Exploring Space and Investing in the Future: Perceptions and Experiences of a Retired NASA Astronaut



Bonnie J. Dunbar, PhD NAE

University of Houston
Professor, Mechanical Engineering
Director, UH STEM Center
Director, Aerospace Grad. Pgm



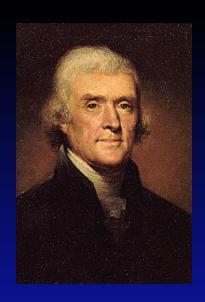


The Milky Way: Inspiring Dreams





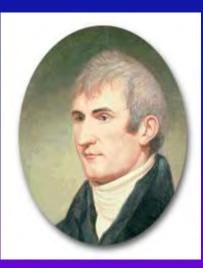
Departed Camp Dubois on May 14, 1804. In 28 months, covered 8000 miles



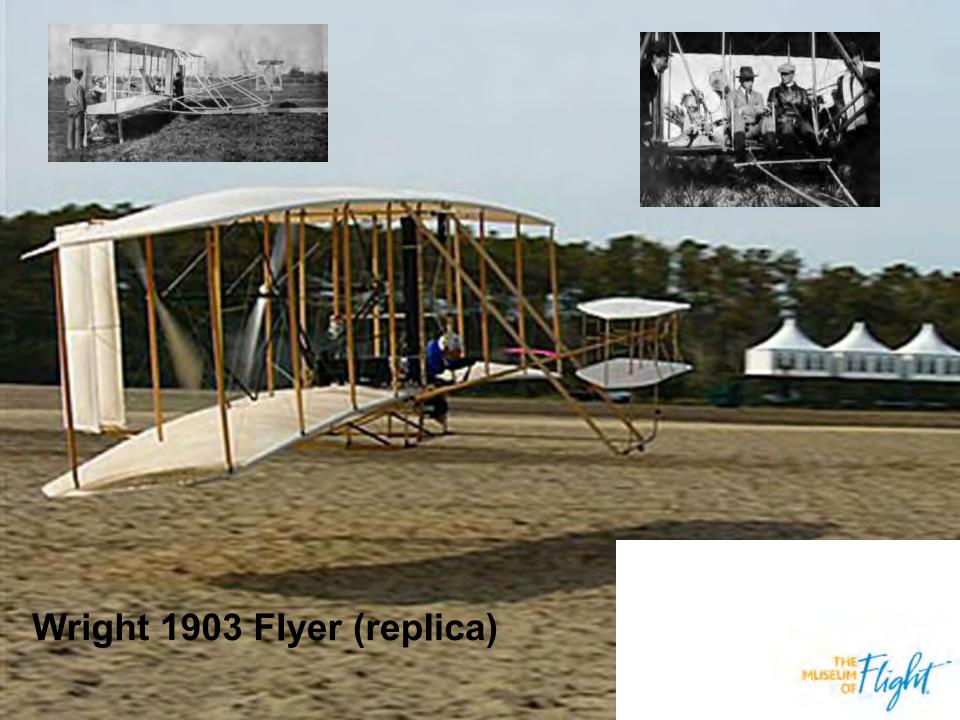
President Thomas Jefferson



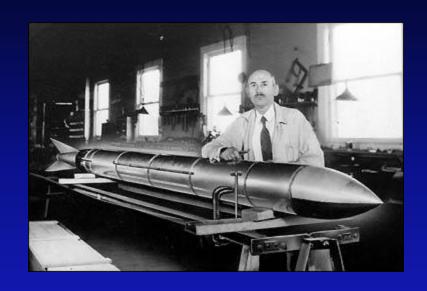
William Clark



Meriwether Lewis



Robert Goddard 1882 - 1945



"It was one of the quiet, colorful afternoons of sheer beauty which we have in October in New England, and as I looked toward the fields at the east, I imagined how wonderful it would be to make some device which had even the *possibility* of ascending to Mars, and how it would look on a small scale, if sent up from the meadow at my feet."

"I was a different boy when I descended the tree from when I ascended, for existence at last seemed very purposive." 1899



Soviet Union--Yuri Gagarin: First Human to Orbit the Earth: April 12, 1961

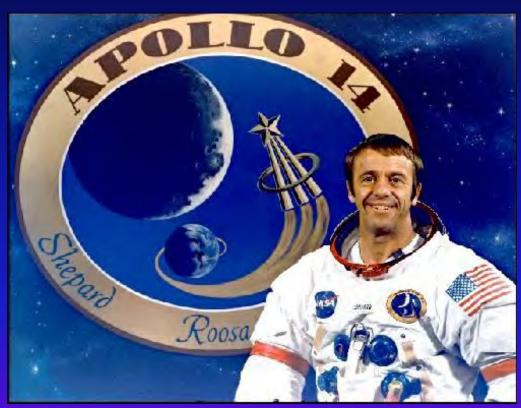






United States: May 5, 1961 Alan Shepherd launched Sub-orbital





Mercury 7

United States: John Glenn launched into orbit Feb 20, 1962





Flies again on Space Shuttle at age 77

President Kennedy Commits the Nation

Rice University, Houston, TX - 9/12/62

- "...This generation does not intend to founder in the backwash of the coming age of space. We mean to be a part of it – we mean to lead it."



President Kennedy Commits the Nation

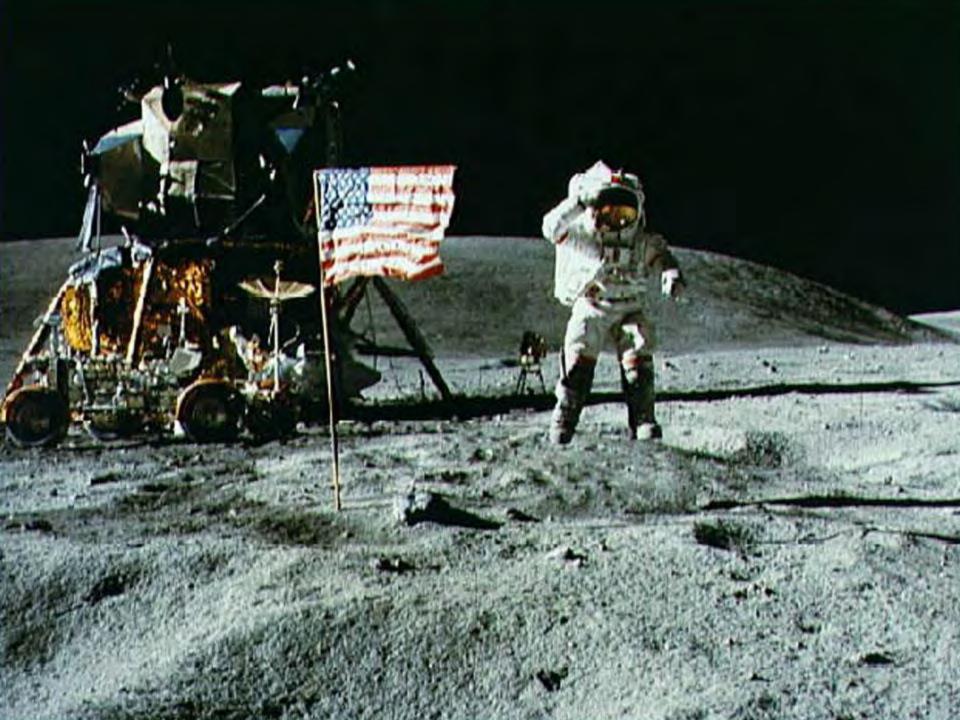
Rice University, Houston, TX - 9/12/62

 ...This country was conquered by those who moved forward -and so will space...We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard...The growth of our science and education will be enriched by new knowledge of our universe and environment....





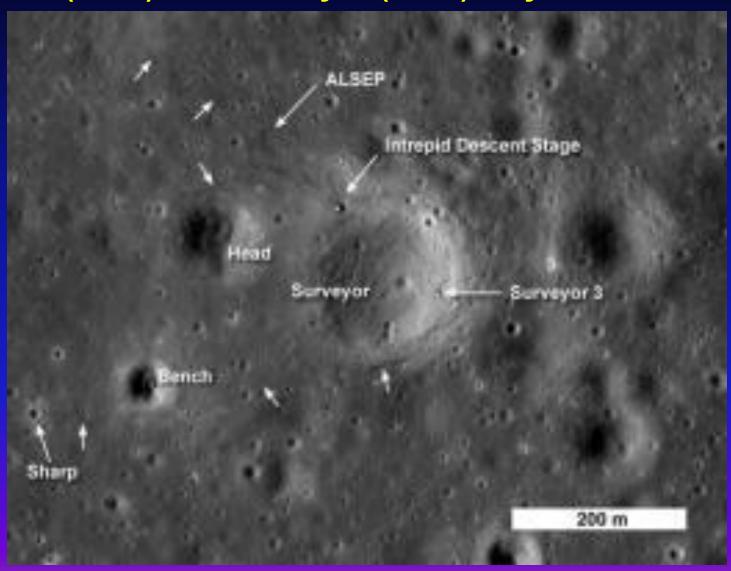
July 20, 1969: Neil Armstrong walked on the Moon

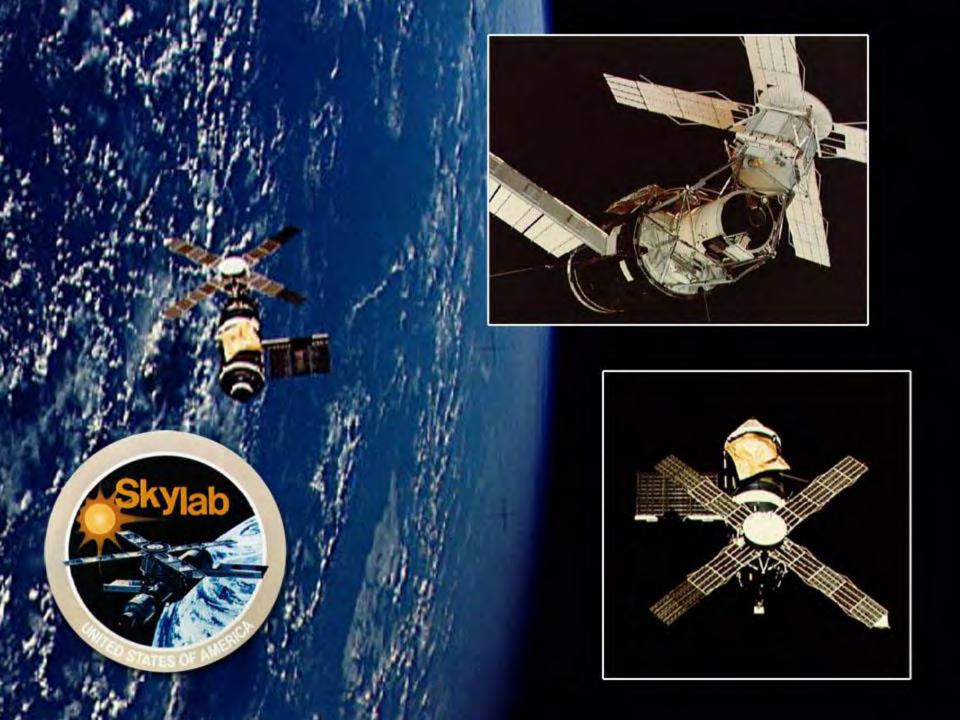






Lunar Reconnaisance Orbiter (LRO) Viewed Apollo 12 (1969) and Surveyor (1967) 40 years after







NASA

8-82-01840A

Nominal Orbit 165/165 n. ml. Inclination 28.5 Duration 169, 2 hours Mission Elapse Time (hr:min:sec) No. Revolutions 113

Space Shuttle Nominal Mission Profile for STS-4

LA/FM2/L DAVIS AS OF 8-23-82



On-Orbit Operations 7 Day Duration

2 oms maneuvers to 165 x 165 n. mi. orbit)

OMS-2 (0:37:39) 130/130 n. ml.

OMS-1 (0:10:32) 34/130 n. ml. (perigee/apogee)

SEP (00:08:50) 58 n. ml., 811 n. ml. DR

MECO (0:08:34) 351,227 ft, 726 n. ml. DR

SRB SEP (0:02:05) 157,209 ft., 27 n. mi. DR

Max. Dyn Pressure (0:01:03) 39,140 ft.

SRB Landing (0:07:01)

Deorbit 168:15:00 0/165 n. mi.

(over Indian Ocean)

> Entry Interface

168:42:00 400,000 ft., 65.8 n. mi.

From Edwards 3822 n. mi.

ET Impact Indian Ocean

10,400 n. mi. Landing speed 201 knots downrange

Landing

Lift-off

KSC 138 n. mi. downrange (DR) 62 n. mi.

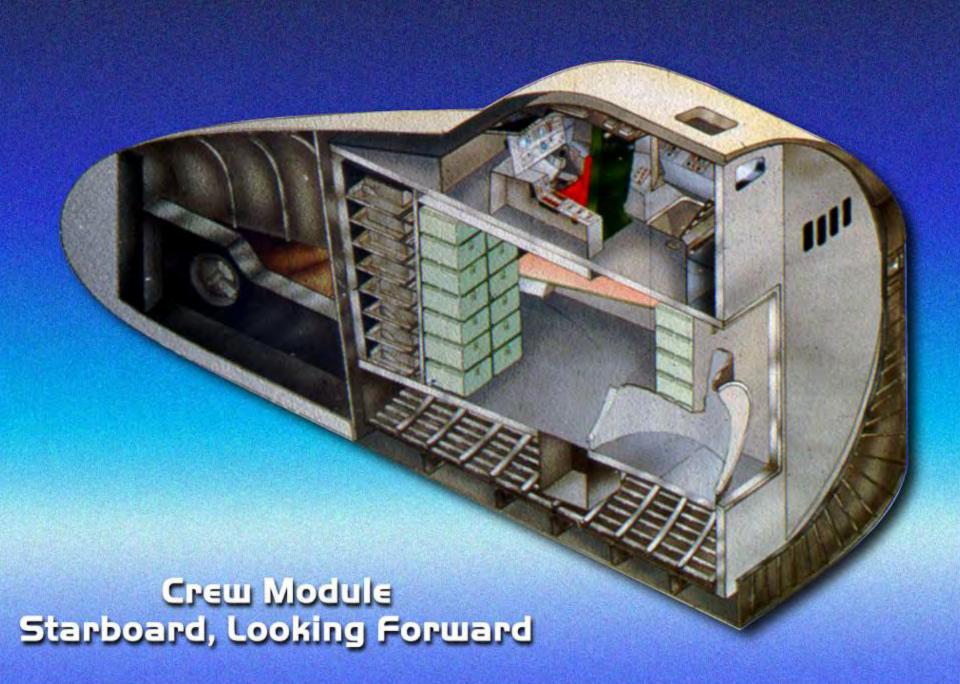
2100 n. mi

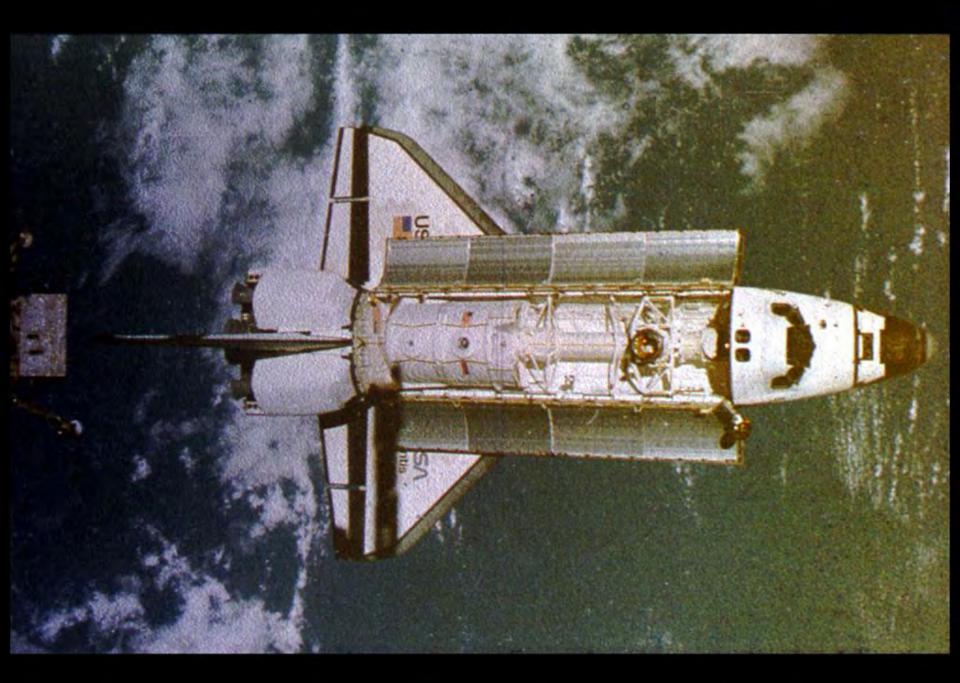
Edwards 169:12:00











Reentry (Artist Concept c.1968)



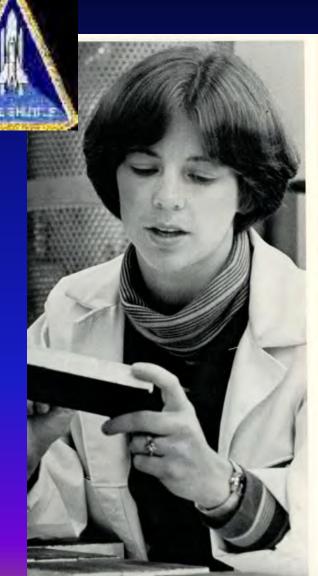
Dr. James I. Mueller (Doc)

University of Washington Mining, Metallurgical and Ceramic Engineering





Rockwell International Space Division 1976-78



Bonnie Dunbar Has Her Sights On the Stars

'Tm helping to build the Space Shuttle. Now I want to fly in it," says Bonnie Dunbar, a research ceramic engineer working on the Orbiter's thermal protection system at Downey.

"Everyone feels that there is something they want to do, and even though I love my job, space travel fascinates me. I want to be an astronaut," she declares decisively. Suiting her dreams to action, Bonnie has

Suiting her dreams to action, Bonnie has been taking flying lessons. She soloed last February. She has been selected as one of about 200 astronaut applicants for the individual interviews and physical exams—out of 8000 who applied.

Tknow what the odds are "she says," but I'm young and I feel I'm prepared." In January NASA will select as many as 20 candidates as mission specialists who in mid-1978 will begin two years of training and evaluation.

Raised on a farm in Yakima Valley, state of Washington, Bonnie earned her master's degree in 1975 in Ceramic Engineering, which she puts to work on developing the tiles which will protect the Orbiter during re-entry into Earth atmosphere.

"The field of ceramics is exciting because there are so many new applications," she explains.

One of those applications will be out of this world, and that's where an astronauthopeful named Bonnie would like to go.

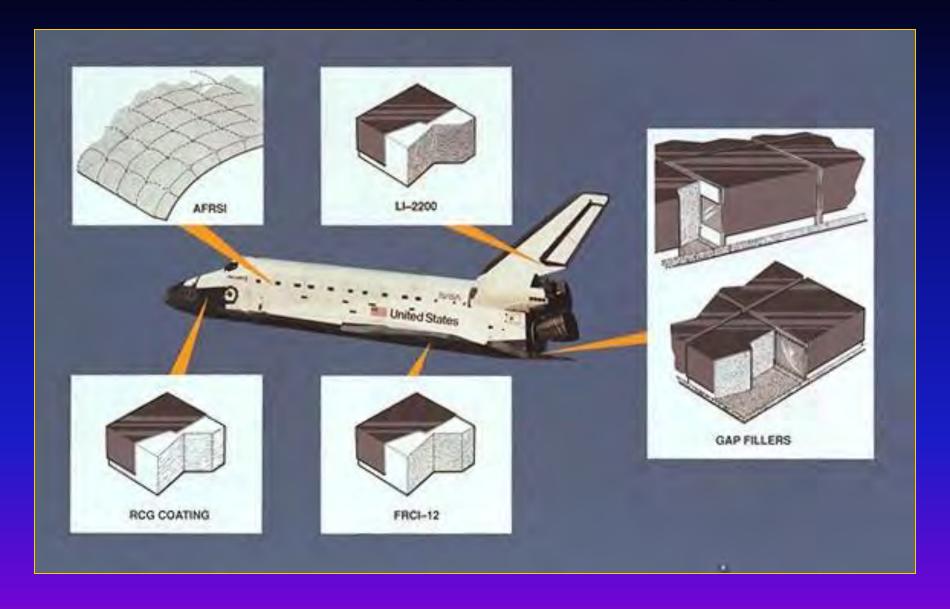




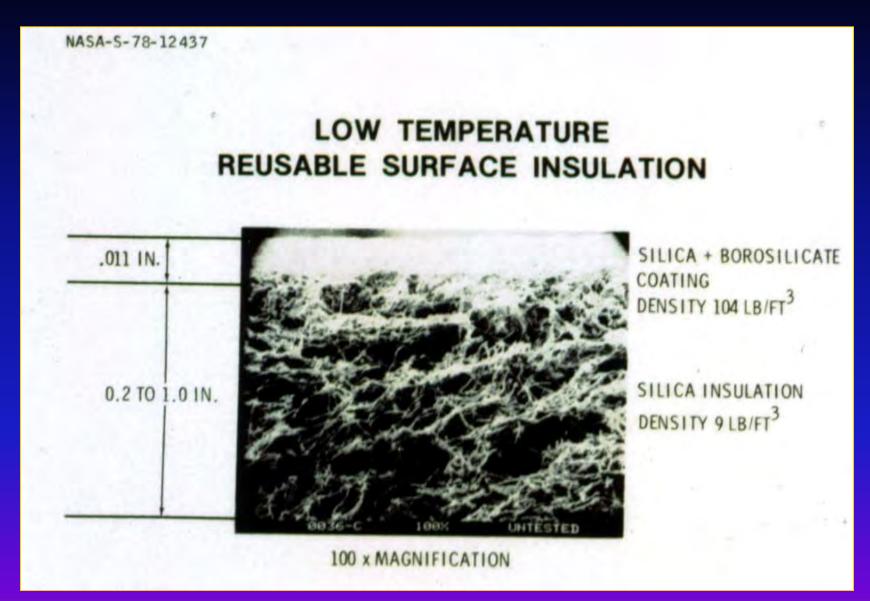




Thermal Protection Materials

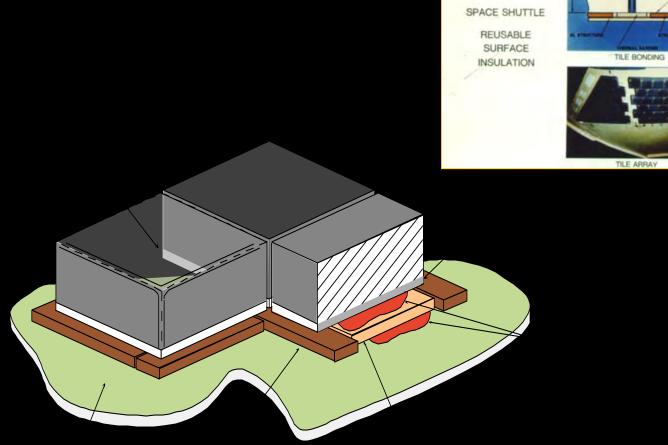


Shuttle Thermal Protection Tiles

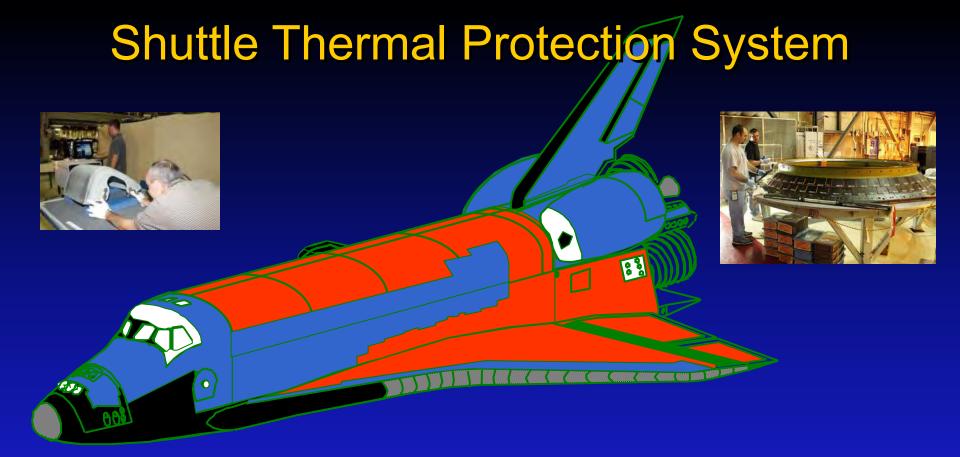


Note: all fibers waterproofed: e.g. hydrophobic silane

High Temperature Reusable Surface Insulation (HRSI) Tile System



NASA-5-77-10027 A



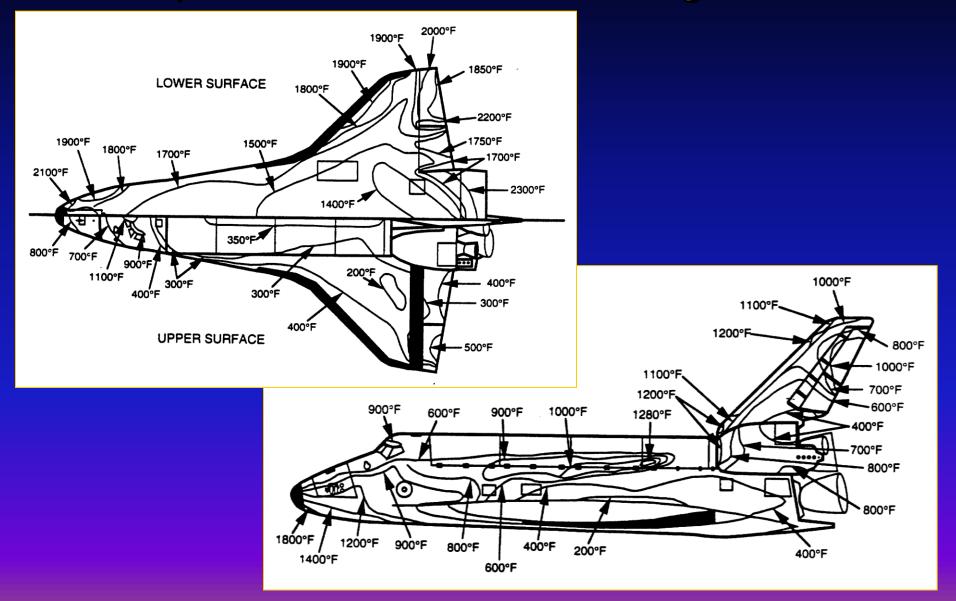
RCC - Re-Inforced Carbon-Carbon

HRSI - High-temperature Reusable Surface Insulation

LRSI - Low-temperature Reusable Surface Insulation AFRSI (FIB) - Advanced Flexible Reusable Surface Insulation

FRSI - Flexible Reusable Surface Insulation

Maximum Recorded OML Surface Temperatures - STS-1 through STS-5



Dr. James I Mueller ("Doc")

"I will introduce you to NASA Engineers....."





University Of Washington
Chair, Mining, Metallurgical and Ceramic Engineering (Materials Science and Engineering)

Astronaut Class 1980







Five Space Shuttle Flights: 50 Days

Columbia (x2), Challenger, Atlantis, Endeavor



STS-61A, D-1 10-30-1985 7 Days Challenger







STS-32 January 1990 Columbia 11 days



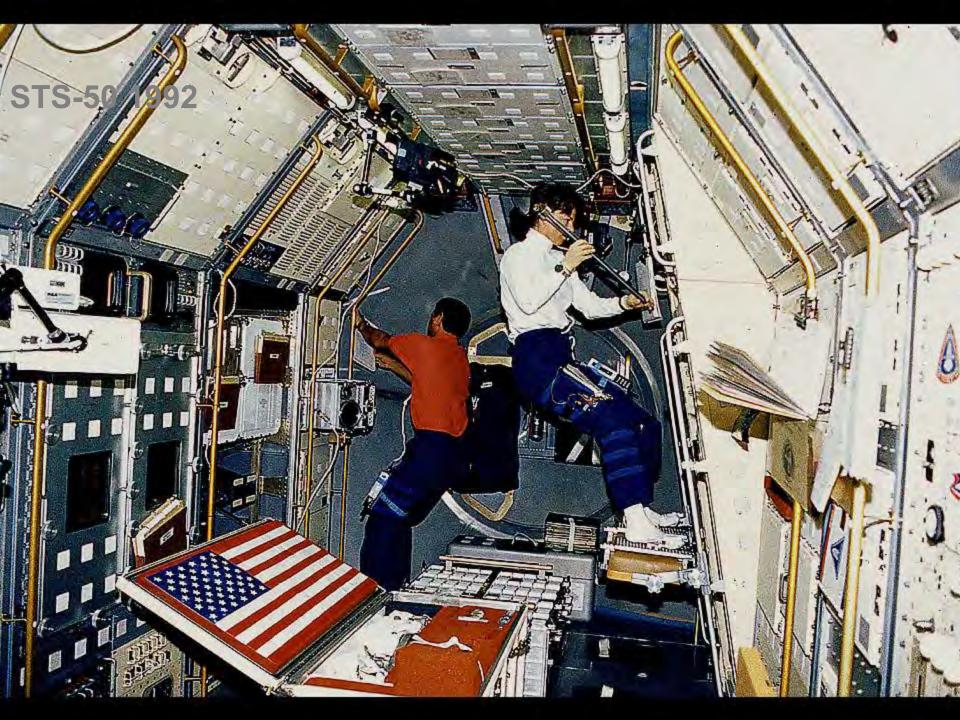


STS-50 USML-1 (United States Microgravity Lab) June 1992 13 Days









Back-up To First Shuttle-MIR Crew, 1995

Anatoly Solovyev Bonnie J. Dunbar Nicolai Budarin



Training in Russia





Valentina Tereshkova (USSR) Roberta Bondar (Canada) Mary Cleave (USA) Svetlana Saviskaya (USSR) Bonnie J. Dunbar (USA) Helen Sharman (UK)

Meeting international pioneers in Russia

Winter Survival in Siberia





STS-71 First Shuttle-MIR Docking Mission June 1995











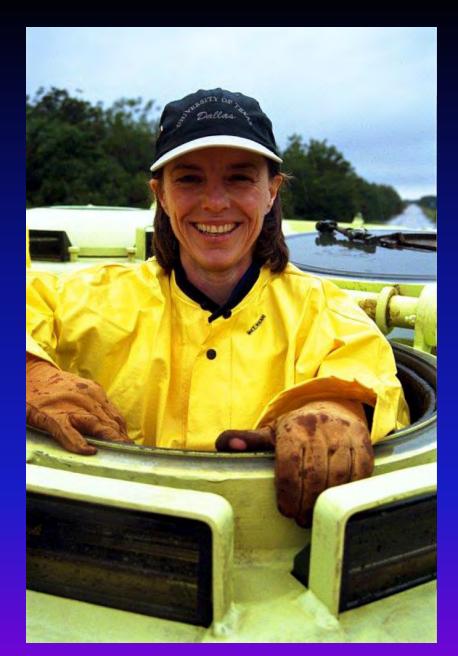
Medical Experiments in the Spacelab

Singing in the MIR























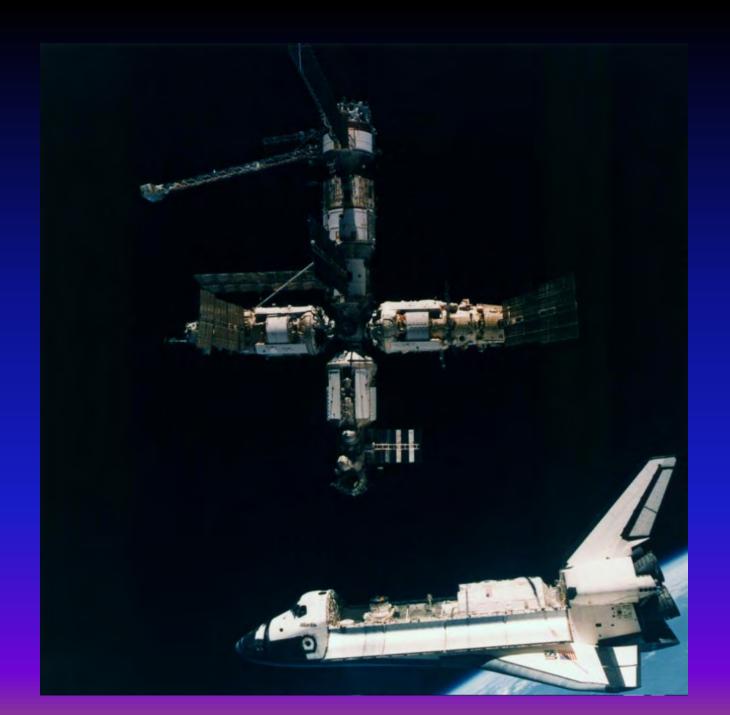






















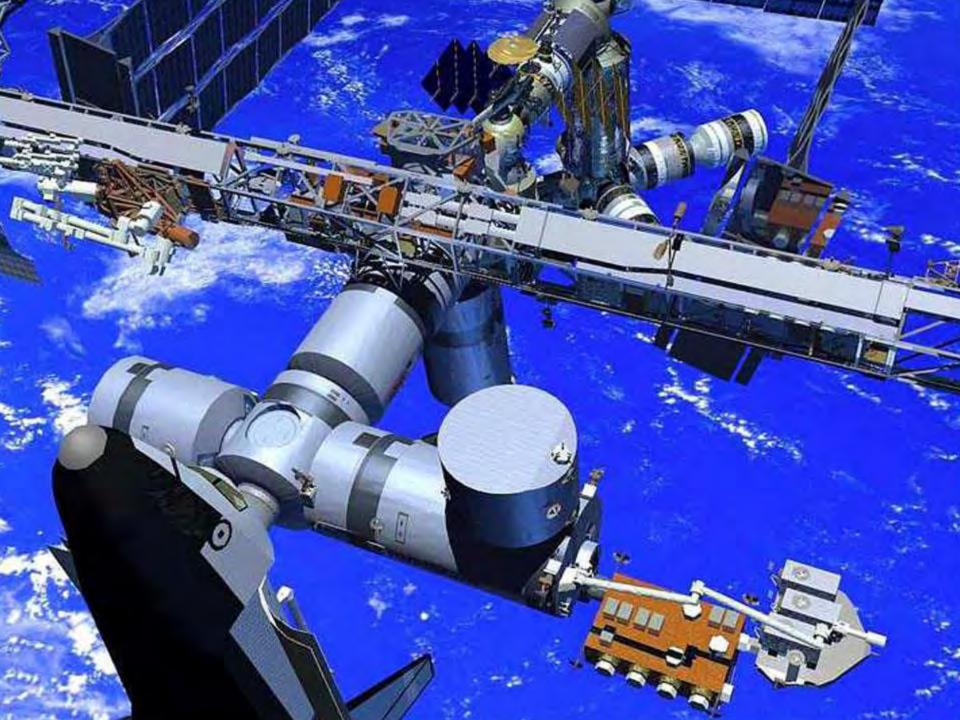
























"Wheresoever you go...
go with all your heart."

Confucius











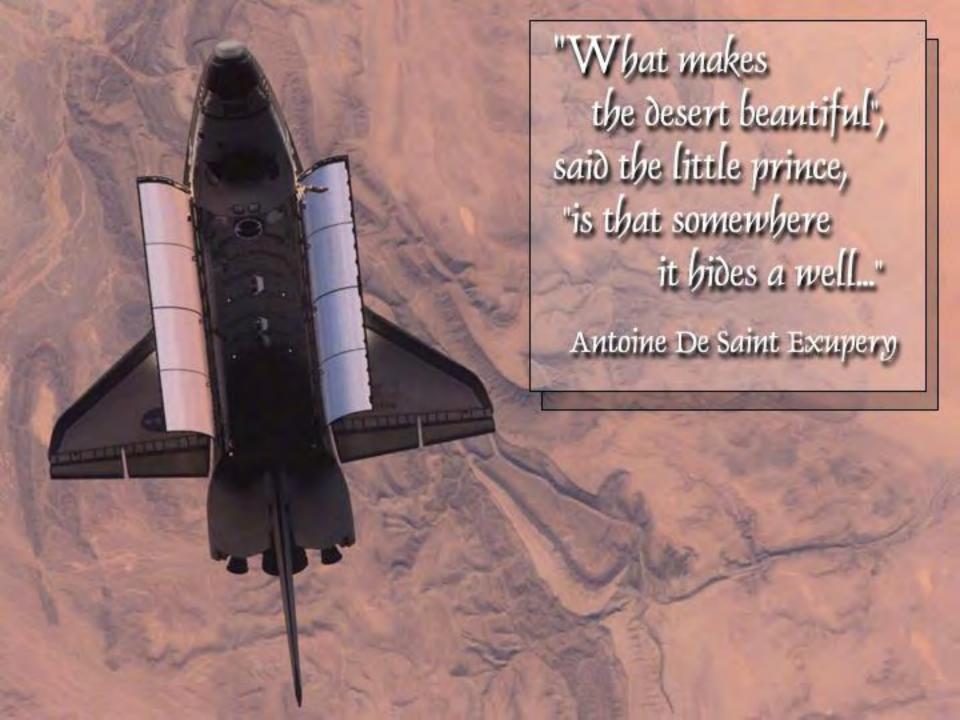








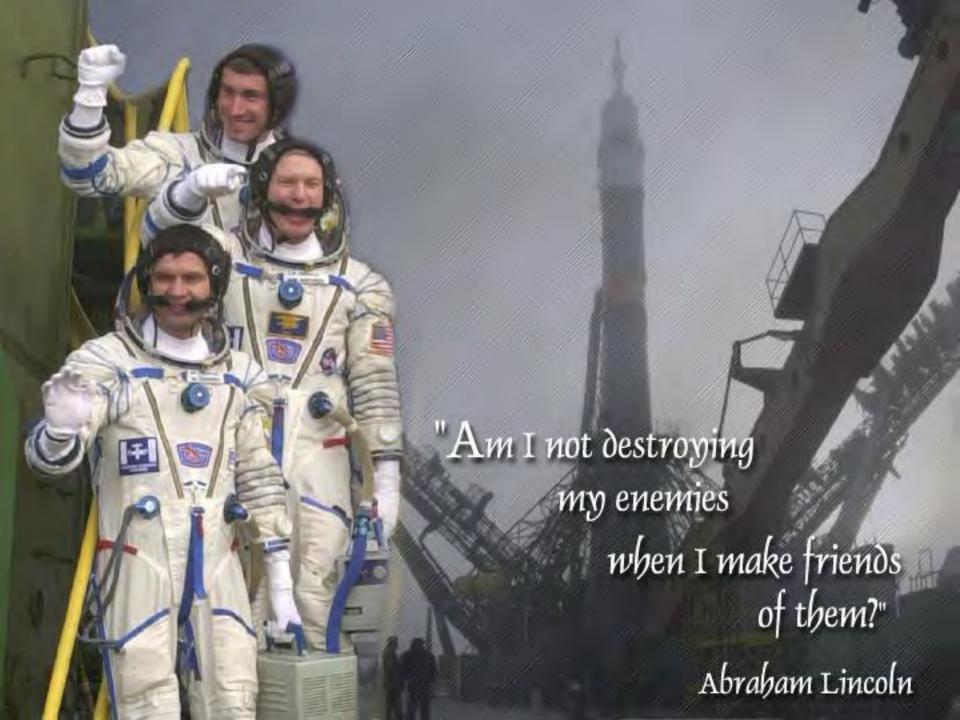


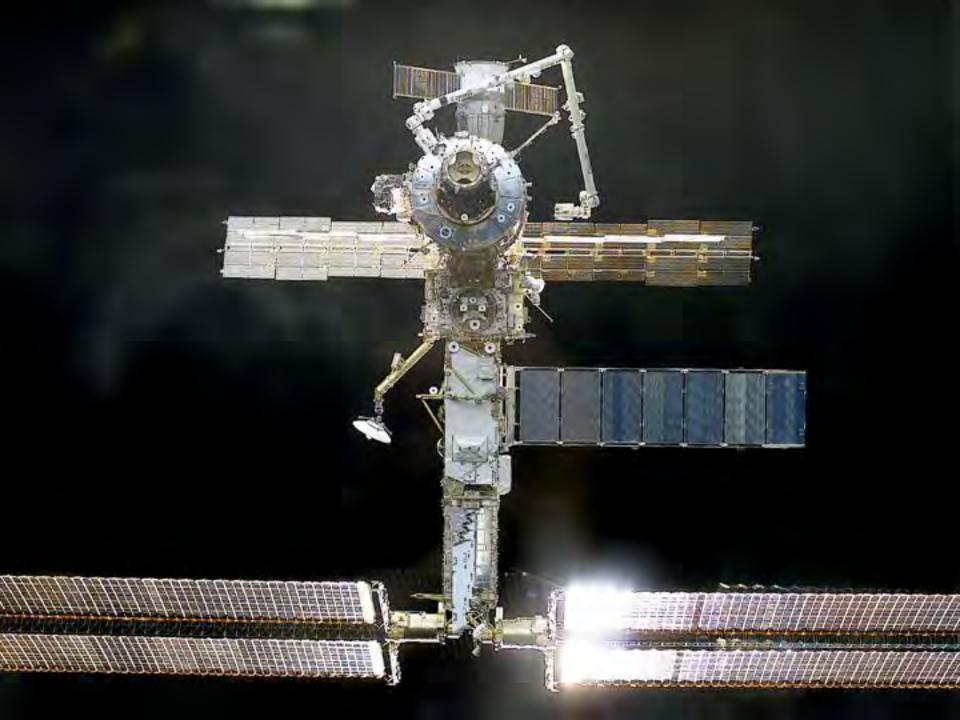


















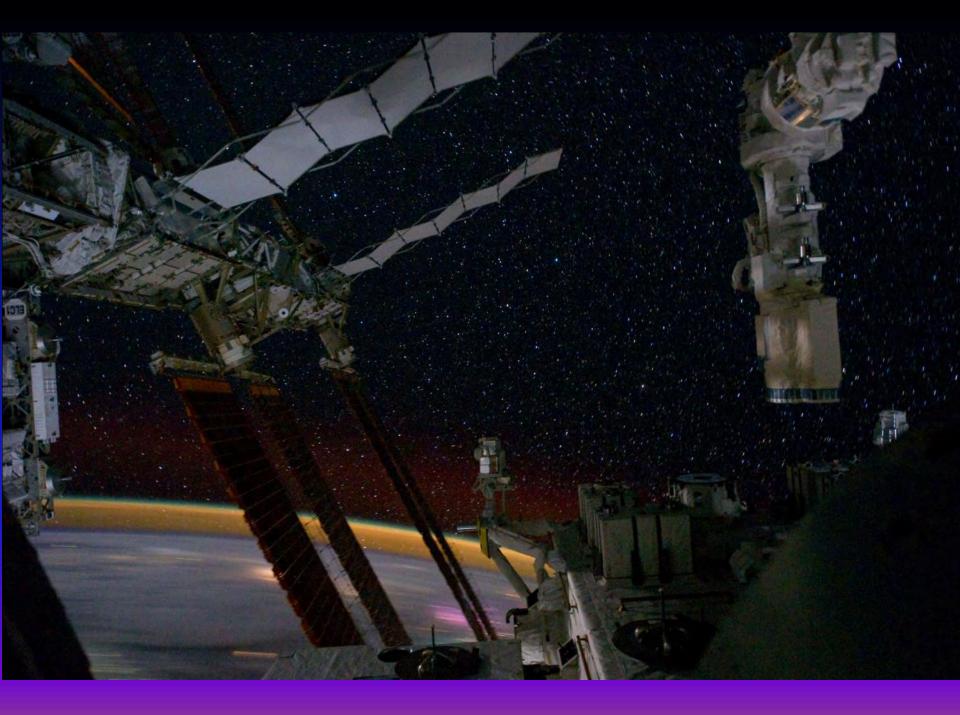














THE INTERATIONAL SPACE STATION:

OVER TEN YEARS OF CONTINUOUS HUMAN OCCUPATON

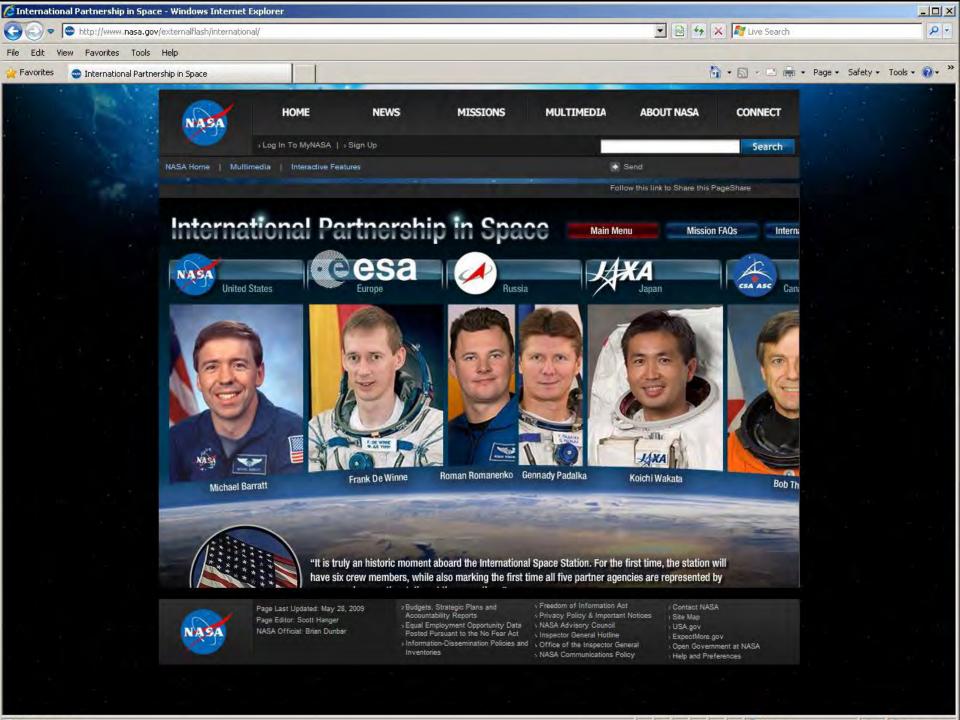














Discovery Rolls to Pad for Last flight: February, 2011



Spaceflight and "micro" gravity — How Do Things Work or Don't Work?

In microgravity, there is no.....

Convection





A candle burns on Earth (top) & in microgravity (bottom).

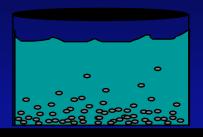
Buoyancy

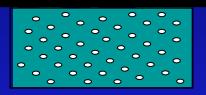




Fluid flows through a pipe in Earth's gravity (top) and in microgravity (bottom).

Sedimentation





On Earth, particulates settle out of a liquid (top), but in space, particulates are suspended evenly (bottom).



Combustion in Micro-g



Bioastronautics Elements

All elements of Bioastronautics rely upon development and integration of enabling technologies. (http://www.nsbri.org)





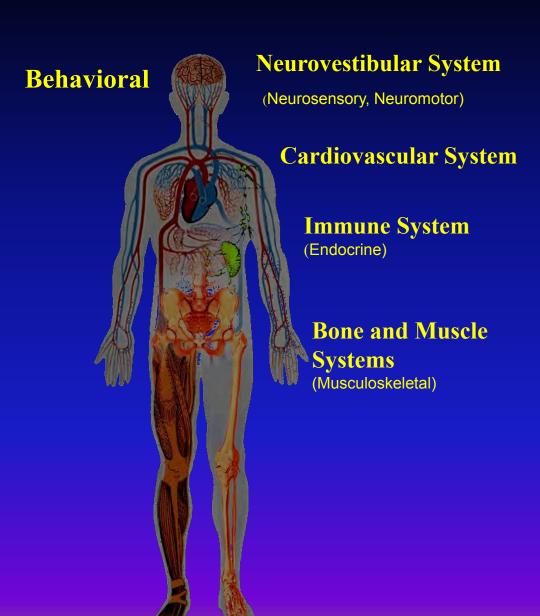
Summary of Known Space Flight Medical Risks Tothe Human System and Subsystems

Astronauts experience a spectrum of adaptations during space flight and even post flight



Behavioral Changes
Balance disorders
Cardiovascular deconditioning
Decreased immune function
Muscle atrophy
Bone loss

Additional influences include the unique Radiation environment and Nutritional/Food Limitations







Research Areas O

Earth Benefits O

Education and Outreach O

Research Announcements O

News/Public Outreach O

Industry Forum O

About NSBRI O

Search/Site Map O

myPORTAL O

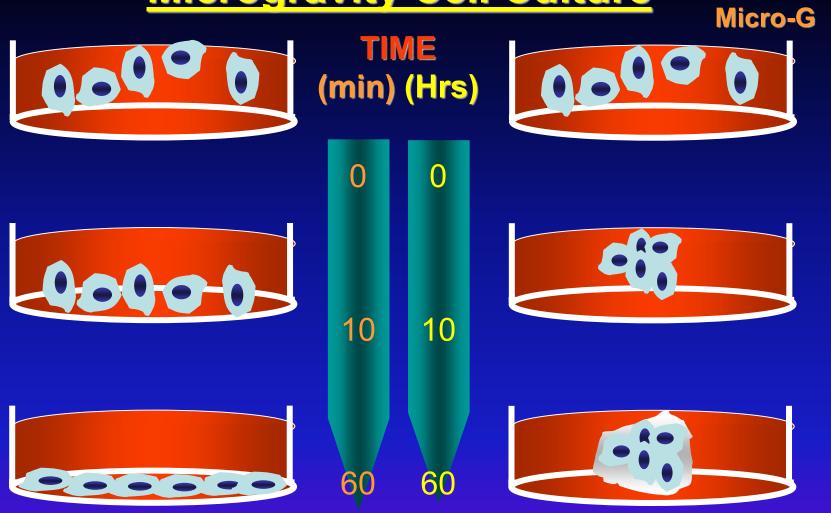
Intranet O

NSBRI research seeks solutions to health concerns facing astronauts on long missions. Patients on Earth suffering from similar conditions will benefit from these advances.



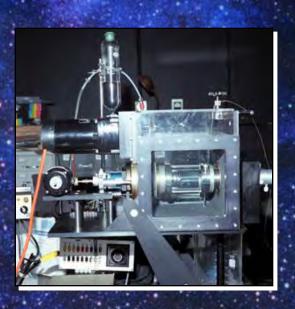
National Space Biomedical Research Institute
One Baylor Plaza, NA-425, Houston, TX 77030
713-798-7412 (phone), 713-798-7413 (fax)
For more information contact info@www.nsbri.org

Microgravity Cell Culture



Cellular Biotechnology





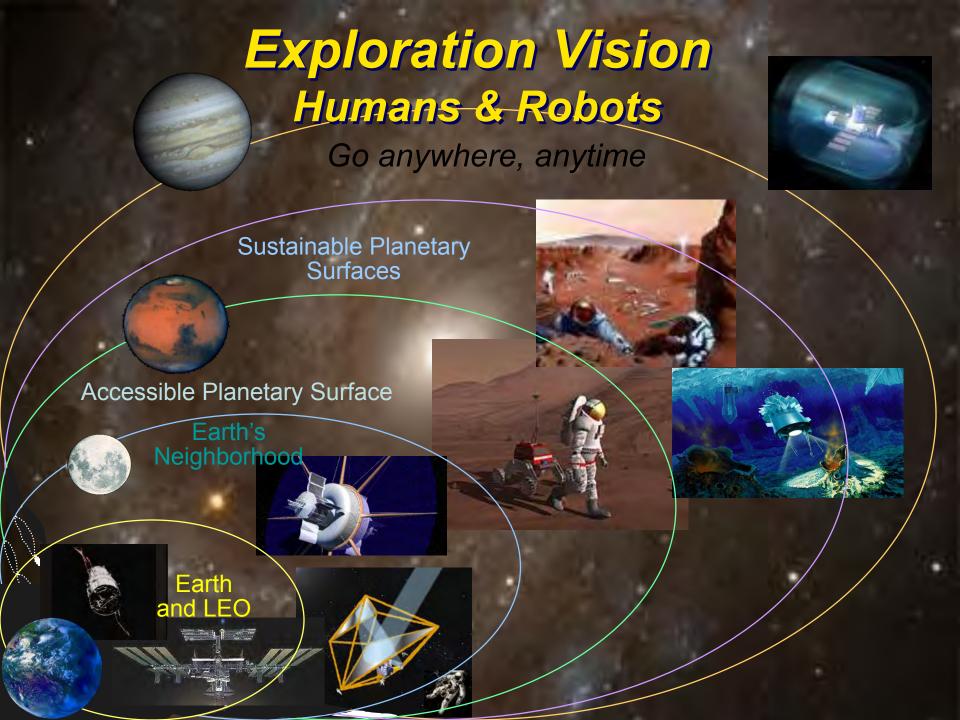






What's Next?







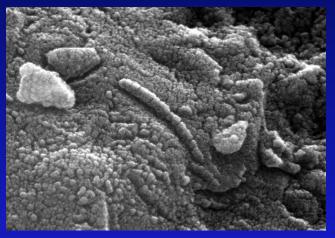
Center of Excellence:

Astromaterials collection, curation, and analysis















Lunar Base

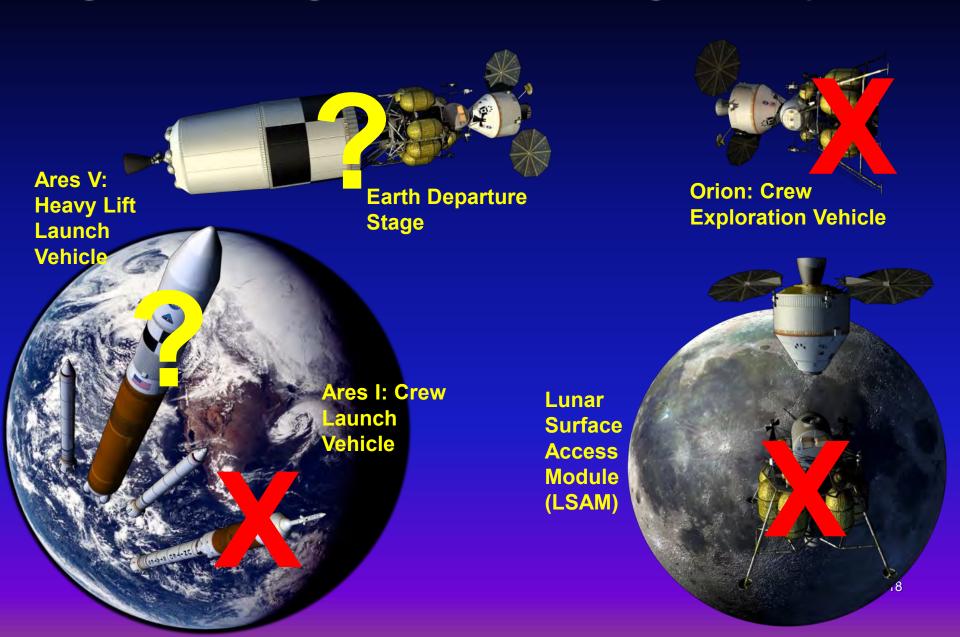




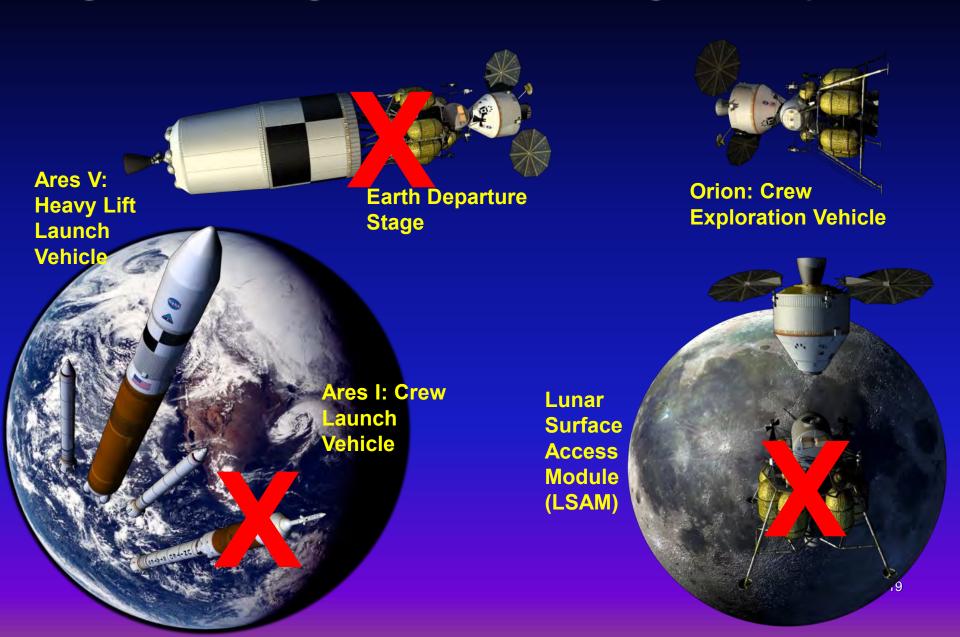
Martian Base



Original 2010 Budget: Constellation Program Components

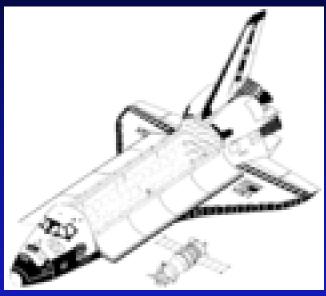


Original 2010 Budget: Constellation Program Components



Russian Soyuz: Only method of reaching ISS after 9/2010



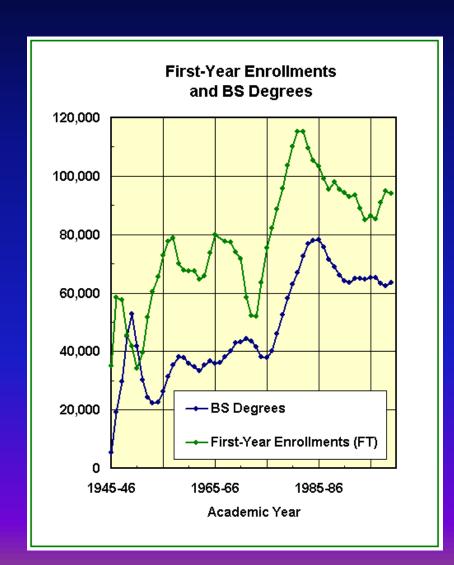


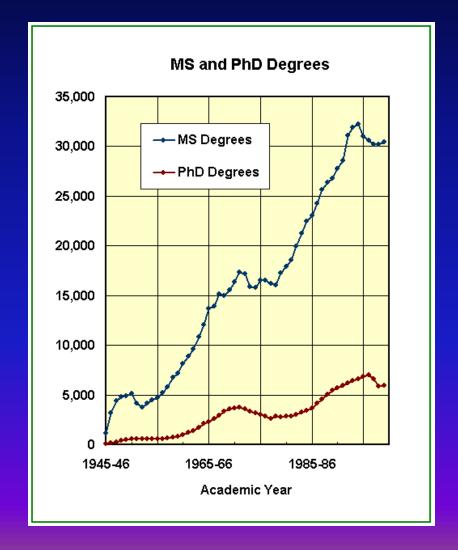
- Crew Transport Vehicle (3 crewmembers)
- Launches from Kazakstan



National Engineering Education Challenge

Engineering Degrees 1945-2001





The U.S. Engineering and Physical Sciences Workforce "Crises" (Not new News)

- 1945 2012: National Science Foundation "Indicators":
- 1989 Space Policy Institute Report on Origins of Scientists and Engineers
- 2001 Hart Rudman: Commission on National Security/21st Century
- 2002 Walker Aerospace Commission Report:

2005: National Academy of Engineering

Norman R. Augustine

Craig Barrett

Gail Cassell

Stephen P. Chu

Robert M. Gates

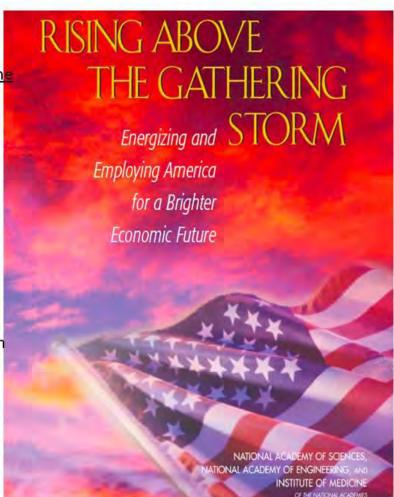
Nancy Grasmick

Charles Holliday, Jr

Shirley Ann Jackson

Anita K. Jones

Joshua Lederberg



Richard Levin

C. D. (Dan) Mote

Cherry Murray

Peter O'Donnell, Jr.

Lee R. Raymond

Robert C. Richardson

P. Roy Vagelos

Charles M. Vest

George M. Whitesides

Richard N. Zare

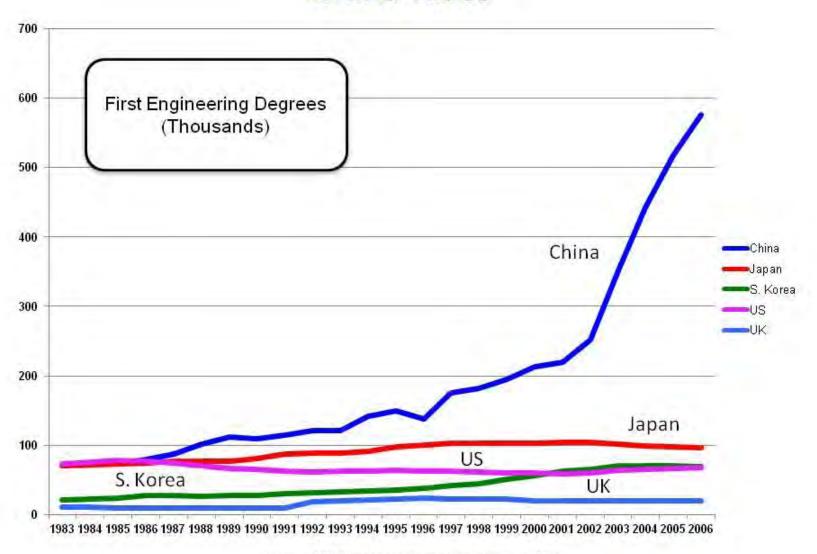
NAE 2010

Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5



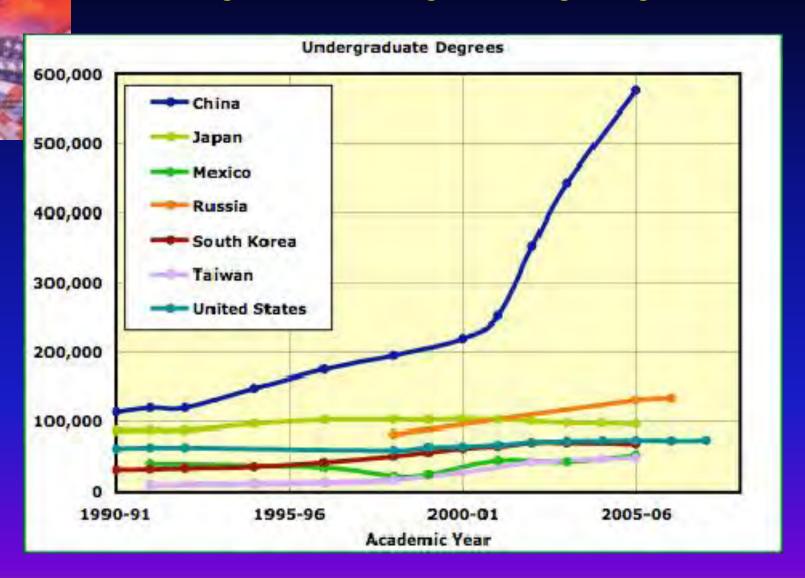


China Rises

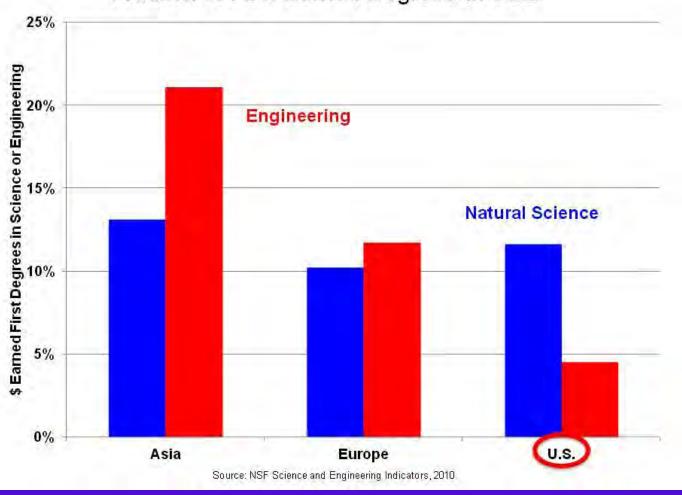




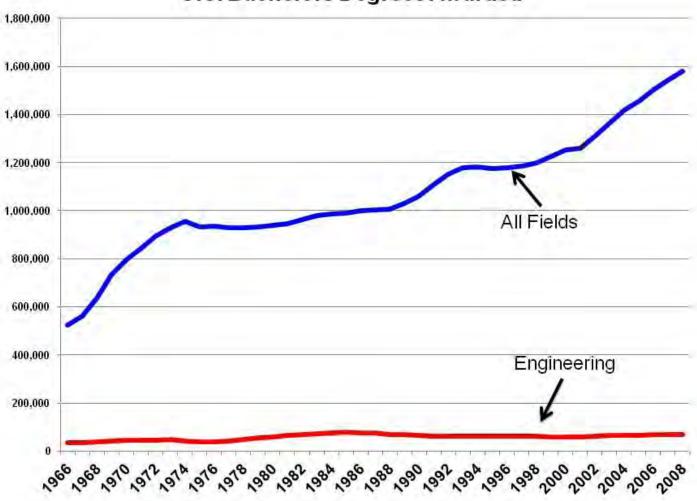
Undergraduate Engineering Degrees



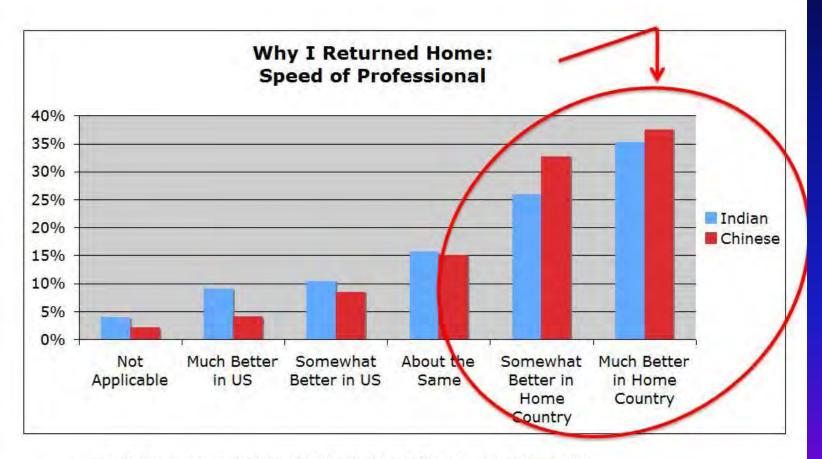
Fraction of First Earned Degrees in S&E



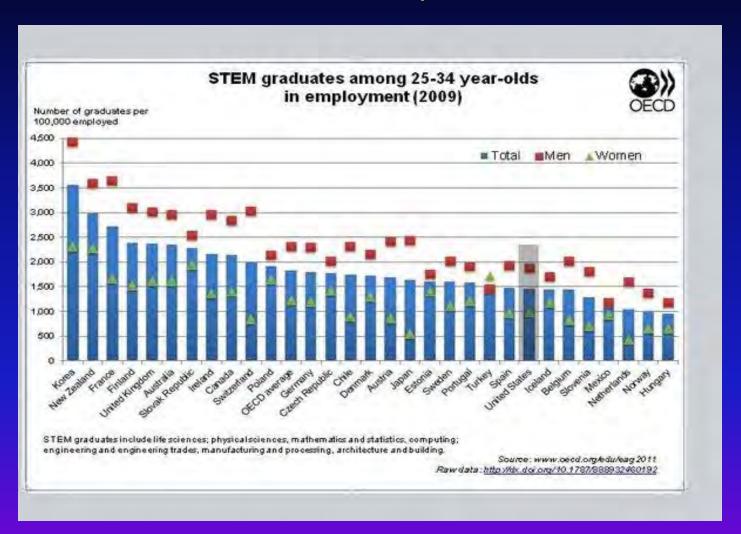
U.S. Bachelors Degrees Awarded



Source: S&E Degrees: 1966-2008, NSF 11-316, June 2011



US workers behind Korea, UK, Germany, 19 others in Employed STEM graduates (between Spain and Iceland)



April, 2013: Brookings Report "STEM DEMAND"

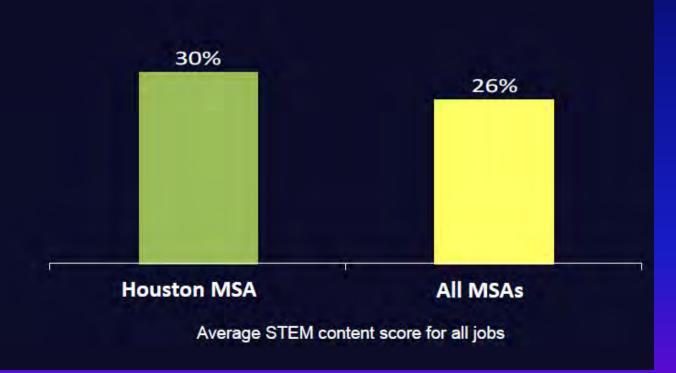
About one third of Houston's jobs are in STEM-focused fields

Share of jobs with aboveaverage STEM content, 2011

Source: Brookings analysis of Bureau of Labor Statistics data

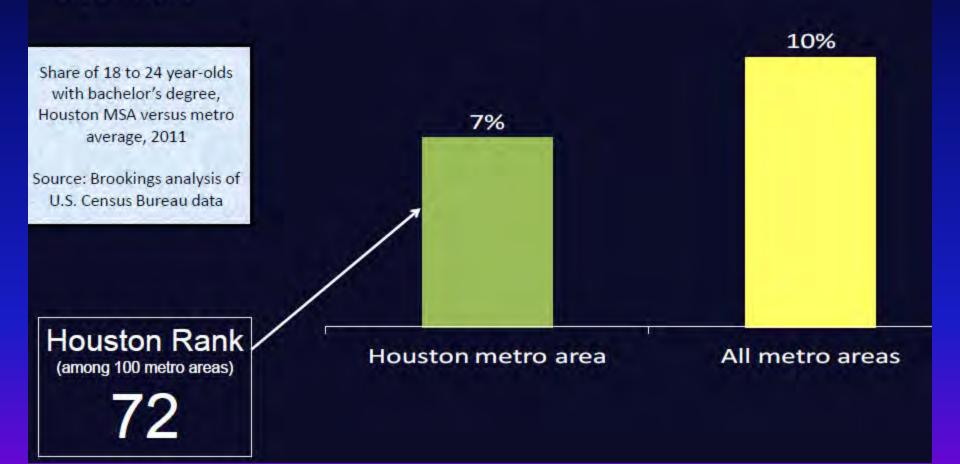
> Houston Rank (among 100 metro areas)

> > 5



April, 2013: Brookings Report: "STEM SUPPLY"

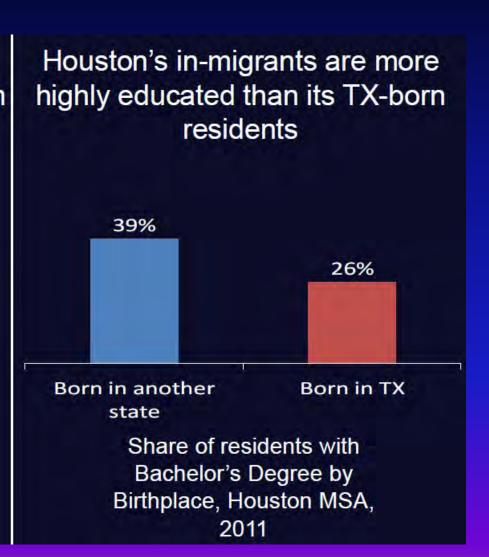
Houston's young adults are less highly educated than those elsewhere



April, 2013: Brookings Report



Degree Holders, Houston MSA, 2011

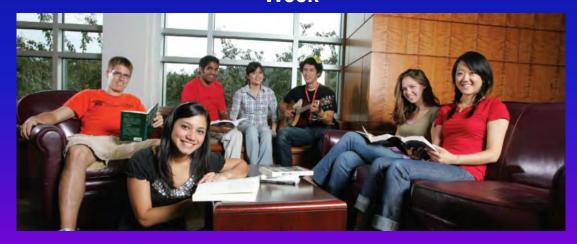


UH STEM Center: College of Engineering STEM Outreach



GK-12
GRADE Camp
STEP Forward Camp
PROMES Outreach
RET (Teachers)
REU (Undergraduates)
ISIP (Industrial Interns)
Science and
Engineering Fair,
Houston
National Engineers
Week

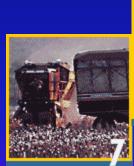


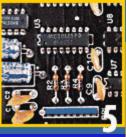




From The Pyramids to Mars Exploration

A great nation's health and prosperity depends upon its technological innovation, solutions to the problems of supporting life, and inspiration of its youth. It will depend upon the production and development of its scientists, mathematicians, engineers, chemists, and physicists.......







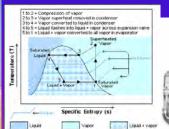
















Inspiring and Teaching the Next Generation

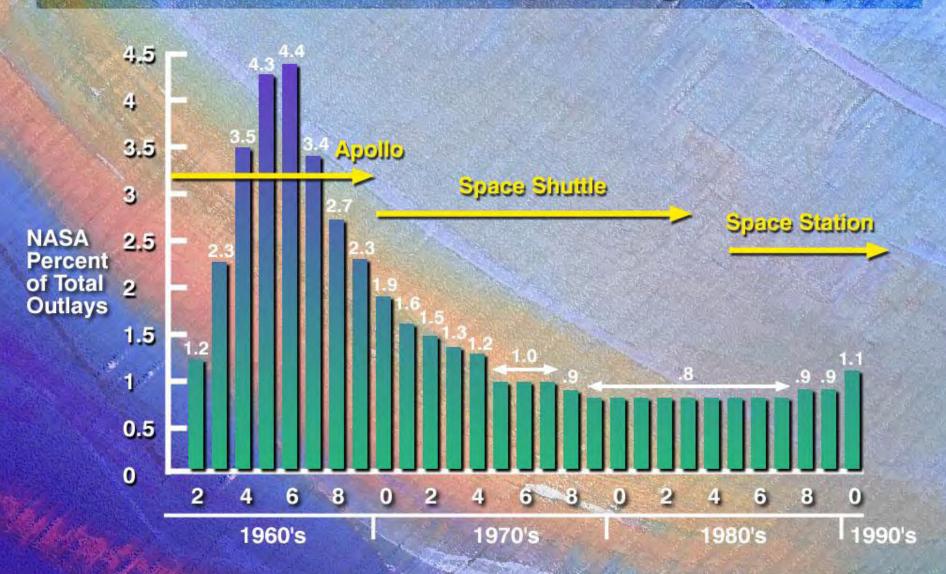


Math, Chemistry and Physics are the languages of the Natural World --





NASA Historical Percent of Budget Outlays





Revisiting Viking 1 and II: Not IF--



-but When and Who?





It is difficult to say what is impossible. For the dreams of yesterday become the hopes of today, and the realities of tomorrow.

Dr. Robert Goddard