Building Stronger Ties to the University community: Perspectives from University Research and Affairs Office

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University Research and Affairs Office
In Memory of Columbia Astronauts...

They will always live in our hearts
Chicago at night from International Space Station
Purpose

PART ONE:
To Provide an overview of Johnson Space Center programs and technology development areas

PART TWO:
To initiate a discussion on the theme of “NASA-University Interactions” (or how to collaborate with Johnson Space Center?)

To explore ways to strengthen ties between JSC/NASA and the Space Grant community and university partners.
Johnson Space Center
Leadership in Human Spaceflight Missions

Mercury  Gemini  Apollo  Skylab  Shuttle  Station

2020 & Beyond
Shuttle Program

Return to Flight
Examples of Work

• Ascent orbital debris impact testing and analysis
• Camera development for wing observation
• Sensors for wing
• Rudder speed brake actuators
• RCC and tile repair activities
Shuttle- Review of some of the Return to Flight issues

Columbia Accident Investigation Report required changes to inspection of the wing and the external tank

- Test Damage to Leading Edge Wing
- External Tank Connection
- Inspection of the Wing On-Orbit
External Tank and Connection to Shuttle

ET/SRB Attach, Forward
- EB-1, Left
- EB-2, Right
Assembly Complete
(Baseline)
Bringing Nations Together
International Space Station Assembly Complete

* RM and MLM are launched by Russian vehicles.

• Lighter colored modules are under consideration.
Cosmonaut Salizhan S. Sharipov, Flight Engineer
Astronaut Leroy Chiao, Commander, and NASA ISS science officer
For the Benefit of Life on Earth...
Life and Microgravity Science

Gravitational Biology
Materials Science
Microgravity Physics
Life and Microgravity Science

Biomedical Science
Biotechnology
Fluid Physics
Combustion Science
Potentially Debilitating Effects of Microgravity

- Bone Demineralization – Osteoporosis
- Impaired Fracture Healing – Non-Union
- Renal Stone Formation & Soft Tissue Calcification
- Orthostatic Intolerance (on return to gravity)
- Cardiac Arrhythmias
- Dehydration (on return to gravity)

- Decreased Aerobic Capacity
- Impaired Coordination
- Muscle Atrophy (Loss of Strength)
- Radiation Sickness
- Increased Cancer Risk
- Impaired Immune Function
- Behavioral Changes & Performance Decrement
- Medical Treatments at Risk
Research in Artificial Gravity – Human Centrifuge
The Cellular Biotechnology Program

Bio-Nanotechnology Objective:

To use nanotechnology tools to study the affects of the space environment at the sub-cellular level and to develop relevant assays and countermeasures.

Current Bio-Nanotechnology Projects:

- Multiple simultaneous bio-assays using a flow cytometer and microbeads with ‘bar codes’ made from quantum dots.
- Mechanical properties of live cells and affects on signaling pathways.
- Role of apatite nanoparticles – nanobacteria – in calcification.
Bar-coded beads are ‘scanned’ one at a time
Each bead provides: 1) type of antigen
2) presence of antigen

One blood sample can be used to simultaneously perform many assays in parallel
Cadmium-Zinc-Telluride Research

Earth-grown

“Twins”
(Lattice defect causing mirror image of structure on opposite sides)

Dislocations
(800,000 cm$^{-2}$)
(In best commercial product = 30,000cm$^{-2}$)

Space-grown

“Twins” virtually eliminated

Dislocations = 800 cm$^{-2}$

Ref. Dr. David J. Larson, Jr., State University of New York, Stony Brook
Hurricane Frances 9/2/04 as imaged by ISS
Astronaut Mike Fincke
Astromaterials Acquisition and Curation

• Current Collections
  • Apollo Lunar Samples
  • Antarctic Meteorites
  • Cosmic Dust
  • Space Exposed Hardware

• Acquisition / Future Curation
  • Stardust
  • Genesis
  • Muses-C
  • New mission proposals

• Advanced Curation Research
  • Robotic sample handling
  • Cold curation
  • Planetary protection
Curation

- Protect, preserve, document, and distribute samples
  - Protect and preserve samples
    - Class 10 storage and processing
    - Clean, N₂ purgeable containers (storage and transport)
  - Document
    - Provide sample information to science community
    - Document and track all sample transactions
  - Distribute allocated samples to approved PIs
    - Clean collector surfaces, if necessary
    - Subdivide samples for allocation
  - Provide all of the above for space exposed hardware
The Importance of Sample Return Missions

- Science is done on the ground
- Instrumentation is state-of-the-art and more
- Ultimate in precision & sensitivity
- Not limited by mass, power, cost or reliability
- Results can be confirmed by several methods
- Instruments can be calibrated
- Analysis is iterative not limited by pre-conceived ideas
- Samples - a resource for present and future study
The Genesis Mission: Samples now at JSC

- Place a Spacecraft Outside the Earth’s Magnetosphere
- Expose Ultra-Pure Materials
- Return Imbedded Solar Wind Samples to Earth
- First NASA Extraterrestrial Samples Returned Since Apollo
The Genesis Mission:
Samples now at JSC
NASA-University Interactions:

Where to begin?
Cracking the code?
Are there any good models?
There is nothing which can better deserve our patronage than the promotion of science and literature. Knowledge is in every country the surest basis of public happiness.

George Washington, Address to Congress, January 8, 1790
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Space Grant consortia:
NASA’s Representatives in the States

- Benefits of long-term relationship between NASA and the states
- Makes contributions to NASA’s workforce and pipeline priorities and the agency initiatives in Education

(from NASA HQ website)
NASA Centers are different and have their unique cultures that have evolved over the years.

Understanding the cultural traits of your center is vital for successful interactions.
NASA/JSC Culture

- Advisory/participatory management style
- Emphasis on hands-on engineering
- Demand technical accuracy
- Development of sophisticated testing facilities
- Emphasis on systems engineering

(A History of Johnson Space Center, 1993)
JSC is an Engineering and Operational Center
Mission Operations are a very “High Priority”
JSC initiatives require a systems approach with integrated solutions and assessments.
JSC Values
Applied Research and Technology Development
What is unique about JSC?

JSC is an engineering and operational center. Mission Operations are a “high priority”. JSC values applied research and technology development. JSC initiatives require a systems approach with integrated solutions and assessments.
What does JSC want from the University Community?

*Two-way Technical Interchange:*

JSC Engineers need state-of-the-art technological innovations and information from universities for applications in mission operations.

JSC Engineers would like to communicate their technical developments to the universities (e.g., inspection days).

JSC endorses the concept of "Capstone courses" in engineering that emphasize systems approaches.
What does JSC want from the University community?

Workforce development:
JSC strongly supports the diversity in workforce and would like universities to enhance minority engineering education.
University Research and Affairs Office
Interfaces at JSC

NASA Management

NASA HQ

AH Education Program
AJ Minority Program

University Research and Affairs Office

Colleges and Universities
Universities and NASA/JSC

**University research and technology**
- Basic and applied research, test facilities, prototype development, low to mid range Technology Readiness levels
- Trained work force
  - Undergraduate
  - Continuing education
  - Advanced degrees

**NASA/JSC provides**
- Expertise, mentoring, and inspiration
- Collaboration
- Teaching at Universities
- Facilities

**NASA/JSC needs**
- Employees
- Research and technology
JSC education programs:

University/College: Engineering /Science
160+ Coops in 2003-2004
25+ Summer Interns
15 NRC Postdoctoral Associates
25 Postdocs in life sciences/engineering
22 Faculty in NFFP and dozens in various JSC science/engineering Labs.
Over 120 High school students in Various JSC programs
Spending a sabbatical at JSC
Conduct collaborative research on-site at JSC

“There is a tremendous infusion of faculty and students at JSC. The numbers may not show it. The statistics do not capture this vital interaction….”

Dr. Helen Lane, URAO
Some recent examples faculty collaborations with JSC (not a complete list):

National Biomedical Research Institute’s Consortium (Baylor College of Medicine and others)

Rice University/JSC collaboration in Nanotechnology/Space Physics

Lunar Planetary Institute

Minority University Research Centers (e.g. Texas Southern University, Prairie View A and M University)
Opportunities at JSC

Undergraduate education programs
Community College Aerospace Scholars (CCAS)
KC-135 student flight opportunities
Lunar and Planetary Institute
Summer Intern Program in Planetary Science
Program Objectives:

- Build a strong relationship between universities, students, and NASA JSC
- Provide hands-on career exploration opportunities for students
- Provide student work exposure to the aerospace industry
- Encourage student interest in science, technology, engineering, and mathematics fields
- Train and develop students for future employment in the aerospace industry

Applicant Requirements:

- Enrolled in an accredited college or university pursuing a bachelor’s degree in Engineering, Science, or Business
- US Citizen
- Available to work at NASA JSC a minimum of 15 weeks (duration must be acceptable to the organization) during Spring or Fall semester

Cost to Your College/ University:

The cost to sponsor a student at NASA Johnson Space Center for a 15-week semester session is approximately $8300. For your investment, you will receive:

- The opportunity for your student to work directly with NASA engineers and scientists on human space flight projects
- Career development and financial stipends to deserving students
- Strengthen affiliation between university and NASA

For more information, please contact
Bob Musgrove at robert.p.musgrove@nasa.gov or 281-483-3065

Classification: Higher Education
Collaboration: JSC/Space Grant
Opportunities at JSC

National Space Grant College and Fellowship Program
Summer temporary program leading to college training

Undergraduate Student Researcher Program
Space Science Outreach and Research
Minority Serving Universities
Challenges:

Communications
Changes in NASA staff and changes in NASA missions, focus

Culture at NASA Centers:
Space Grant not considered a NASA program at Centers
Competition instead of cooperation with NASA centers
Role/s of UAO at NASA Centers
Summary

• NASA Johnson Space Center will benefit from universities in:
  • Basic research for next generation of exploration initiatives
  • Accelerated development of critical technologies
    • Power
    • Computing, communications, networking
    • Nanotechnology
    • Robotics
    • Advanced Materials
• Requires collaborative work across NASA Centers, universities, and industry
http://research.jsc.nasa.gov

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