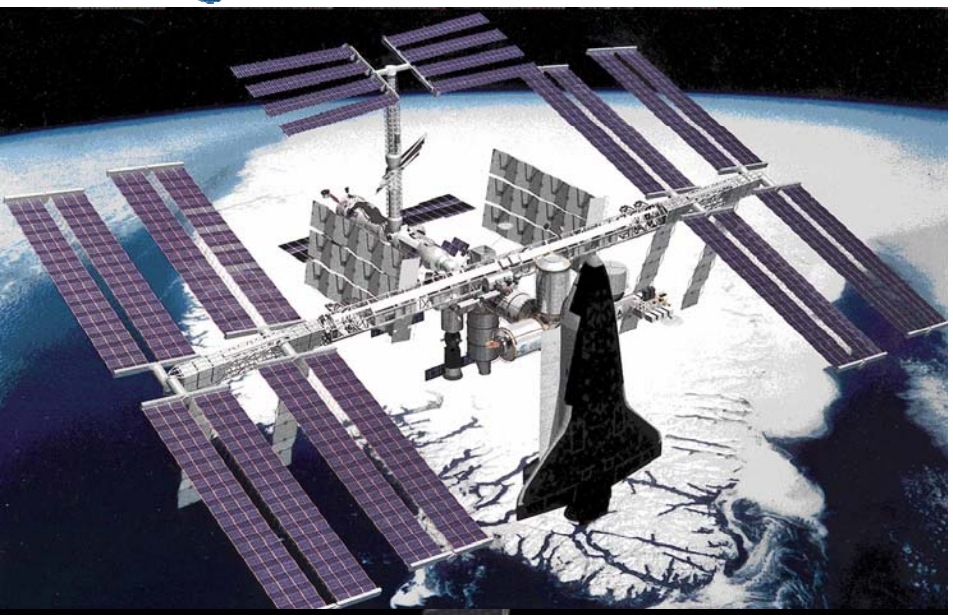
wyle
NASA ISS
Research
Academy
Don't
Leave Earth
Without Us℠
Integrated Science
& Engineering Group
4 August 2010

Contact Information



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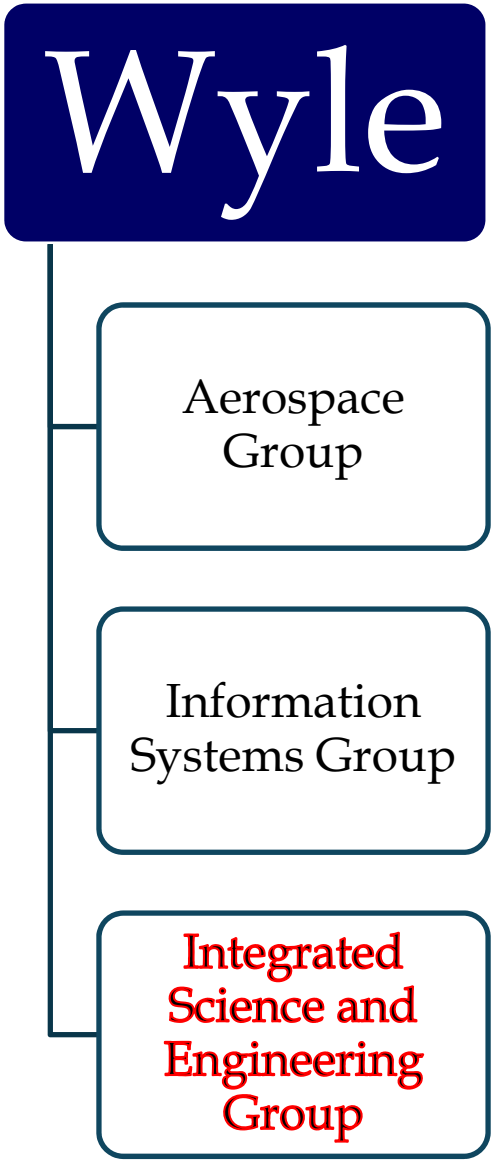
Who are we?

- $800+ million diversified government services contractor
- ~4,100 employees,
- Defense and Federal Civil customers:
  - US Navy
  - NASA
  - US Air Force
  - NOAA / FAA / DARPA
- Key competencies:
  - Integrated Science and Engineering
  - Human Health and Performance
  - Operational Test and Evaluation
  - Acquisitions Program Management
  - Program Assessment and Cost Analysis
  - Systems Engineering
  - Space Launch and Operations Support
  - IT and Telecommunications
  - Test Pilot and Test Aircrew Services



Wyle Integrated Science and Engineering

- **Operating since 1963**
- **Key Contractor to NASA and USAF for over 40 years**
- **Provides for the health and safety of US Astronauts, now extending to ESA, CSA, JAXA and commercial space participants**
- **Provides innovative solutions to meet the scientific, health, and engineering needs for users of systems that operate in harsh environments**
- **Core capabilities include**
  - Health and Human Performance Services
  - Scientific Research Services
  - Systems Engineering and Engineering Support
  - Occupational Health
- **Operates through 5 facilities across the US and Europe**
  - Headquartered in Houston, TX

Core Capabilities

* Human Health & Performance

Human Factors Engineering

Human Ratings Development

Occupational & Aerospace Medicine

Occupational Health

Medicine At A Distance

* Biomedical Research & Laboratory Management

* Environmental monitoring and laboratory management

* Mission Planning & Operations

* Flight Hardware DDT&E

SR&QA for Spacecraft Systems

Mockup Development

* Systems Engineering & Integration

* Advanced Technology Development

Medical Informatics & Biomedical Information Systems

Support Disciplines

Program & Project Management

Strategic Analysis

Risk Management

ISO 9001-2008

OSHA VPP Star Site

Safety, Reliability and Quality Assurance

Financial Accounting, EVMS

Health Management & Medical Ops

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Occupational Medicine

Occupational Health

Medicine in harsh environments

Telemedicine

Pharmacy

Behavioral Medicine

Clinical Lab

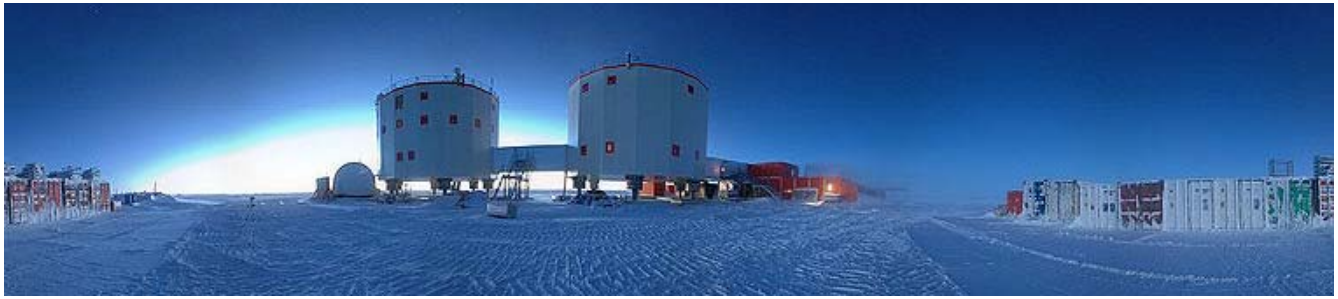
Medical Contingency

Medical Monitoring

Flight Medicine

Epidemiology

Biomedical Research and Lab Management



Cell Biology & Tissue Engineering

Radiation Biophysics

Environmental Physiology

Immunology

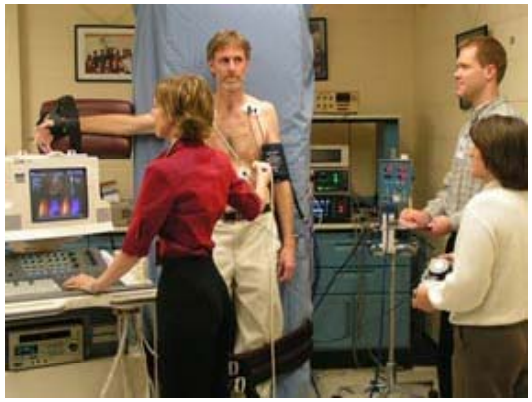
Pharmacology

Bone and Muscle

Nutrition

Neurophysiology

Cardiovascular Physiology



Environmental Factors and Facility Ops

- Microbiology
- Hypo- & Hyperbaric Chamber Operations
- Radiation Monitoring
- Human Factors
- Mockup Development
- Habitability
- Centrifuge Operations
- Toxicology
- Water and Food Analysis
- Thermoregulation Lab
- Food Systems

Mission Execution

Training

Mission Planning and Execution

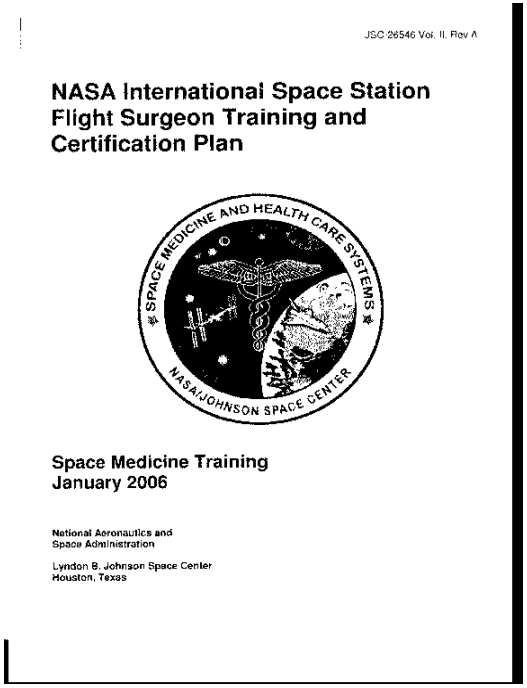
Behavioral Support

Contingency Preparedness

Clinical Certification

Requirements and Process Management

International Coordination and Cooperation



JSC 26546 Vol. II, Rev A

NASA International Space Station Flight Surgeon Training and Certification Plan

SPACE MEDICINE AND HEALTH CARE SYSTEMS
NASA/JOHNSON SPACE CENTER

Space Medicine Training
January 2006

National Aeronautics and Space Administration

Lyndon B. Johnson Space Center
Houston, Texas

Aircrew Protection

Life support systems

Crew protection

Improved human performance

Specialized test facilities

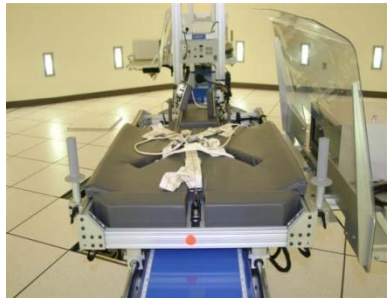
Technology development for flight systems

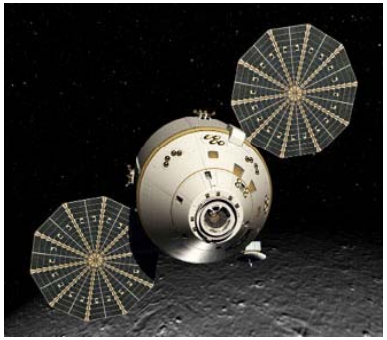
Operating specialized test facilities, Wyle personnel evaluate:

- breathing systems,
- night vision systems,
- anti-g suits,
- laser eye protection,
- and other aircrew protection components.

Engineering

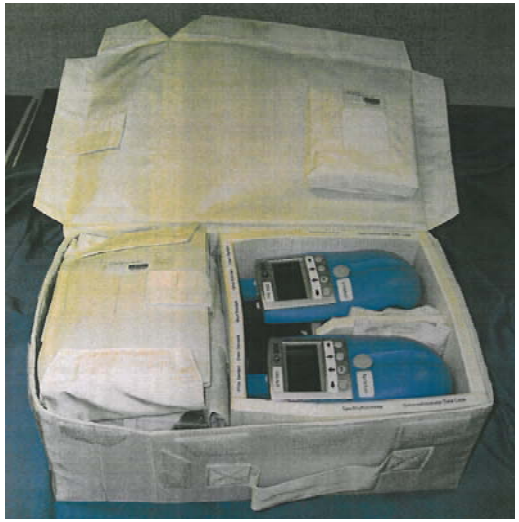
- Project Management for DDT&E
- Engineering Analysis Supporting DDT&E
- Mechanical Engineering Design, Fabrication, and Manufacturing
- Systems Engineering
- Electrical Design and Fabrication
- Software Development
- Assembly and Test Lab
- Integration and Test
- SRM&QA

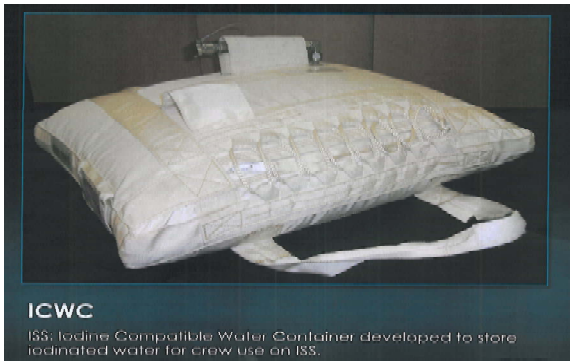




Softgoods Capabilities

- Pattern development
- Prototype Fabrication
- Flight Unit Fabrication
- Foam Fabrication
- Packaging Expertise
- Durability and Loading Assessment
- Fire-retardant chemical treatment of materials for spaceflight
- 13+ years of NASA experience





Payload Integration Capabilities

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Wyle's payload integration experience is primarily in 4 categories:

- Biotechnology
- Human Research/Human Medical Operations
- Exercise Countermeasures
- Plant and Materials Science

Wyle has performed payload integration for flight in the following vehicles/environments:

- Space Shuttle
- International Space Station
- Russian MIR Space Station
- Russian Soyuz
- Analog Environments: Desert RATS, NEEMO

Wyle is capable of "cradle to grave" integration efforts:

- Subject Matter Experts
- Program Management
- Systems Engineering

Payload Integration Products by Phase

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Strategic

- Gather PI customer resource requirements
- Develop proposed traffic model for planned investigations
- Work with the Payloads Office to request payload assignments
- Work with assigned Payload Integration Manager to develop, deliver, and support the following:
  - Design Reviews
  - Payload Integration Agreements
  - Safety Reviews
  - Support Technical Interchange Meetings
  - Interface Control Documents

Tactical

- Procedure development
- Planning data sets
- Operations data sets
- Manifest and stowage drawings
- Safety Reviews
- Payload verification data
- Crew training
- Production of crew training DVDs for onboard refresher training
- Mission simulations
- Interface verifications
- Launch vehicle integration
- CoFR documentation
- Launch payload handover

Operations

- Launch
- On-orbit operations
- Ground experiment operations
- Data analysis
- Landing
- Post-landing operations
- Hardware de-integration
- Sample processing and delivery to PI
- Data analysis

Specific Payload Integration Tasks

- Feasibility assessments
- Definition of baseline, functional, launch, and integration requirements
- Design of flight and ground support hardware and software
- Fabrication of flight and ground support hardware and software
- Modification of Commercial Off-the-Shelf (COTS) hardware
- Manifest support for hardware and payload
- Flight certification of hardware and software
- Development of flight procedures
- Development of training products (crew, flight controllers)
- Launch integration
- Post-flight processing and data analysis
- Ground support for activation, check-out and nominal operations, including real-time and logged telemetry monitoring
- Sustaining engineering and resupply
- Ground processing/turnaround of flight-returned equipment
- Disposal of hazardous and biological wastes
- Project Management from project initiation to project close-out
- Safety, Reliability, Maintainability & Quality Assurance (SRM&QA)
- Information Technology & Data Management
- Risk Management
- ISO 9001 certified

Integrating Science, Engineering, Medicine and Operations

Examples of BIOTECHNOLOGY Payload Integration Experience & Support

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- Cellular Biotechnology Operations Support System (CBOSS), consisting of:
  - Biotechnology Cell Science Stowage (BCSS)
  - Biotechnology Specimen Temperature Controller (BSTC)
  - Biotechnology Refrigerator (BTR)
  - Biotechnology Gas Supply Module (GSM)
  - ARCTIC refrigerator/freezer/incubator (Wyle's integration role began at flight hardware certification phase)
  - Commercial Refrigerator/Incubator Module (CRIM) (Wyle provided operational support)
- Rotating Wall Perfused System (RWPS) Bioreactor
- Detailed Supplementary Objective (DSO) 316 Bioreactor/Flow and Particle Trajectory in Microgravity, STS-44
- DSO 322 Human Lymphocyte Locomotion in Microgravity, STS-54 and STS-56
- Bioreactor Demonstration System (BDS)-02 on STS-62, BDS -03 on STS-70, BDS-04 on STS-90, BDS-05 on STS-85 and BDS-07 on STS-107

Examples of BIOTECHNOLOGY Payload Integration Experience & Support (continued)

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- BioTechnology System (BTS)- Cart in space (STS-79, MIR 3, STS-81)
- BTS – (STS-86, MIR 6, STS-89)
- BTS- Cocult (STS-89, MIR 7, STS-91)
- Human Renal Cortical Epithelial (HRCE), Principal Investigator: Tim Hammond, M.B.B.S., Tulane University
- Rat pheochromocytoma cells neuroendocrine development model in microgravity (PC-12), Principal Investigator: Peter Lelkes, Ph.D. Drexel University
- Human ovarian carcinoma model in microgravity (LN-1), Principal Investigator: Jeanne Becker, Ph.D., University of South Florida
- Human colorectal carcinoma model in microgravity (MIP-101), Principal Investigator: Milburn Jessup, M.D., University of Texas Health Science Center
- Murine (mouse) erythroleukemia cells (EMS-3), Principal Investigator: Arthur Sytkowski, M.D., Harvard Medical School
- Human Lymphoid Tissue (HLT), Principal Investigator: Joshua Zimmerberg, M.D., NASA NIH Center for 3 Dimensional Tissue Culture, National Institutes of Health
- StelSys human liver cell research, Principal Investigator: Dr. Albert Li, Ph.D., StelSys, Inc., Baltimore, MD

Examples of HUMAN RESEARCH/HUMAN MEDICAL OPERATIONS Payload Integration Experience & Support

- NASA Space Shuttle Orbiter Medical System (SOMS)
  - Emergency Medical Kit (EMK) & Medications & Bandage Kit (MBK)
  - Saliva and urine collection kits
  - Microbial monitoring kits
  - Crew/Flight Surgeon requested items (usually material cert only)
- NASA Space Shuttle toxicology and radiation support
  - Grab Sample Containers (GSCs)
  - Compound Specific Analyzer for Combustion Products (CSA-CP)
  - Tissue Equivalent Proportional Counter (TEPC)
- NASA International Space Station (ISS) Crew Health Care System (CHeCS)
  - Ambulatory Medical Pack (AMP)/Advanced Life Support Pack (ALSP)
  - Volatile Organic Analyzer (VOA)
  - Medical Equipment Computer (MEC) and associated software
  - Defibrillator with real-time data downlink
  - Automated External Defibrillator (COTS development)
  - Blood Pressure monitor with Electrocardiogram (BP/ECG)
  - Microbial Monitoring Kits (air/water/surfaces)

Examples of HUMAN RESEARCH/HUMAN MEDICAL OPERATIONS Payload Integration Experience & Support (cont'd)

wyle

- NASA International Space Station (ISS) Crew Health Care System (CHeCS) (con'd)
  - Total Organic Carbon Analyzer (TOCA) – 3 generations of hardware enhancements including elimination of hazardous reagents in latest version
  - Gas Chromatograph/Differential Mobility Spectrometer (GC-DMS)- certification of next generation, Air Quality Monitor (AQM) in-work
  - Cycle Ergometer with Vibration Isolation System (CEVIS)
  - Treadmill with Vibration Isolation System (TVIS)
  - ISS Second Treadmill System (T2) (aka COLBERT)
  - Panoptic (certified & delivered with procedures and training in 2 weeks)
  - Bose Headset
  - Grab Sample Containers (GSCs)
  - Crew/Flight Surgeon requested items (usually material cert only)
- MIR Crew Health Care System
- NASA ISS Medical Project (ISSMP)/Human Research Facility (HRF)

Examples of PLANT AND MATERIAL SCIENCES Payload Integration Experience & Support

- Zeolite Crystal Growth (ZCG) Furnace, Principal Investigator: Dr. Al Sacco, Jr., Center for Advanced Microgravity Materials Processing (CAMMP), Northeastern University, Boston, MA
- Biomass Production System (BPS), Principal Investigator: Robert Morrow, PhD., Orbital Technologies Corporation, Madison, WI

Rotating Wall Perfused Vessel (RWPS) w/ Gas Supply Module (GSM)

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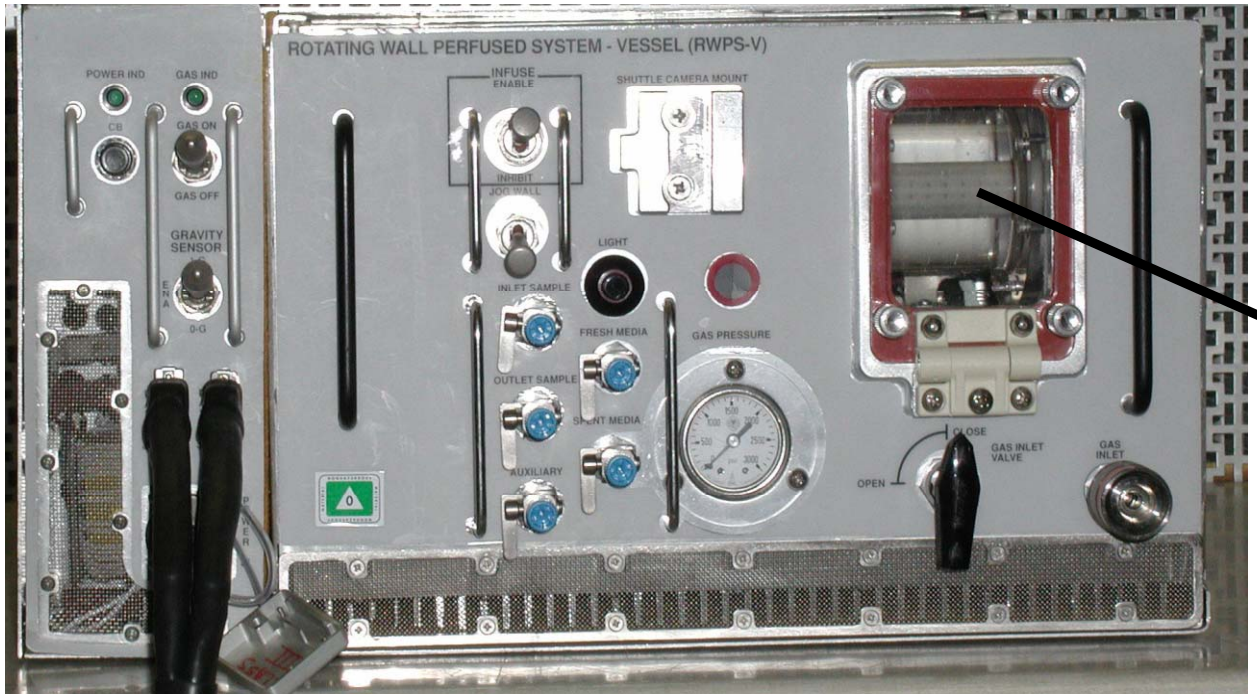

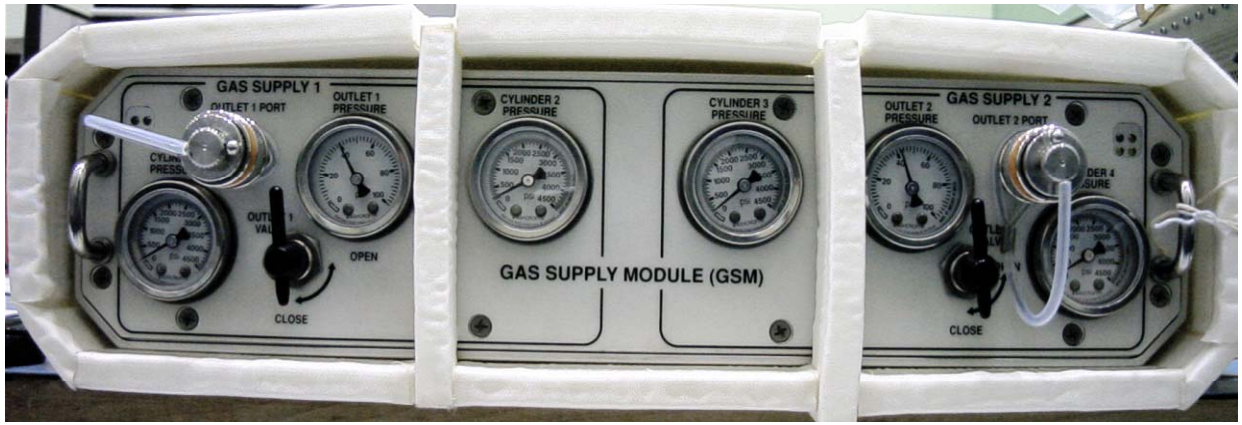

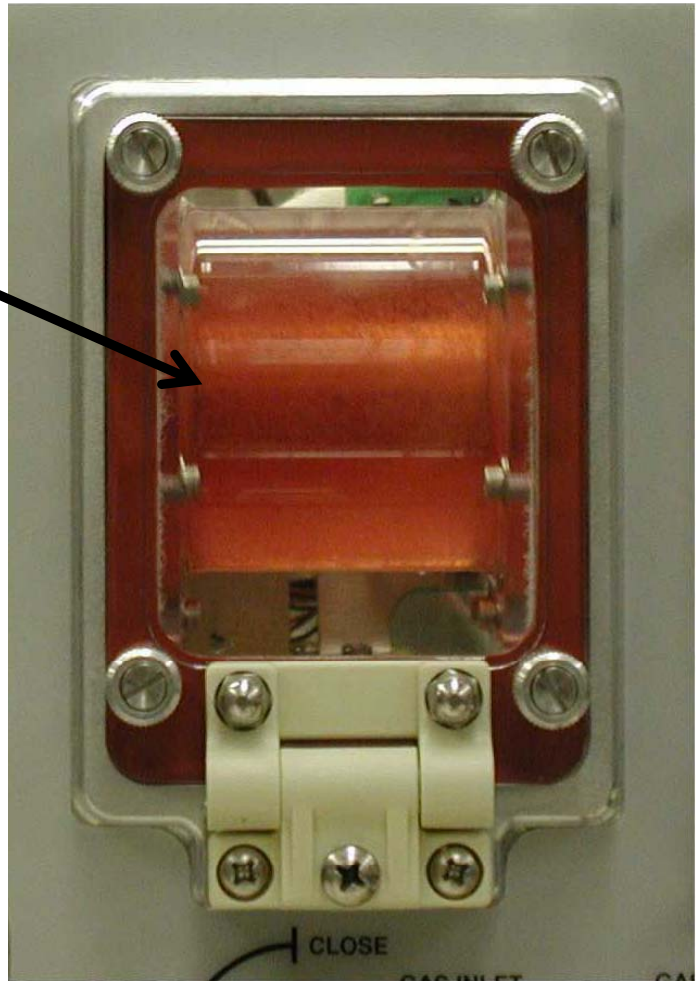

Biotechnology Specimen Temperature Controller (BSTC) w/GSM

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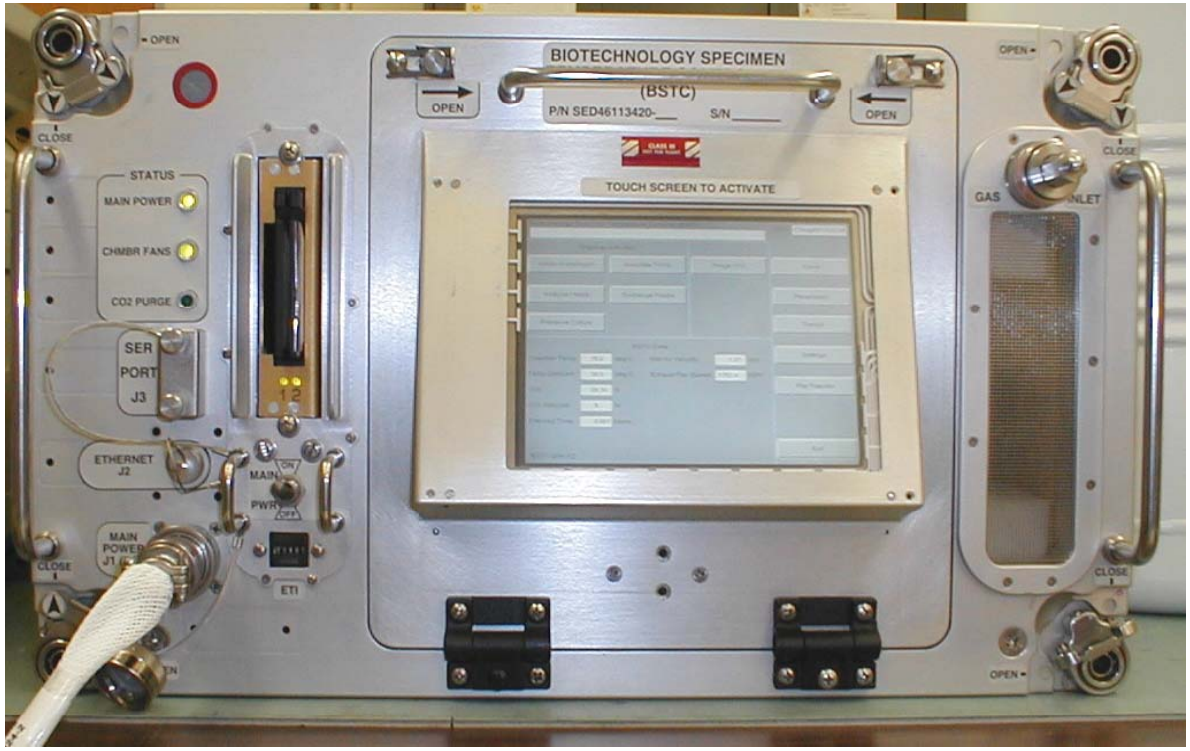

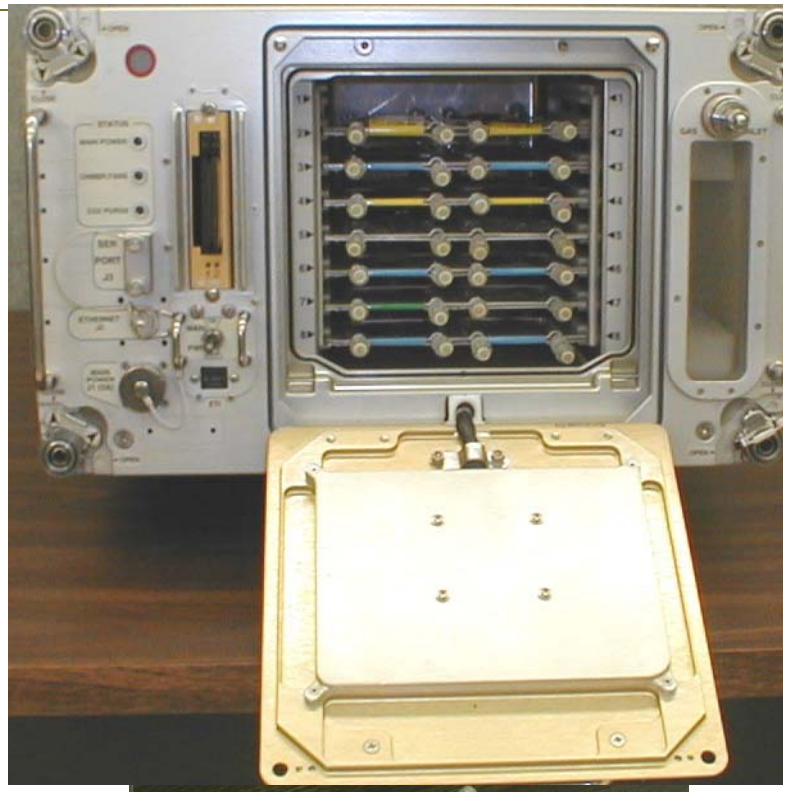

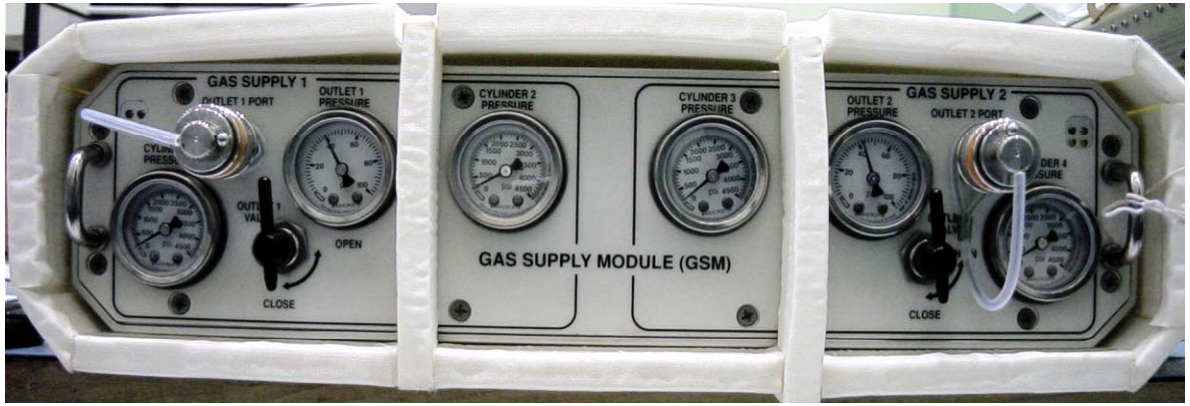

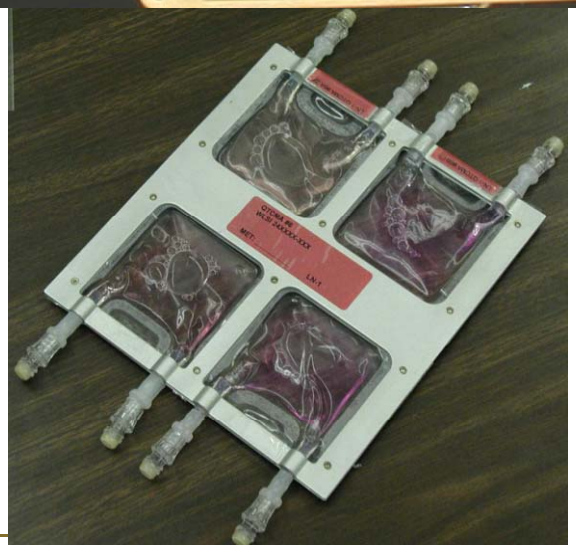

Examples of BIOTECHNOLOGY Payload Integration Experience & Support (continued)

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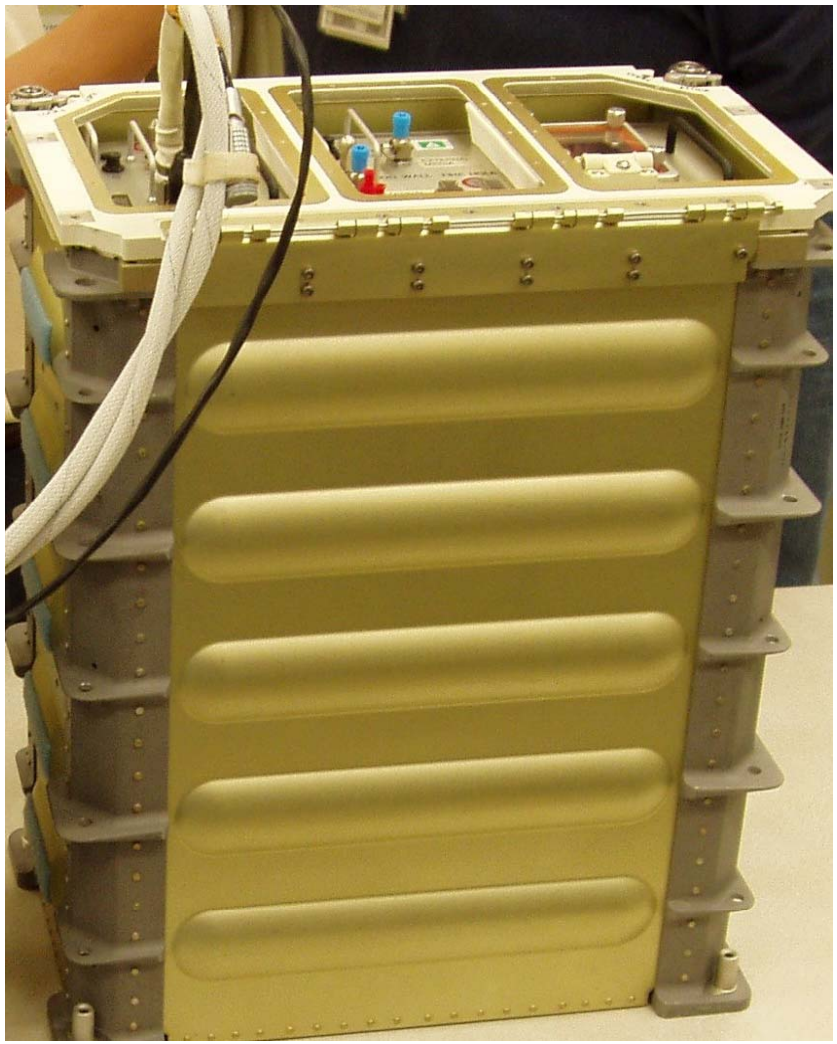
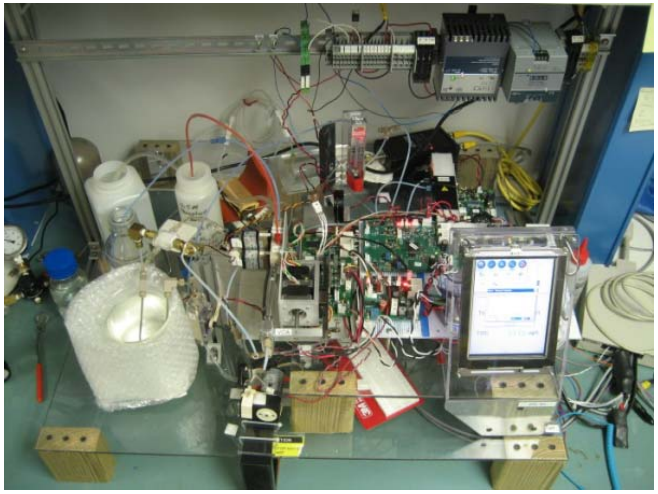


- Biotechnology Cell Science Stowage (BCSS)
- Bench Review

- Bioreactor Demonstration System (BDS)
- KSC Launch Handover Processing

"TOCA"



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T2 – a.k.a "COLBERT"

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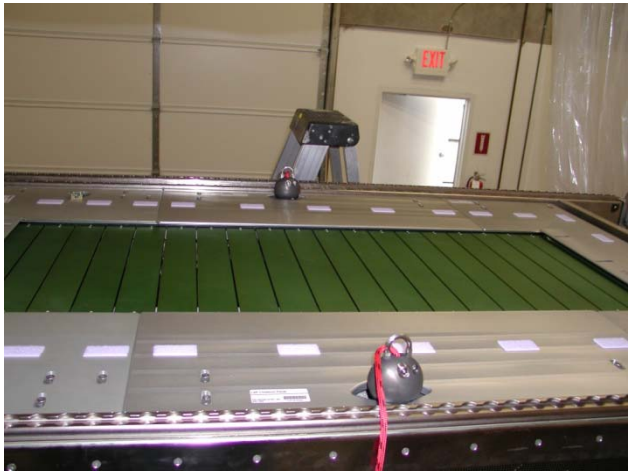
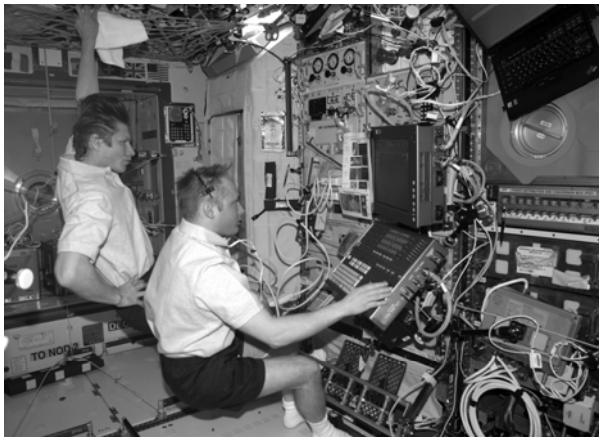
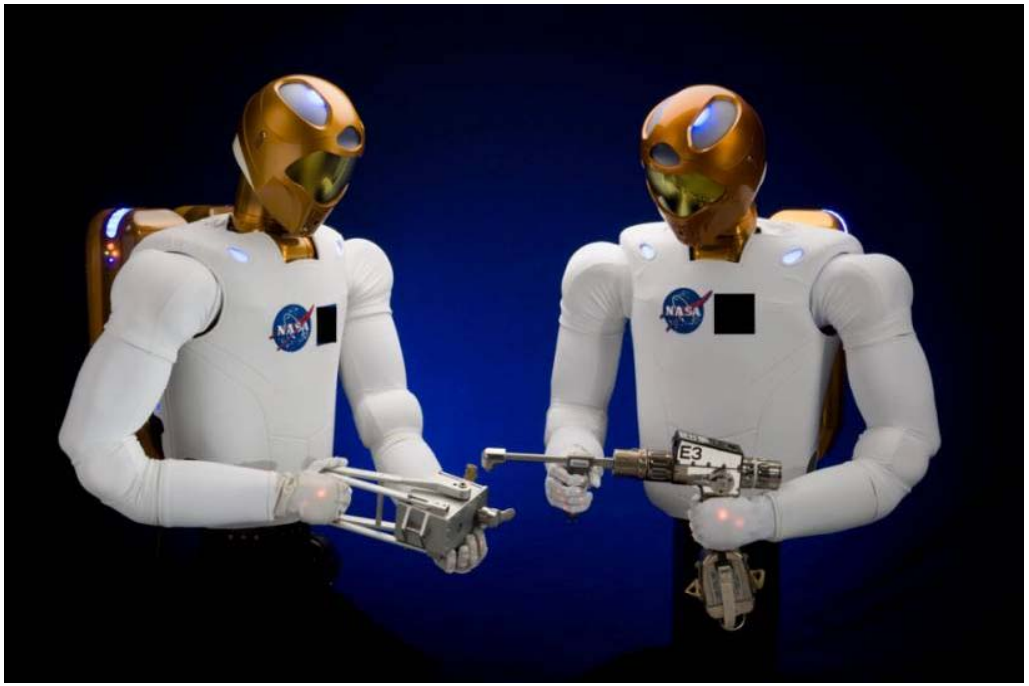


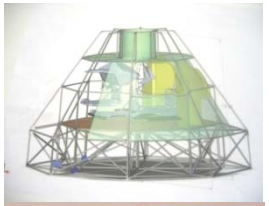
HRF and MARES

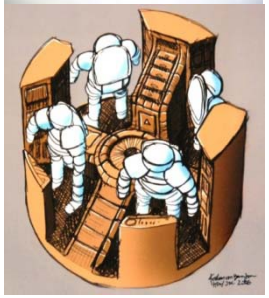


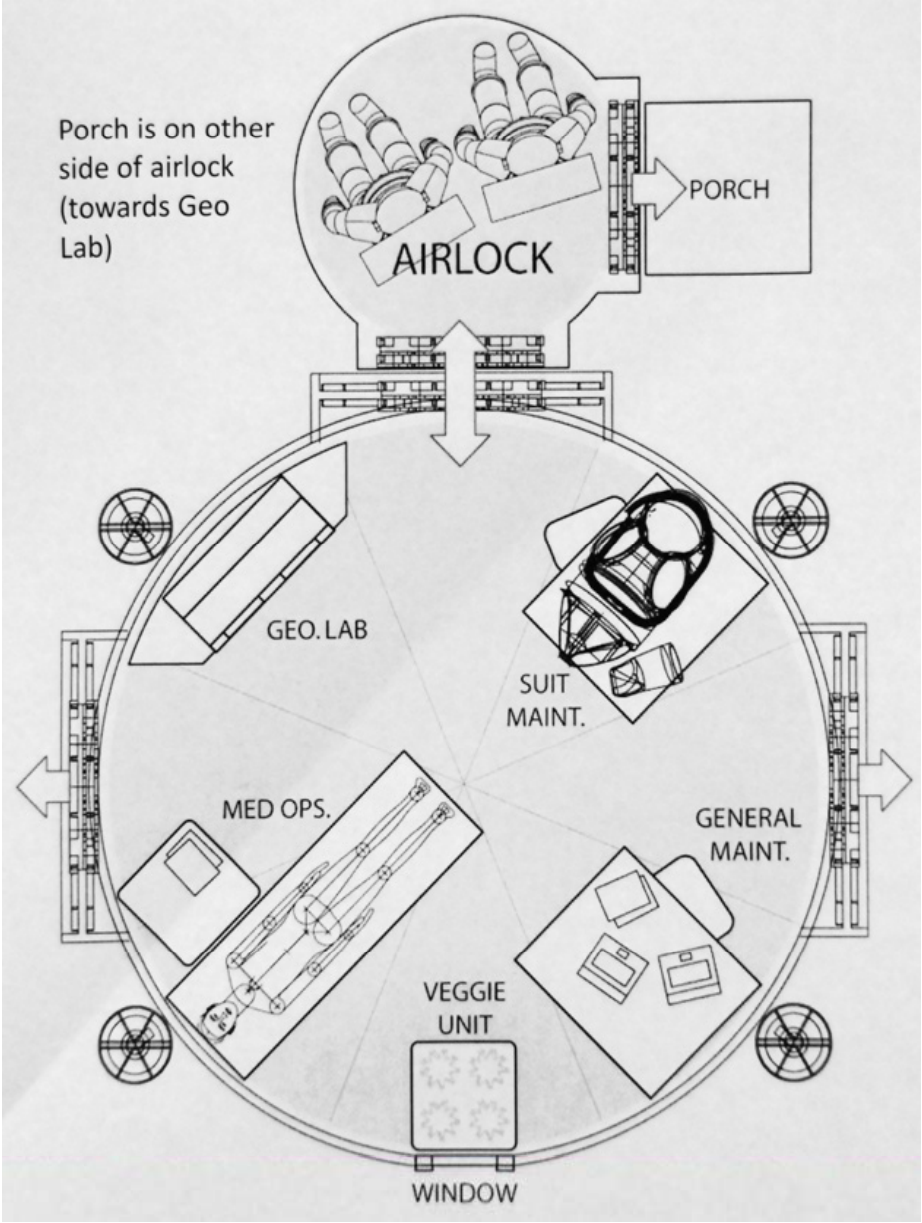
Robonaut



Development – Mockups and Prototypes

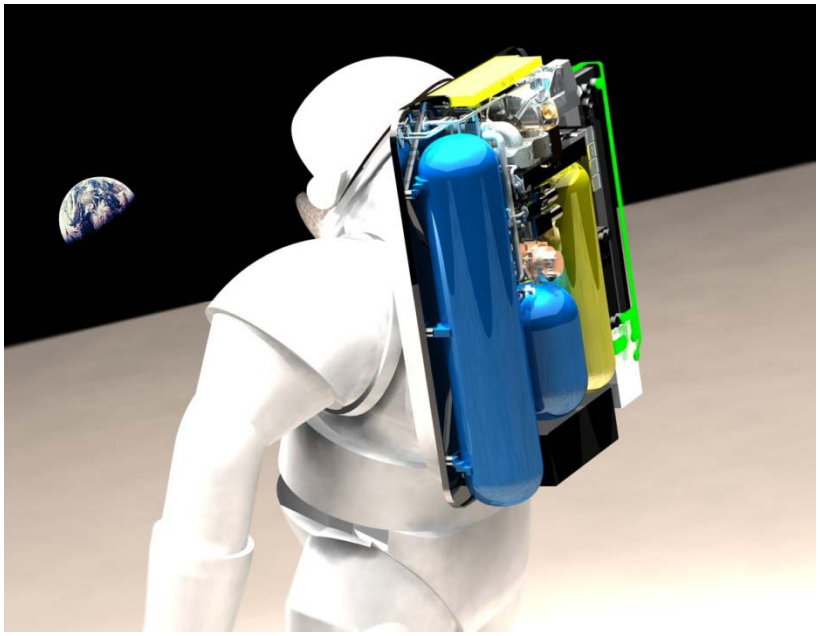






Human Factors Assessments

Trade Studies for Complex Systems



- *Trade studies on Future PLSS (Portable Life Support System) Architectures*

- *Note: this project was a joint effort among NASA and several contractors including Wyle. Actual mockup fabrication [right] by ESCG.*

Flight Hardware & Payload Integration Experience

wyle

Second Treadmill, “Colbert”

Short Radius Centrifuge

ISS Medical Projects, “HRF”

Human Research Racks 1 and 2 and associated payloads (GASMAP, SLAMMD, Ultrasound, HRF Power supplies)

Rotating Bioreactor Cell Growth Systems

Audio Dosimeters, Automatic External Defibrillator, Headsets, HMS and Med Kits

Gas Chromatography/Differential Mobility Spectrometry

Colormetric-Solid Phased Extraction (CSPE) for In-Flight Water Analysis

CBCS Power Supply

Collapsible US Food Containers

Total Organic Carbon Analyzer

IVA Flight Crew Equipment

Iodine Compatible Water Container

O2 Generation (Sorption Compressor), O2 Sensor, CO Sensor, CxP Suit

Water Transfer Sustaining

Electrochemical Disinfection

Gas Delivery Systems

Advanced Radiation Hardware Development

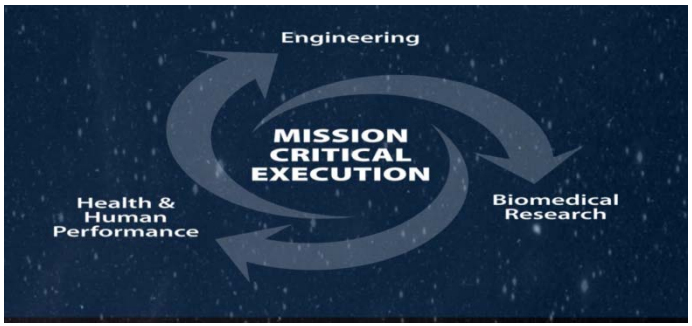
Robonaut Integration and Certification

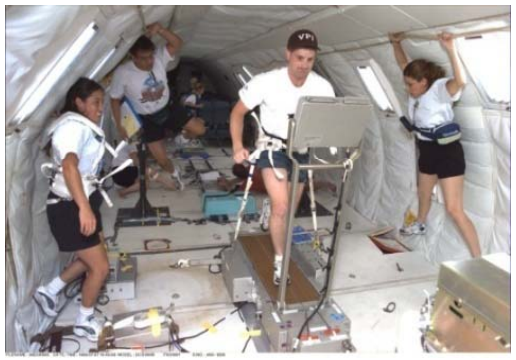
ISS Portable Oxygen Monitor (IPOM)

02 Generator (CASEO)

Temp. Urine & Brine Stowage System (TUBSS)

Countering the effects of extreme environments





Flying in the environment of space exposes the human system to many operational and health risks, such as bone and muscle loss, cardiovascular changes, behavioral stressors, radiation, immune alterations.

<u>Wyle scientists</u> characterize the biomedical effects, define steps to mitigate these effects, write requirements for countermeasures and tools

<u>Wyle engineers</u> design, build, deploy and operate ISS countermeasure hardware and diagnostic tools based on science and medical requirements

<u>Wyle Physicians</u> monitor and manage crew health and performance using these mission critical capabilities

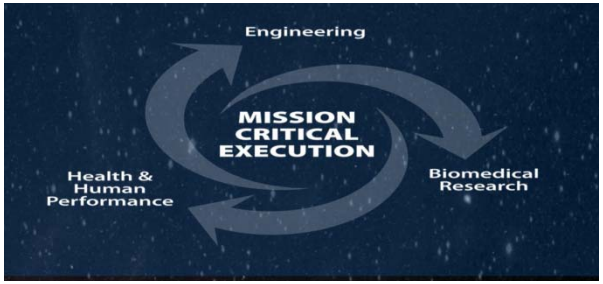
The Systems and Hardware for Science and Medicine

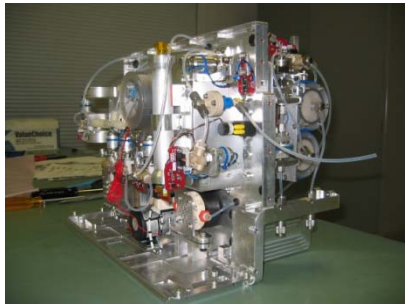
Space flight requires are certified for operation under the constraints of space flight and environment.

<u>Wyle scientists and physicians</u> develop operational requirements, validate solutions and utilize the systems in ISS and Shuttle operations.

<u>Wyle engineers</u> design, build, deploy and maintain the hardware and biomedical systems.

<u>Wyle Medical Operations personnel</u> train crews, provide console support in mission control, and support mission planning and anomaly resolution.

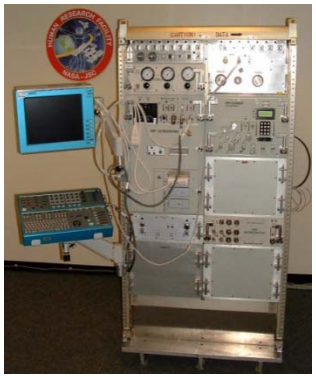


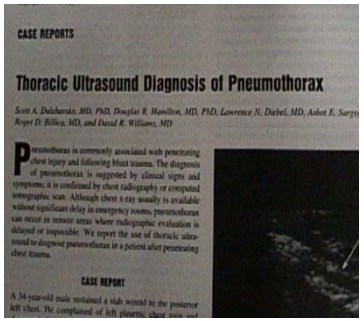


Medicine at a Distance

Accurate medical diagnoses are critical for crew health and mission management. But until recently in-flight diagnostic imaging was not possible.

<u>Wyle scientists, engineers, clinicians, and operations specialists</u> designed, deployed, and validated an unprecedented diagnostic ultrasound capability for ISS.




CASE REPORTS

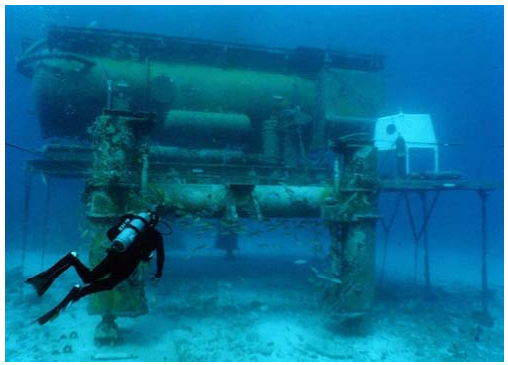
Thoracic Ultrasound Diagnosis of Pneumothorax

CASE REPORT

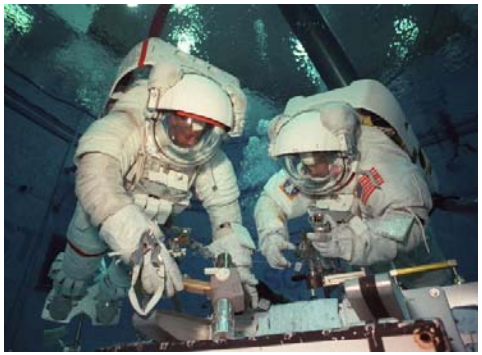
Wyle participated in the development and transfer of revolutionary clinical diagnostic techniques into civilian and military health care changing medical standards of care around the world.

Analog Environments

<u>Wyle scientists, clinicians and engineers</u> design and conduct human research studies, evaluate engineering systems and test clinical protocols in multiple analog environments designed to simulate specific operational challenges and conditions



Fit For Flight and Operations



Keeping the JSC and MSFC workforce healthy, safe, and able to do their jobs is mission critical.

<u>Wyle clinicians</u> provide health screenings, medical exams, and emergency response services to all JSC personnel.

<u>Wyle engineers, operations specialists, and occupational health experts</u> monitor air and water quality and perform worksite evaluations to ensure a safe work environment.

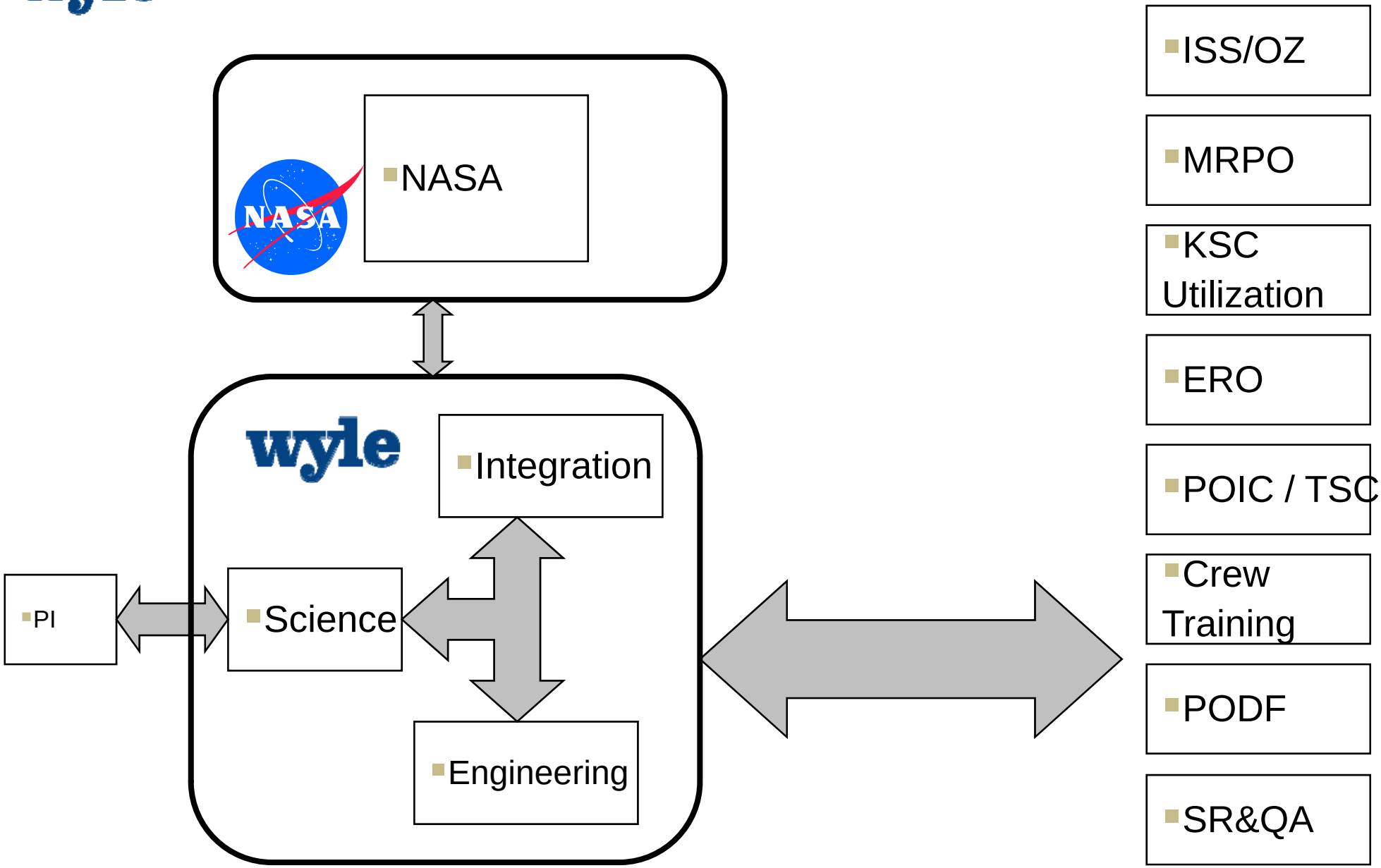
<u>Wyle engineers and medical experts</u> provide medical monitoring of astronauts during hazardous training activities at the Neutral Buoyancy Laboratory (NBL) and offer CPR, First Aid, and AED training.

Wyle's occupational medicine and health capabilities complement operations at other NASA locations as well, including White Sands and Russia.

Representative Governmental, Academic & Industry Affiliations

- NASA Human Spaceflight Organizations
- International Partner Space Agencies
- Aerospace Medical Association
- American Society of Space & Gravitational Biology
- American Society for Cell Biology
- Society for In Vitro Biology
- Universities and Medical Schools around the world
- National Institutes of Health
- Centers for Disease Control
- Various STEM Education Organizations
- Commercial Spaceflight Federation
- FAA/COMSTAC

PI Experience & Interface Organizations



Facilities

- The Wyle Mechanical Engineering Design and Fabrication facilities located in Houston, TX provide the following capabilities:

- Flight hardware design
- Design and model translation from Pro/E to Solid Works and back and general model exchanges
- Assembly, test, and analysis
- COTS modifications and certifications
- Prototype and hardware fabrication – build to print/build to solid model, 100 years machinist experience, metal finishing and inspection
- Soft-goods fabrication (i.e. kits)
- Controlled access areas
- AS9100 compliant