



Space Life Sciences New Initiatives Core Competencies

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New Initiatives

- 2011 Budget Proposal and new/enhanced program offices at JSC
 - Flagship Technology Demonstration Program - Program Office (new) – reports to Exploration Systems Mission Directorate (Doug Cooke)
 - Demonstrate critical space exploration technologies primarily through flight tests in space
 - Close collaboration with ISS Program Office to use ISS as a testbed
 - Commercial Crew Development Program – deputy program manager (new) Works with Program Manager at KSC
 - Leverages JSC expertise in Commercial Crew/Cargo Program Office (C3PO). Includes new Commercial Crew Development (CCDev) Space Act Agreements
 - Additional FY 2011 funds to incentivize current program
 - Works closely with ISS Program Office



New Initiatives



- 2011 Budget Proposal (cont)
 - Human Research Program (HRP) – existing program office at JSC with increased funding
 - Areas of increased emphasis
 - Biomedical technology
 - Space radiation
 - Behavioral health
 - Funds a substantial (>60%) of the Space Life Sciences Directorate (SLSD) work
 - New research content through competitive solicitations
 - ISS Program Office (existing)
 - Extends the life of ISS to 2020
 - Serves as the ISS national laboratory
 - Biotechnology and ISS Utilization



Commercial Crew



- The primary objective of the proposed commercial crew initiative is to facilitate the development of a U.S. commercial crew space transportation capability with the goal of achieving safe, reliable, and cost effective access to and from LEO and the International Space Station (ISS).
- Once the capability is matured and expected to be available to the Government and other customers, NASA could purchase commercial services to meet its ISS crew transportation needs.



Commercial Crew



- Program approach is planned to be different from a traditional NASA development effort “Commercial Crew” means both NASA and the Commercial Partners (CP”s) have investment funds “in the game”
- NASA will initially take the role of government investor
- Develop tools and processes that allow us to be a Smart Buyer for our government technical and business investment in LEO human transportation systems
- As Smart Buyers, we will clearly state NASA”s safety requirements and ensure they are met through the use of an innovative insight/oversight approach

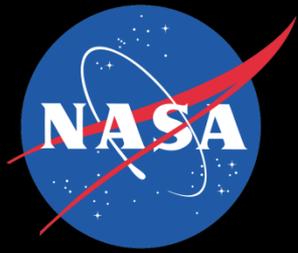


Commercial Crew



- Commercial Crew Development Program planning in full swing
- Program objectives established
- Insight/Oversight Roles established as a foundation for a solid partnership
- CCDev Round 2 will mature concepts, design and certification aspects of Commercial Crew systems
- Industry responsible for all phases of the Concept of Operations
- Minimizing GFE Interfaces to allow competitive innovation
- NASA Facilities available for use through Center and Commercial Partner arrangements
- NASA Commercial Crew effort preparing for development implementation

*SLSD Mission: To Optimize Human
Health and Productivity for Space
Exploration*





SLSD Core Competencies



- Technical core capabilities
 - Human health and performance in the space environment
 - Space medicine
 - Physiological and behavioral effects of spaceflight
 - Space environmental definition, including radiation, and its effects on human health and performance
 - Space human factors
 - Human-centered risk assessments and risk mitigation
 - Human health, environmental and performance standards and requirements development
- Home of the ESMD/Human Research Program Office
- Occupational Health Program
- Agency Health and Medical Technical Authority



SLSD New Initiatives



- Risk Management
 - Treat human in space as a “human system
 - Approximately 65 human system risks that defines the clinical, physiological, environmental and human factors work performed by SLSD
- Open Innovation and Collaboration
 - Pilot projects with open innovation service providers
 - InnoCentive
 - Yet2.com
 - TopCoder
 - Annual Rice Business Plan competition for Earth/Space life sciences prizes
- NASA Human Health and Performance Center
 - Link NASA centers, other agencies, academia and industry



Human System Risks

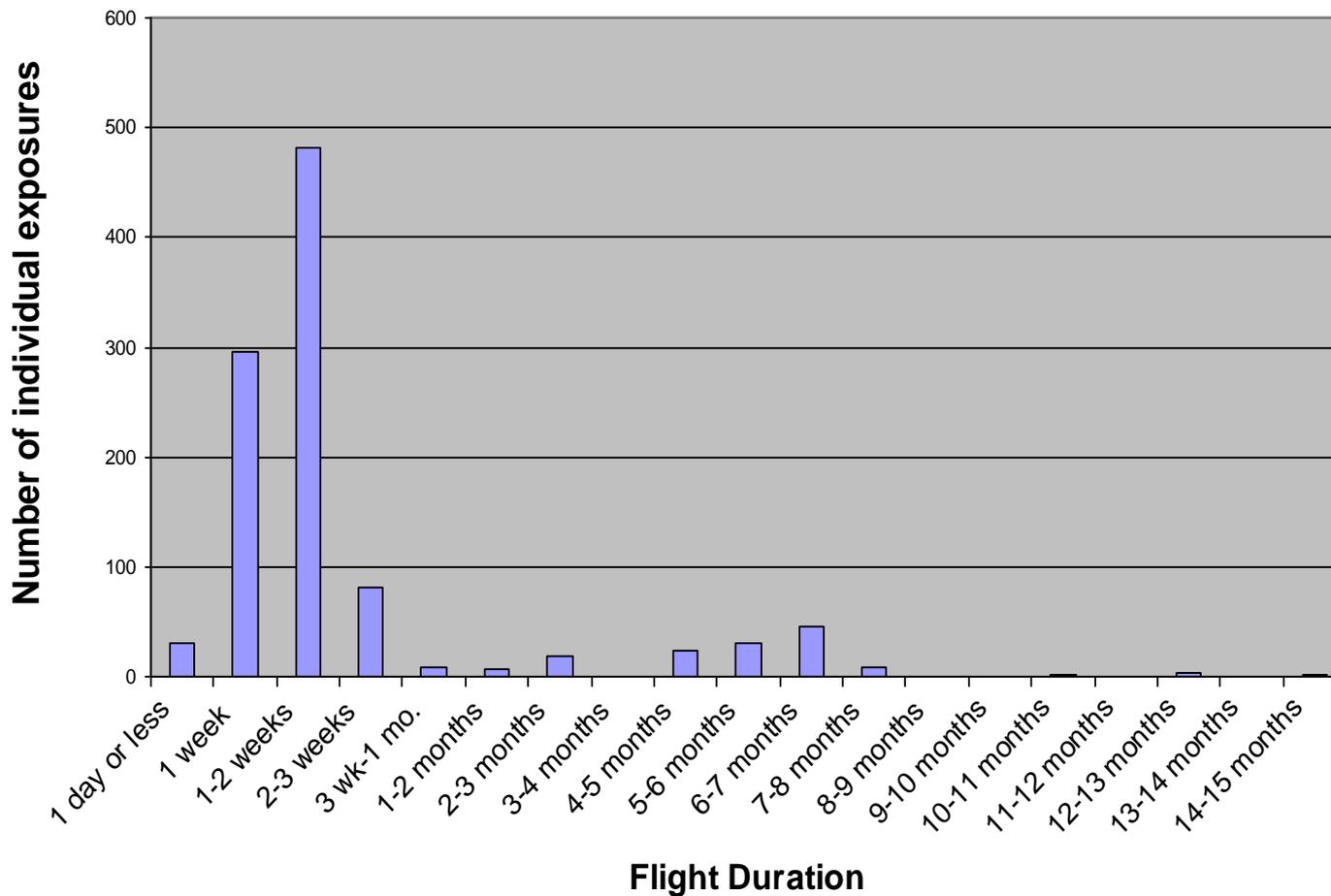


- The human is a key component of human spaceflight - challenges vary by mission
 - Low earth orbit
 - Moon
 - Mars
- Human system risk drivers
 - Human adaptation to space
 - Clinical diagnoses unrelated to spaceflight
 - System design
 - Environmental factors (air, water, microbiology, acoustics, radiation)
- JSC/Space Life Sciences Directorate provides expertise and leadership to actively manage human system risks





Human Spaceflight Experience

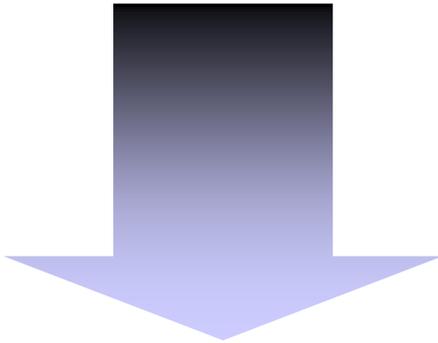




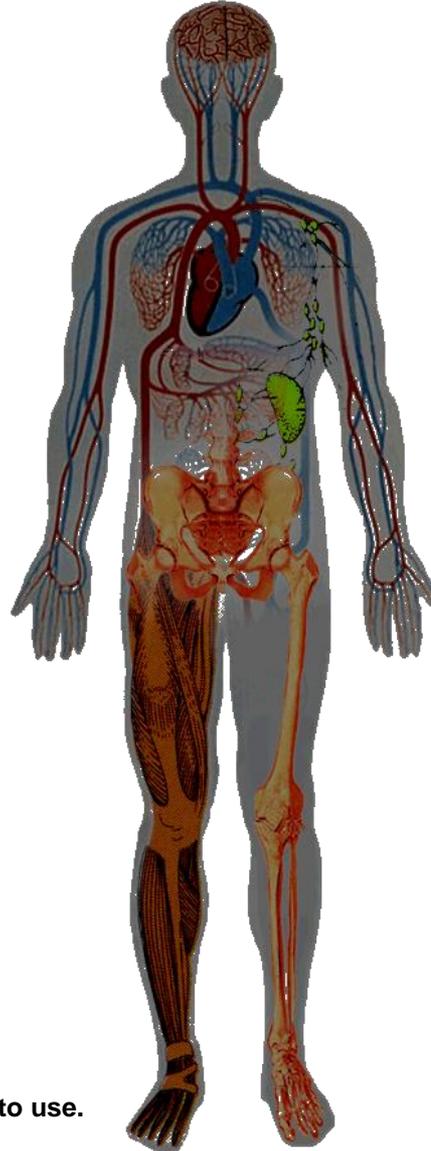
Human Response to Spaceflight



Astronauts experience a spectrum of adaptations in flight and postflight



Balance disorders
Cardiovascular deconditioning
Decreased immune function
Muscle atrophy
Bone loss



- Neurovestibular
- Cardiovascular
 - Bone
 - Muscle
- Immunology
- Nutrition
- Behavior
- Radiation



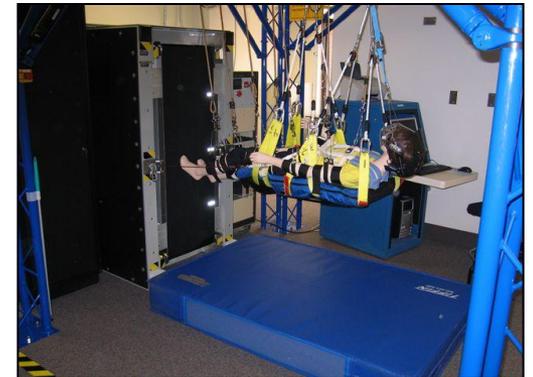
Countermeasures



Operational



Research





Diagnoses in Active Astronauts



- Major categories of Clinical diagnoses
 - Musculoskeletal (e.g. disk herniation)
 - Cardiovascular (e.g. high blood pressure, dysrhythmias)
 - Kidney and gallbladder stones
 - Ulcers and gastrointestinal bleeding
 - Cancer (e.g. skin, prostate)



Designing for the Human System



- Space Systems: mechanical, electrical, propulsion, habitation, information, human, etc.
- Quality human system design requires expertise and commitment
- Humans can adapt to poor designs but reliance on training (or other adaptation) increases operational overhead and life-cycle costs
 - System failures can escalate demands on human performance beyond adaptability limits
- Human crews live 24/7 among systems, therefore habitability risks (sleep, nutrition, exercise, recreation, etc.) must be managed to ensure high levels of human performance readiness





Environmental Factors



- Air and Water Quality Challenges
 - Combustion Events
 - Major events are relatively rare. Smaller-scale events occur
 - Chemical/Microbial Releases
 - Controls are in place, however releases from spacecraft systems or payloads can occur
 - Off-gassing:
 - Controls are in place, however issues occur
- Acoustic environment is a critical issue
- Microbial environment requires vigilance
- Radiation environment monitoring is critical to protect against late effects





Human System Risk Management



- Identify Risks to mission success and long-term health
- Risk identification is driven by specific mission objectives and our evidence base
 - Science – NASA, academic
 - Clinical – NASA, terrestrial
 - Operational experience
- Agency-level Standards used to define acceptable levels of risk
- Research projects to fill knowledge gaps, investigate and validate countermeasures, develop technologies
- Operational mitigations include exercise countermeasures, med kits, AED, etc
- JSC/Space Life Sciences Directorate (SLSD) leads an active risk management process to maximize mission success and quality of astronaut health



Human Research on ISS



- Establish an evidence base on crew health and performance for long duration missions in reduced gravity
- Identify greatest risks and develop optimal approach to mitigations and countermeasures
- Test space biomedical technology and medical care procedures
- Actively collaborate and share resources with the International Partners on space biomedical research

