

Commercial Space Biotech: Supply/Demand/Capital

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Recent Workshops

- ISS Entrepreneurial Paradigm Workshop
June 21-22, 2005
- Entrepreneurial Space Forum October 3-5,
2005
- NASA 2005 Authorization Potluck
Workshop January 17-19, 2006
- Results are posted at
www.alliancespace.net

The Microgravity Biotech Potential

- The only life we know of in the Universe is in its first generations beyond the planet of origin an environment that it has never known before
- Results to date are exciting but not conclusive but provide very real potential for developing **life saving** and **wealth generating** knowledge from microgravity research that can be applied on earth
- The tools developed for the biotech revolution have not been used in space
 - Learning potential has been increased a million fold

Microgravity/RWV* Results

- Significantly improvement in cell cultures of all the major organs, infectious diseases and cancer, kidney and liver disease and diabetes
- Infectivity increased by a factor of 10x
- Plant growth and environmental remediation for lignen
- Protein crystalization success
- RWV is the new standard for 3D cell growth
 - Over 20,000 are in use

*Rotating Wall Vessel

Space – Getting There Is Half The Fun?

- Getting to space (especially with NASA) has been frustrating, time consuming, and expensive:
 - Time required > 3-10 years
 - Cost (more than just the launch)
 - Repeat flights often difficult or impossible
 - Bureaucracy
 - Risks of all sorts
 - Intellectual property protection
- Only the very hardy have been willing to endure this
- Recent program cancellations are being driving investigators off shore

Reliable Throughput Is The Key

- Biotech runs on high throughput and short learning cycles:
 - Develop experiments quickly
 - Integrate and launch experiments
 - Perform experiment
 - ISS, free flyer, private manned laboratory
 - Get samples back and analyze results
 - Iterate experiment and re-fly

Getting To Space Options

- Current launch vehicles
 - Shuttle - NASA
 - Atlas – Lockheed Martin
 - Delta - Boeing
 - Pegasus - Orbital Sciences
- Some of the entrepreneurs include:
 - SpaceX with the Falcon 1,5 & 9 (Elon Musk)
 - Rocketplane/Kistler with the K1
 - tSpace with the CXV
 - Blue Origin (Jeff Bezos)
 - Armadillo Aerospace (John Carmack)
 - Virgin Galactic/Scaled Composites (Branson/Allen)
 - Garvey Spacecraft

On Orbit Service Options

- Manned Facilities
 - ISS – NASA and International
 - Bigelow
 - Space Island Group
 - Requires rendezvous and docking/berthing
- Free flyer
 - SpaceHab
 - Constellation Services
 - NASA

CGBA Currently Onboard ISS

- Commercial Generic Bio-processing Apparatus (CGBA) is currently on-orbit
- Developed by Bioserve Space Technologies University of Colorado
- Middeck locker sized apparatus
- CGBA is capable of holding temperatures between 4 and 37 degrees C for each of 8 sample volumes
- Highly automated
- Only need to add test sample canisters
- There are other bio instruments scheduled to fly from a variety of nations in the next 12 months

ISS 2010 Capability

- 13 International Standard Payload Racks
- 25 kW_{avg}
- 150 Mbps downlink (Ku band)
- 72 Kbps uplink (S band)
- 70-75% transmission coverage
- 35 hrs/week of crew time

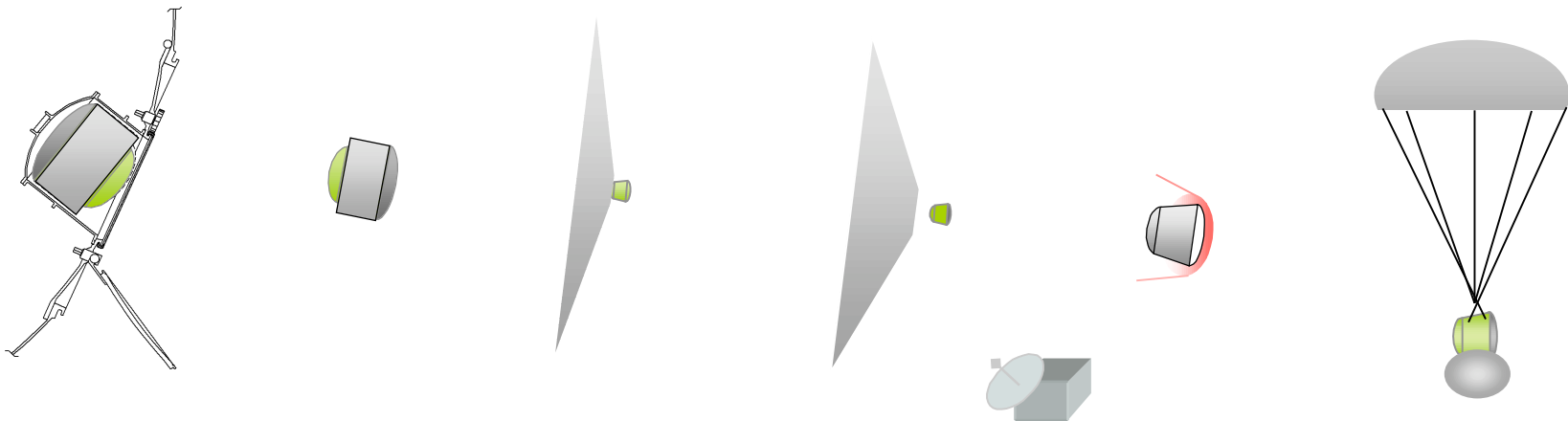
After spending >\$50 billion to develop ISS what will we do with this capability?

Return of Samples Options

- Shuttle
- Soyuz
- SpaceHab
- tSpace
- Small Payload Earth Express Delivery (SPEED)
- Others?

Returning Small Samples To Earth

- Regular, frequent return of small samples for analysis is critical for accelerating the learning cycles
 - Weekly return of small samples 1-2 kg and 3-4 liters seems optimum
- Tether Applications has developed SPEED (Small Payload Earth Express Delivery)



Marriage Made In Heaven

- We have a lot of people who want to build and launch rockets
- We have people who desperately want to fly their experiments in space
- We have people who want to provide on-orbit services
- This has all the makings of a “perfect storm” what is needed is some “pump priming” by the government

Commercial Investment

- Verification of initial results and program continuity
- Regular, cost effective access to and from orbit
- Reliable equipment and resources on orbit to perform experiments
- Ability to rapidly iterate results to accelerate learning cycles
- Protection of intellectual property
- Reasonable regulatory environment
- “Friendly front door” to help guide the process

Government Support Required

- Validate previous experimental results
 - Support to researchers and graduate students who are losing funding
 - Fly experiments that are already in the queue
 - Encourage and support the next generation of scientists
- Support development and initial use of commercial infrastructure
 - Experiment development
 - Launch
 - On-orbit services
 - Return
- Tax incentives for those who invest
- Roll back ITAR

Commercial Space Biotech Potential

- We are on the verge of success
- The pieces that we need are in place or in development
- The new Exploration priorities are putting the biotech potential at great risk
- Help put supply and demand sides together to attract private capital
- Prime the pump with a 5 year program
- Or leave this field for other nations to reap the benefits