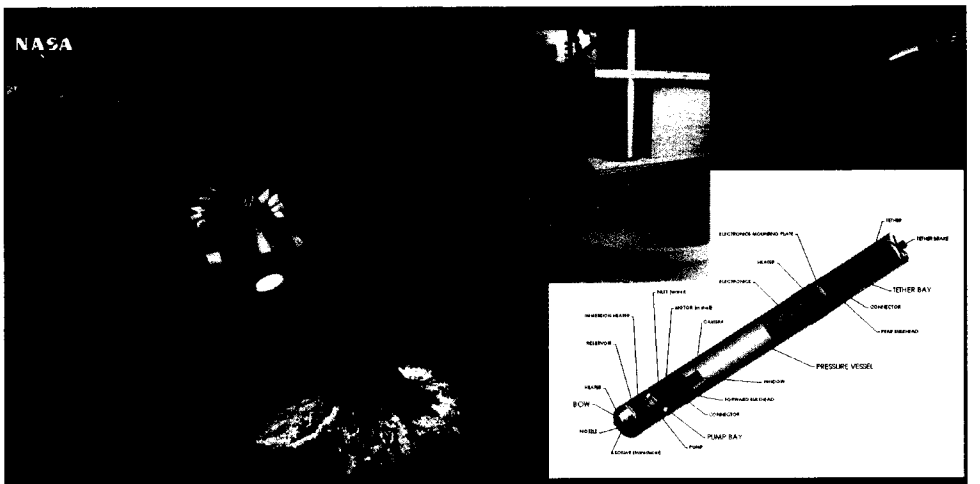
Toward a Thinking Evolvable Spacecraft

(slide taken from another presentation; do not have electronic version)



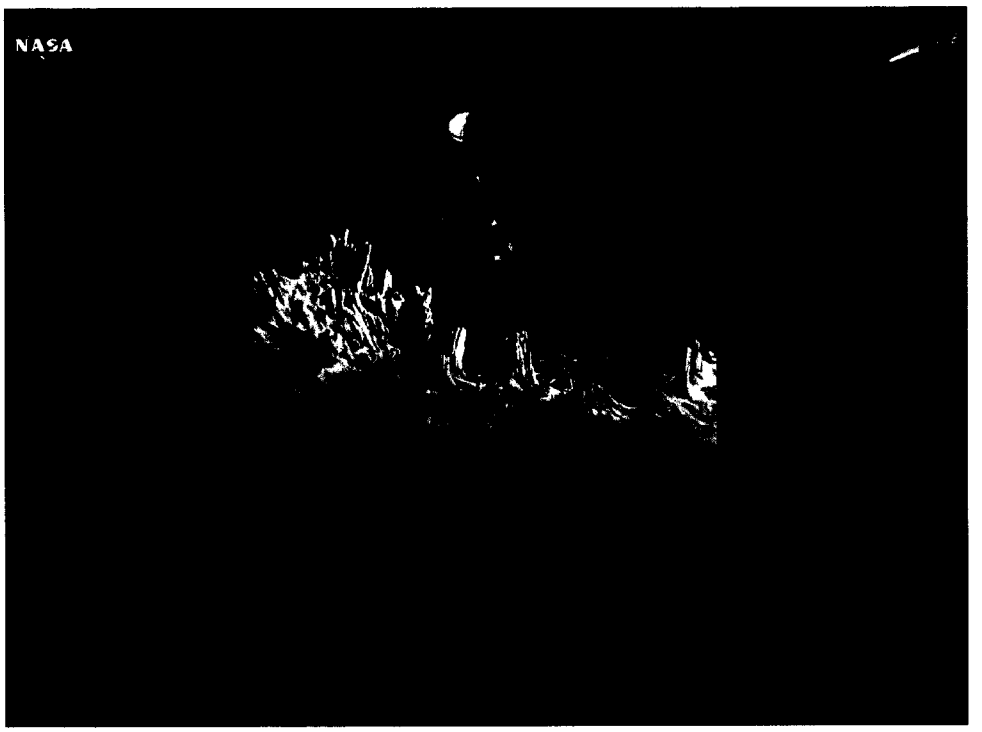

NASA
Planetary Extremes
Relevant Radiation (log scale)
Juptier
Europa
Io
Saturn
Nuclear Reactor
Titan
Volcanoes
Deep Ocean Hydrothermal Vents
Venus
Mars
Earth
Comets
Mercury
Moon
-300
-250
-200
-150
-100
50
200
250
300
350
400
450
500
Temperature, C

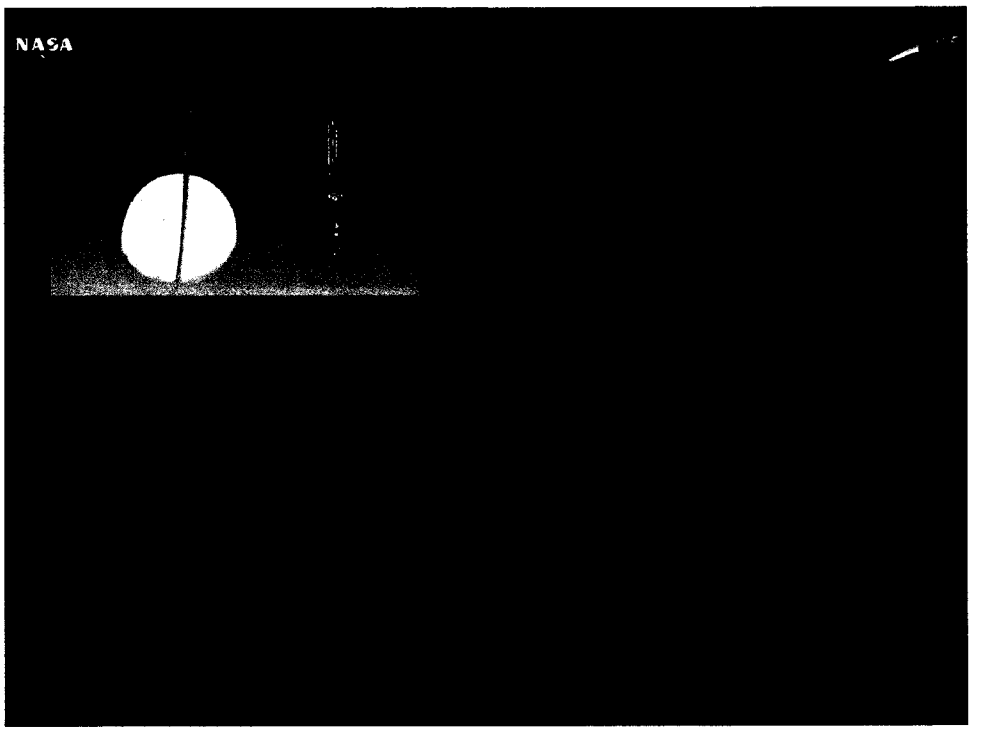

NASA
Learning to Study in Extreme Environments
Lo'ihi
NEPTUNE
Vostok
Europa
Instruments & Sensors
Communications
Navigation
Biological
Geological
Chemical
Real-time data processing and analysis
Underwater communications
Packaging of sensors and electronics for extreme environment



Hydrobot/Cryobot Under the Ice of Europa

A proposed submersible hydrobot and an ice-penetrating cryobot could be used to explore the ice-covered ocean on Jupiter's large satellite, Europa. The cryobot would melt its way through the ice cover and then deploy a hydrobot, a self-propelled underwater vehicle that would analyze the chemical composition of the ice and water in a search for signs of life. Scientists propose first testing these instrument-ladened robots by sending them to Lake Vostok, a subglacial lake in Antarctica.

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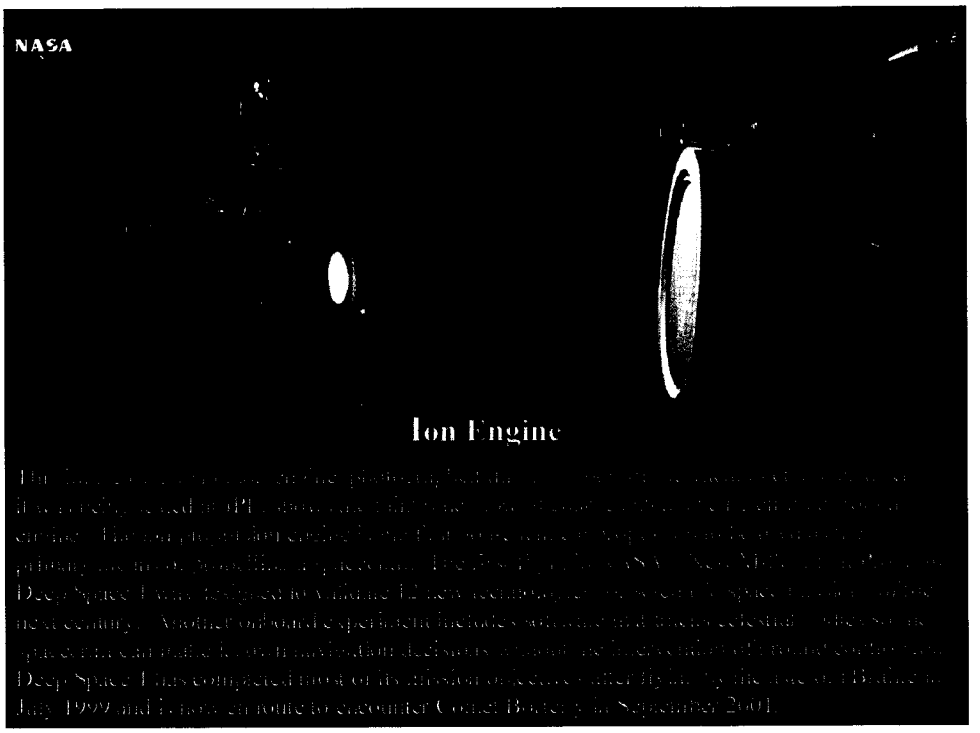
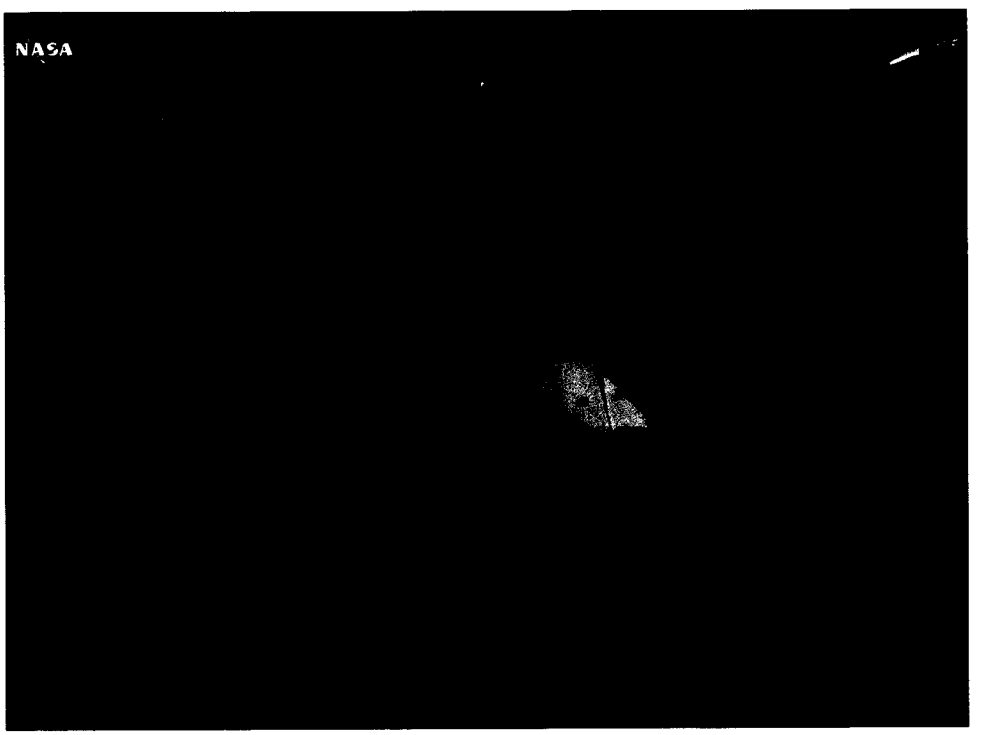
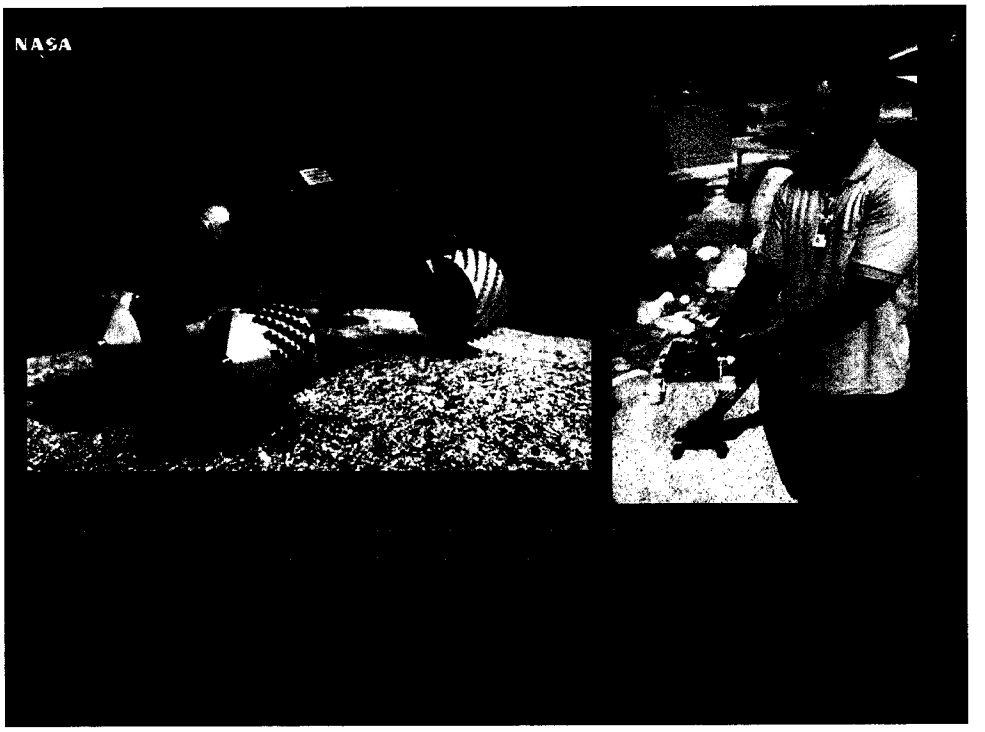
Technologies in Development



Ion Engine

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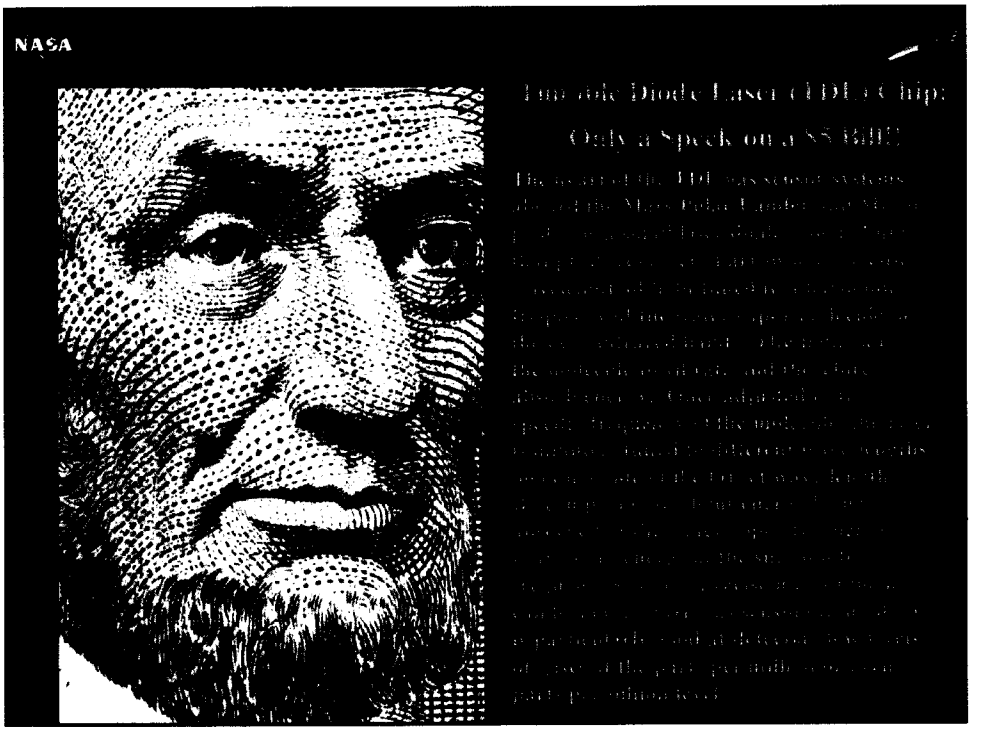
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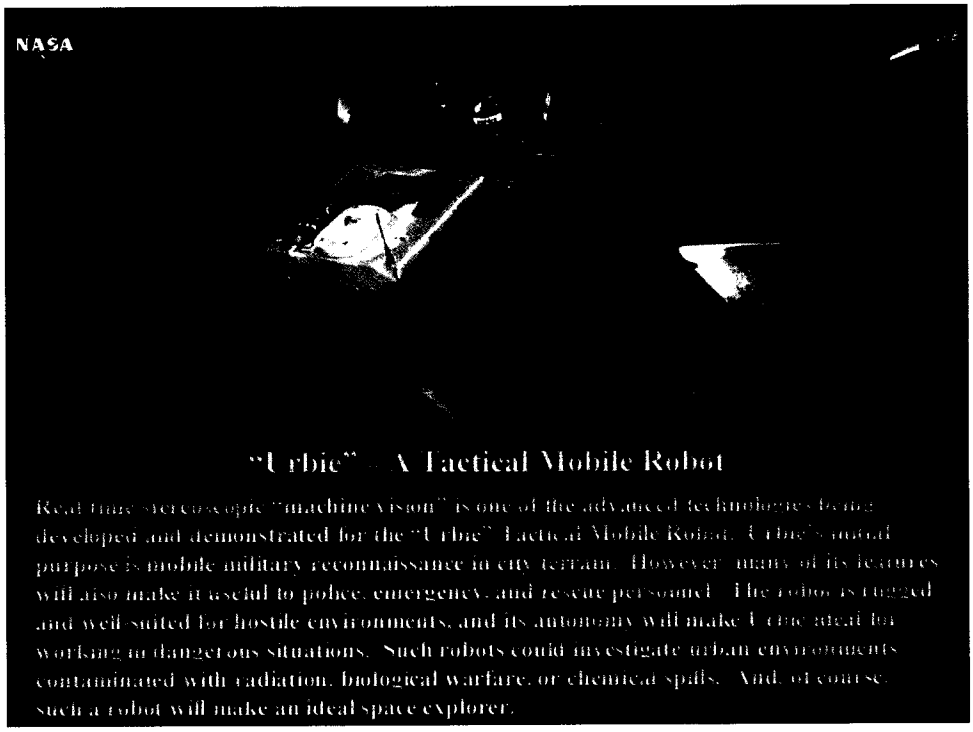
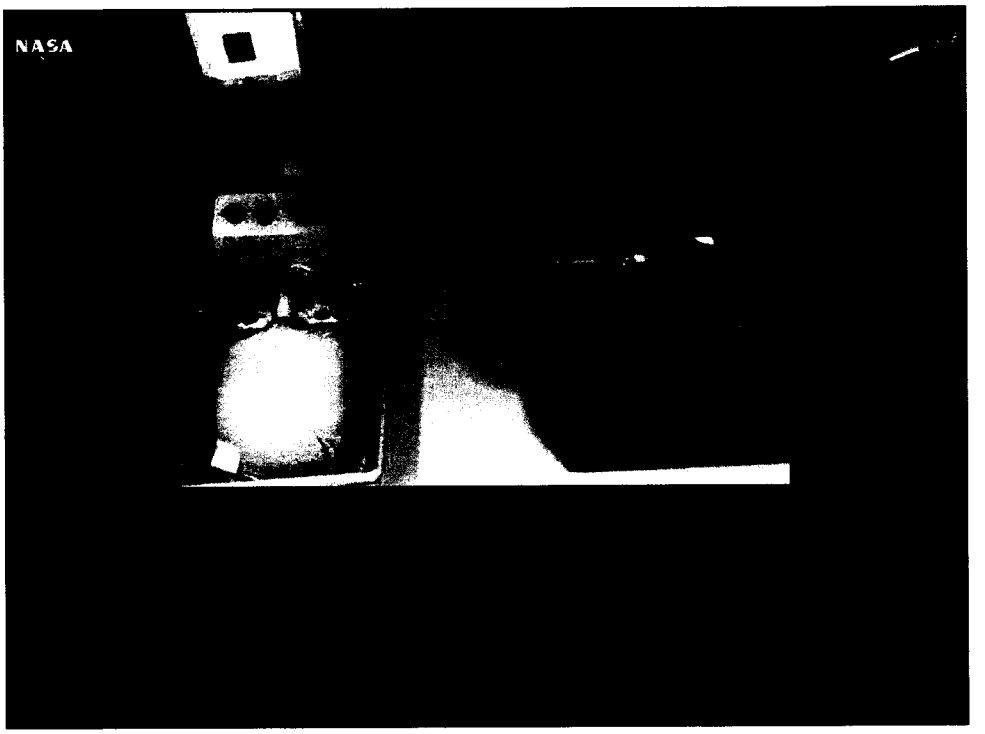


"Urbie" — A Tactical Mobile Robot

Real-time stereoscopic "machine vision" is one of the advanced technologies being developed and demonstrated for the "Urbie" Tactical Mobile Robot. Urbie's initial purpose is mobile military reconnaissance in city terrain. However, many of its features will also make it useful to police, emergency, and rescue personnel. The robot is rugged and well-suited for hostile environments, and its autonomy will make Urbie ideal for working in dangerous situations. Such robots could investigate urban environments contaminated with radiation, biological warfare, or chemical spills. And, of course, such a robot will make an ideal space explorer.



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Exploration

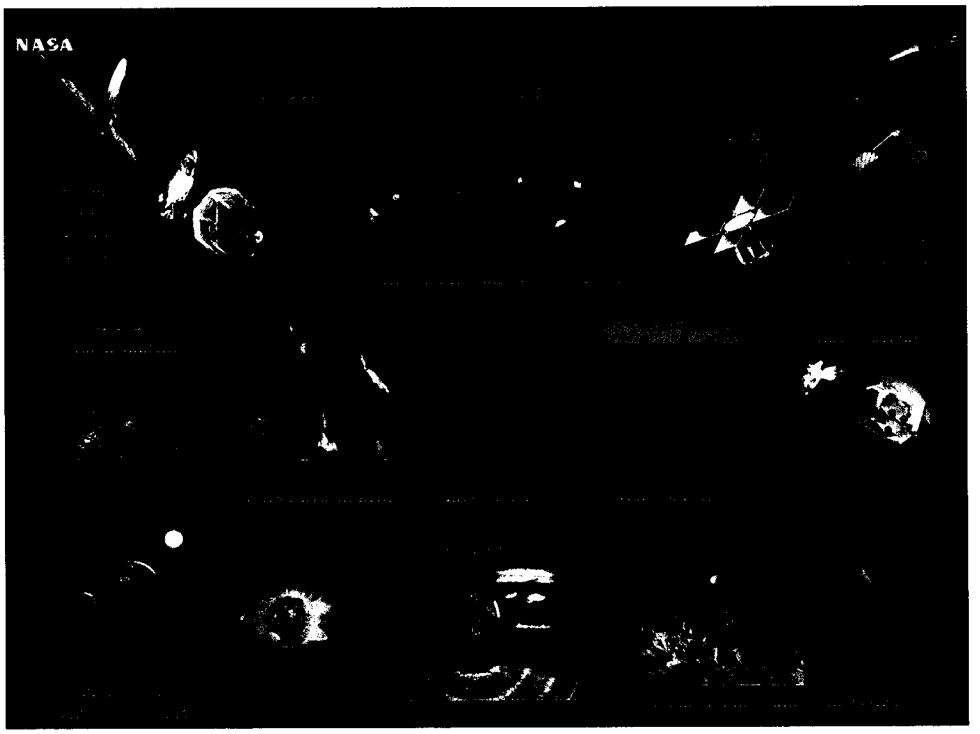
Driving Force

Commitment

Dollars

Technology

Trained People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