NASA-Ames Research Center ... *in Silicon Valley*

Bringing Space Settlements Down to Earth:

Panel Discussion

Specific Recommendation:

=>Use Lunar Analog, Precursor, and Robotic Missions to Demonstrate and Validate Revolutionary Space Technologies

JUSTSAP Conference 2010

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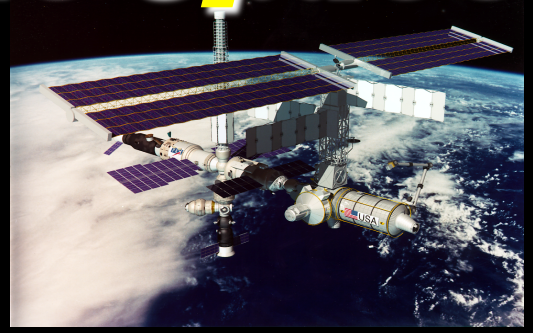
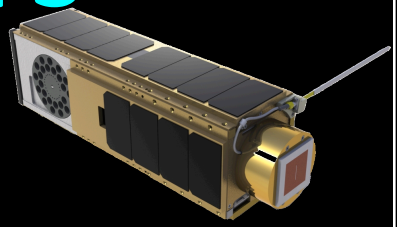
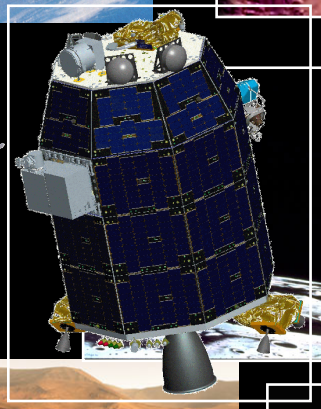
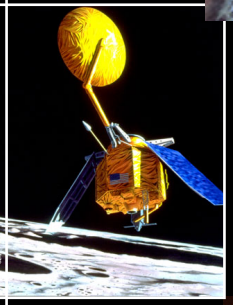
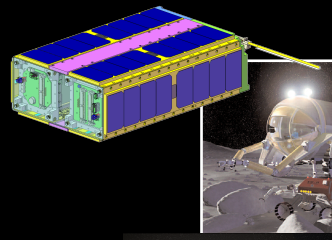
The Space Environment

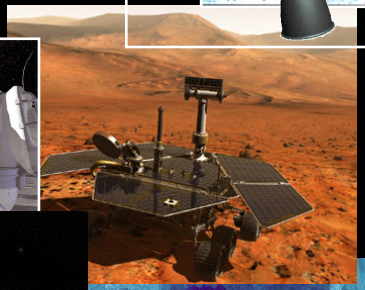
- ISS
- Free Flyers
- Asteroids
- **Moon**
- Mars
- Beyond

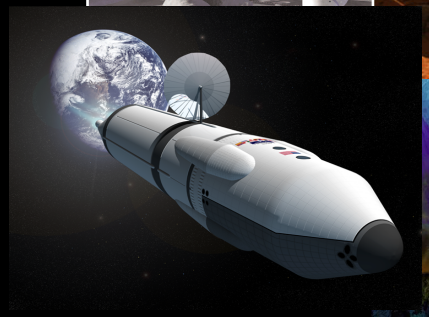
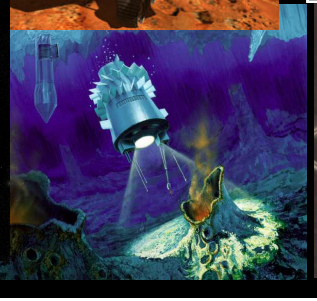


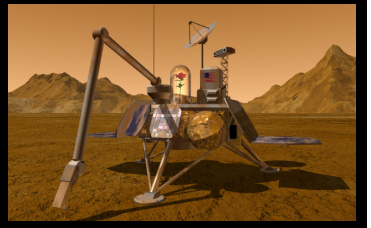








Grand Challenges (DRAFT)

Make space part of our routine environment…

Achieve fast and economical space transportation

Enable in-space commercial/ marketable services

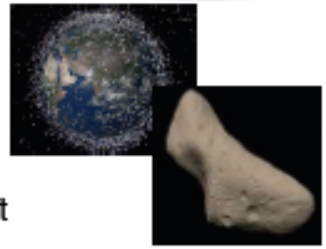
Improve spacecraft safety and protect astronaut health

Communications that enable virtual presence

Manage space as a natural resource…

Gain knowledge 0f climate change and natural disasters

Provide economical energy on demand

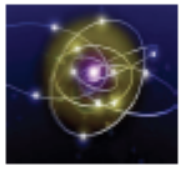


Improve Knowledge of the near-earth environment

Invent the materials of exploration using in-situ manufacturing

Quests of the Future…

Exploit machine intelligence/robotic autonomy



Understand laws of the universe

Discover life and earth–like worlds

Space Technology Roadmap Areas

1. LAUNCH PROPULSION SYSTEMS
2. IN-SPACE PROPULSION SYSTEMS
3. SPACE POWER AND ENERGY STORAGE SYSTEMS
4. ROBOTICS, TELE-ROBOTICS, AND AUTONOMOUS SYSTEMS
5. COMMUNICATION AND NAVIGATION SYSTEMS
6. HUMAN HEALTH, LIFE SUPPORT AND HABITATION SYSTEMS
7. HUMAN EXPLORATION DESTINATION SYSTEMS
8. SCIENTIFIC INSTRUMENTS, OBSERVATORIES, AND SENSOR SYSTEMS
9. ENTRY, DESCENT, AND LANDING SYSTEMS
10. NANOTECHNOLOGY
11. MODELING, SIMULATION, INFORMATION TECHNOLOGY AND PROCESSING
12. MATERIALS, STRUCTURAL AND MECHANICAL SYSTEMS, AND MANUFACTURING
13. GROUND AND LAUNCH SYSTEMS PROCESSING
14. THERMAL MANAGEMENT SYSTEMS
15. AERONAUTICS

Building Disruptive and Game Changing Technology

Strategic Opportunities

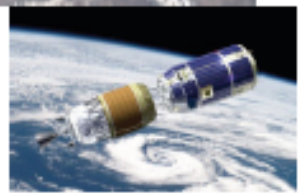
Scientific Discovery

Human and Robotic Exploration

New and Innovative Space Technologies and Mission Capabilities

Challenge Goals

Enabling Capabilities



Systems Capabilities

Transformational Technology Demonstration

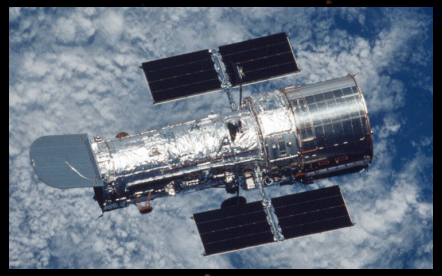
- Energetic Materials
- Inflatable Aerocapture
- Optical Communication
- Nano electronics
- Radiation Shielding
- Expandable Structures
- Robotic Repair
- Engineered Materials

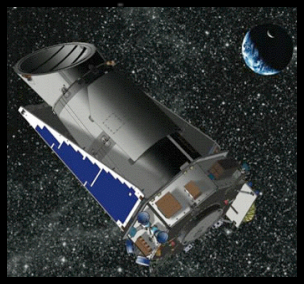
Examples of New Technologies

- Small Satellites
- Synthetic Biology

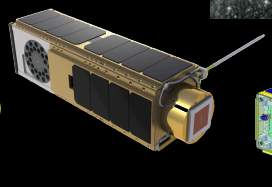
Spacecraft Mission Sizing

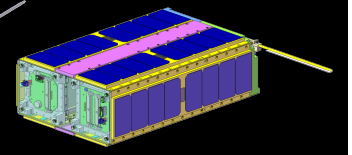
- Larger Spacecraft Excel at:
  - Large Diameter Sensors, Optics, Antennas, Detectors
  - Large Scale Investigations, Several Instruments
  - Lower calculated risk per individual mission
  - Lower cost per kilogram
  - Utilize “Proven Launchers”

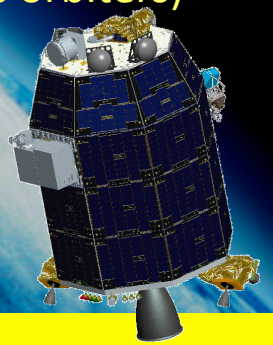


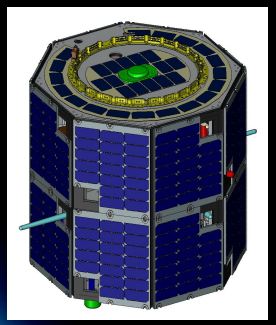


- Smaller Spacecraft Excel at:
  - Simple Focused Missions, Science, Technology or Ops Demo
  - Unique Data Obtained in Near Term (Solar Cycle)
  - Short Duration Missions (<14 days for Landers, <2 years orbiters)
  - Diversity of operating sites, landing sites or Orbits
  - Lower Cost Enables Increased Number Of Missions
  - Faster Learning Cycle, Lead to Lower Costs
  - If New Technology Sooner, Lowers Cost of Flagship Missions
  - Smaller Teams, Fewer Interfaces, Improved Collaboration





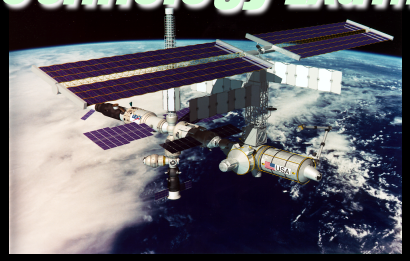




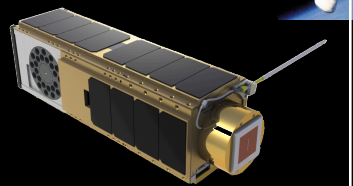
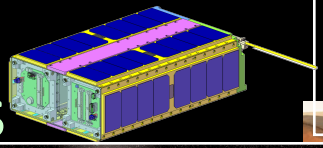
ADVANCES IN MINIATURIZATION ARE CLOSING THE GAP

Synthetic Biology

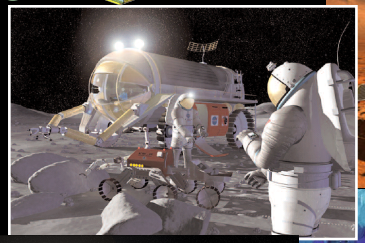
(Disruptive Technology Example and Potential Applications)





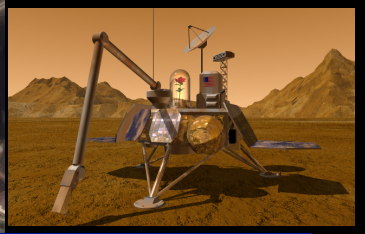











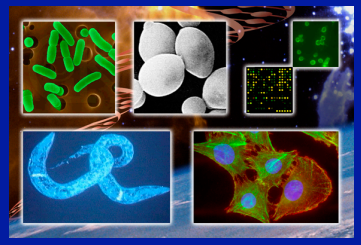
- Food Production
- Biological-ISRU
- Advanced Sensors
- Advanced Materials
- Life support loop-closure
- Space Medicine
- Life Detection
- Scientific Discovery

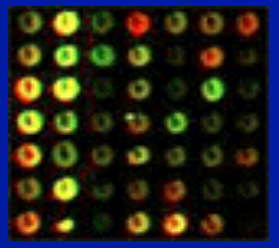
Vision: To harness biology in reliable, robust, engineered systems to support NASA's exploration and science missions, to improve life on Earth, and to help shape NASA's future

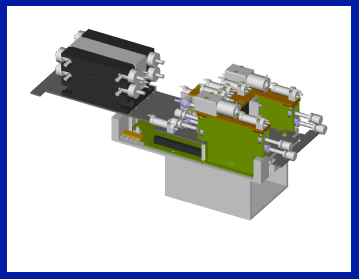
Smart Autonomous Bioanalytical Laboratory (SABL)

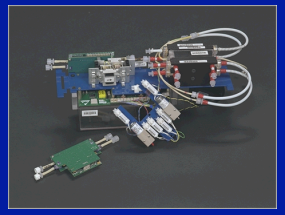
Hardware Elements

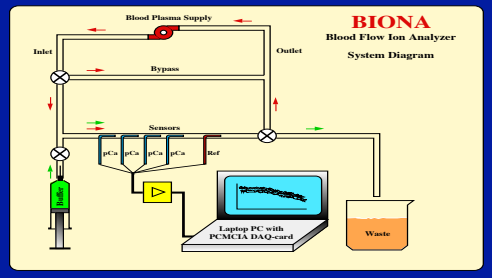
- Specimen Habitat
- Sample Handling
- Process Monitoring
- Process Control
- Bioreactor
- Mtg, Prod (scale up)
- Application/Utilization

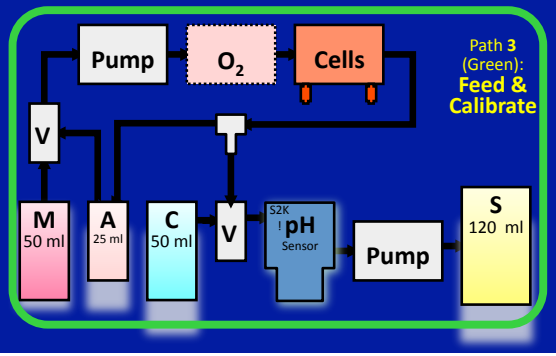


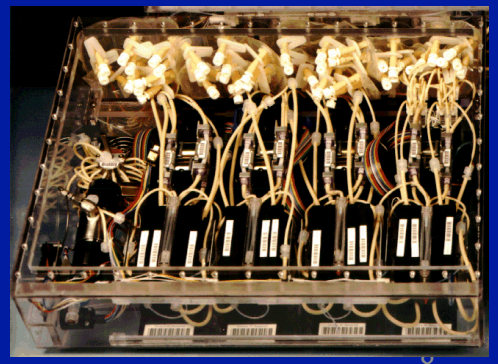




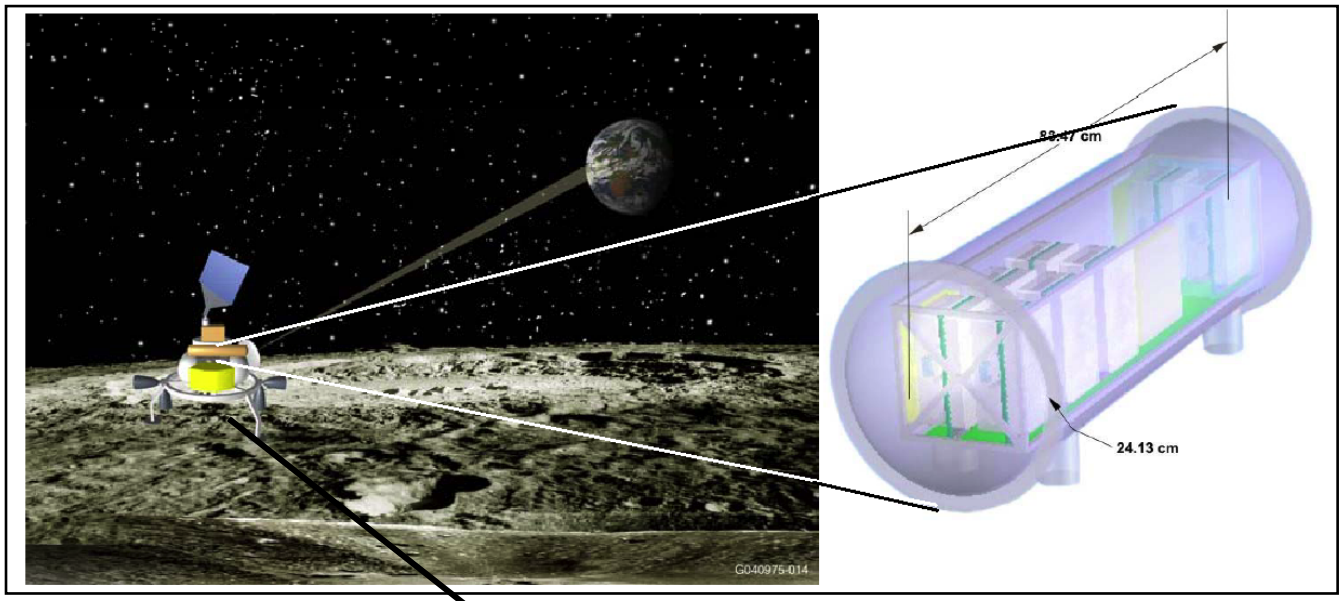


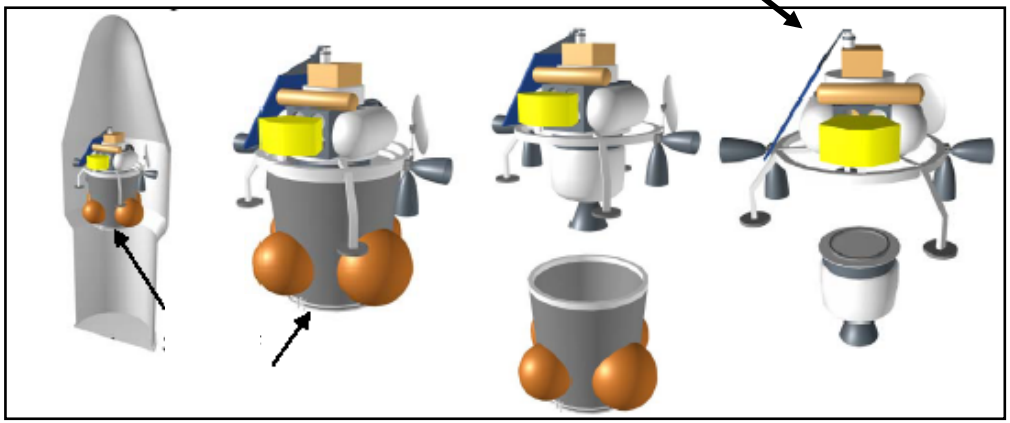


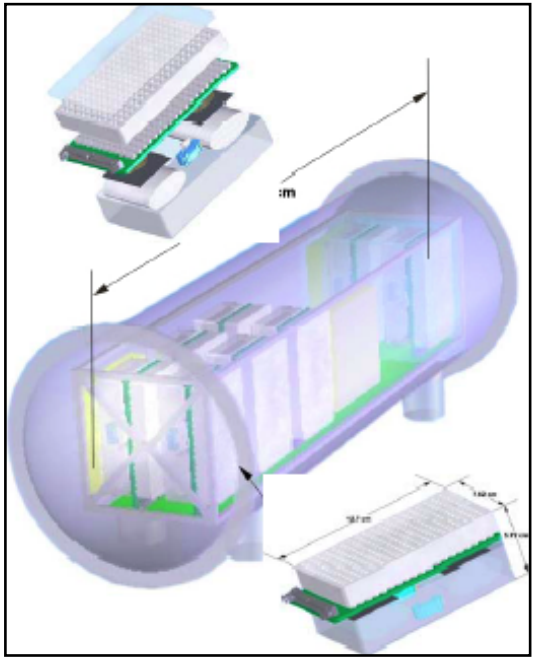




SABL Planetary Laboratory Concept -- (GeneLander Example)







Technology and Innovation Strategy

… Addressing Global Needs