Space Life and Physical Sciences and Applications –

Research for Human Exploration

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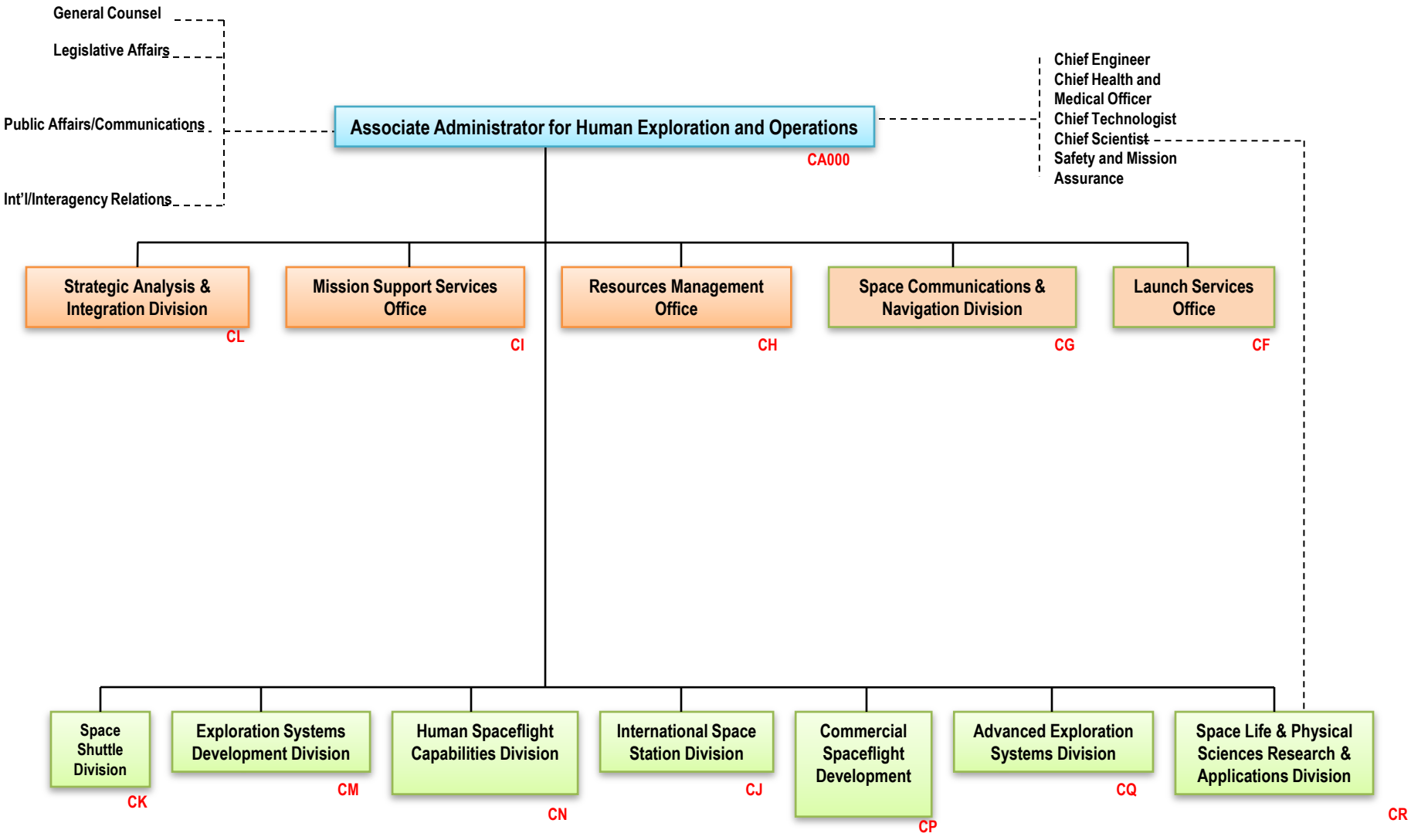
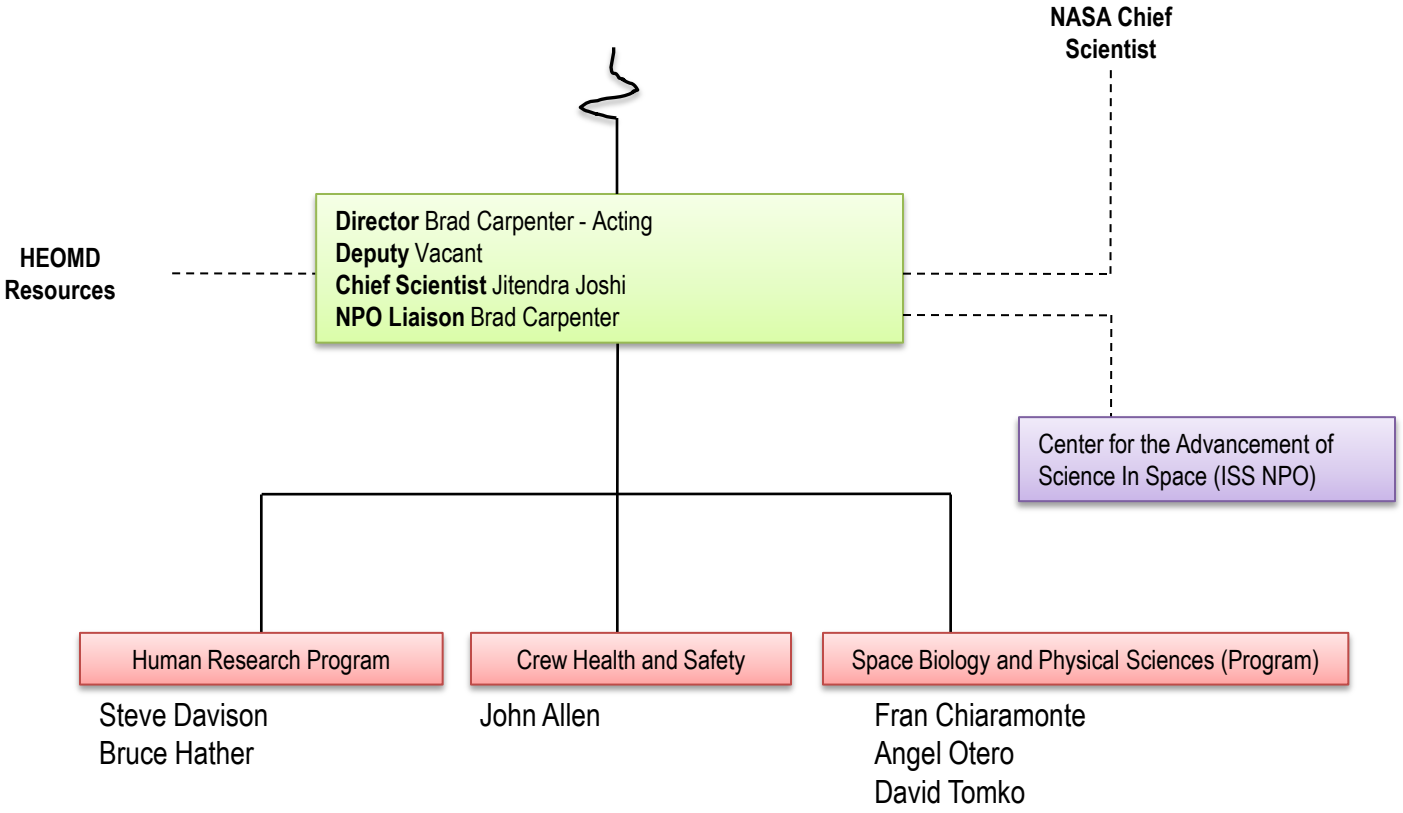
Exploration and Research

- Curiosity, Discovery, and Learning are common to Exploration and Research
- Research is Exploration with structure
- Human Exploration of Space is driven by two big questions – What does the universe contain? and, What is the future of human civilization? Exploration and Research work together to pursue those questions.
- Research prepares for Exploration
- Research creates value from Exploration
- SLPSRA is the Research in Human Exploration

Human Exploration and Operations Mission Directorate



Space Life and Physical Sciences Research and Applications Division



Human Research Program

Reduce spaceflight risks to humans and focus on the highest risks to crew health and performance during exploration missions

Program Element	FY 2012 Planned Procurement Budget ($M)
Program Science Management/NSBRI	35.5
ISS Medical Project	17.2
Space Radiation	38.4
Human Health Countermeasures	31.4
Exploration Medical Capability	6.8
Space Human Factors & Habitability	7.2
Behavioral Health & Performance	3.1
(Total)	139.6

Human Research Program - Outlook

Program architecture of Evidence→ Risks→ Gaps→ Tasks→ Deliverables addresses risks reviewed and endorsed by the National Research Council and Institute of Medicine

Budget is essentially flat at ~$135M

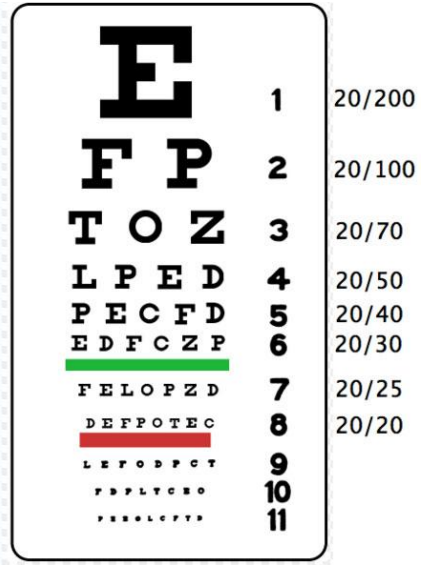
Need dates for exploration mission-related deliverables is uncertain, but HRP's focus is on efficiency of projects, and effective use of the ISS.

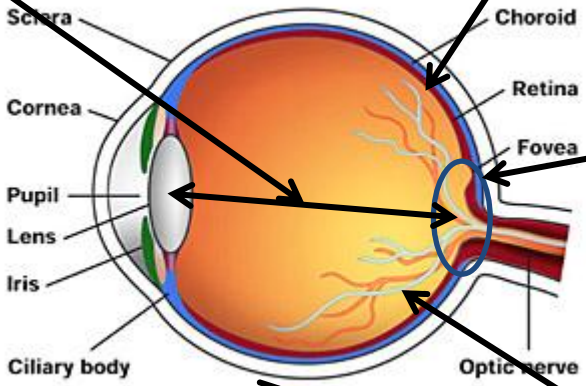
Still learning basics of space physiology – e.g., value of Artificial Gravity and Visual Acuity/ Intracranial Pressure are open areas

Human Research Program – Visual Impairment/Intracranial Pressure

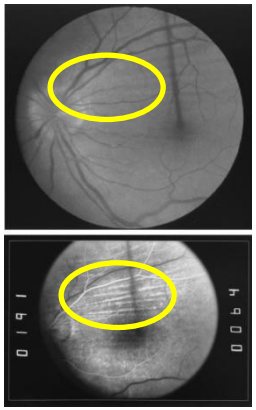
- 7 cases identified (of 34 long duration crew) with inflight visual changes and pre-to-postflight refractive changes.
  - Elevated Intracranial Pressure measured postflight

Hyperopic Shifts
Up to +1.75 diopters

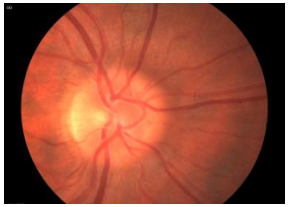




Choroidal Folds
parallel grooves in the posterior pole

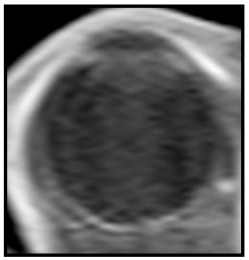


Optic Disc Edema (swelling)

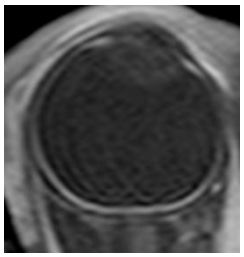


Vision distortion
"wool" spots

Globe Flattening



Normal



Flattened

MRI Orbital Image showing globe flattening

Crew Health and Safety

Medical care and occupational health and safety for past, current, and future astronauts

Program Element	FY 2012 Planned Procurement Budget ($M)
Clinical Services	11.8
Clinical Status Evaluation	0.5
Computerized Medical Information System	1.3
Crew Health Surveillance	0.7
Environmental Monitoring	0.4
Lifetime Surveillance of Astronaut Health	2.0
Remote Medical Diagnostics and Informatics	1.2
Other Small Tasks	1.5
(Total)	19.4

Crew Health and Safety - Outlook

CHS is Budget is essentially flat at $18-19M

Health care costs rising costs 7% per year

Relationship between medical operations and biomedical research is a perennial source of concern

Space Biology and Physical Sciences

Basic research in biological, physical, and engineering sciences, for ISS utilization and future exploration missions

Program Element	FY 2012 Planned Procurement Budget ($M)
Grants/PI Support	9.6
Flight Experiment Development	21.3
Flight Experiment Operations	6.3
Center Science Support	3.7
Center Program Management	3.3
CASIS (ISS Non-Profit Organization)	15.0
(Total)	59.2

Space Biology and Physical Sciences - Outlook

Digesting the recent National Research Council Decadal Survey on Biological and Physical Sciences Research in Space; preparing a plan for OMB on implementation

NRA's open for Fundamental Physics and Space Biology

New capabilities for biological research on ISS through the ISS Functionality budget – rodent habitats and plant research facilities initiated

FY 2013 budget line supports new flight research, including PI-led flight project opportunities. PI-led projects will include a requirement for university engineering student involvement.

Developing initiatives for significant new ISS research capabilities for consideration in 2014 budget process, to prepare for 2020 ISS life extension.

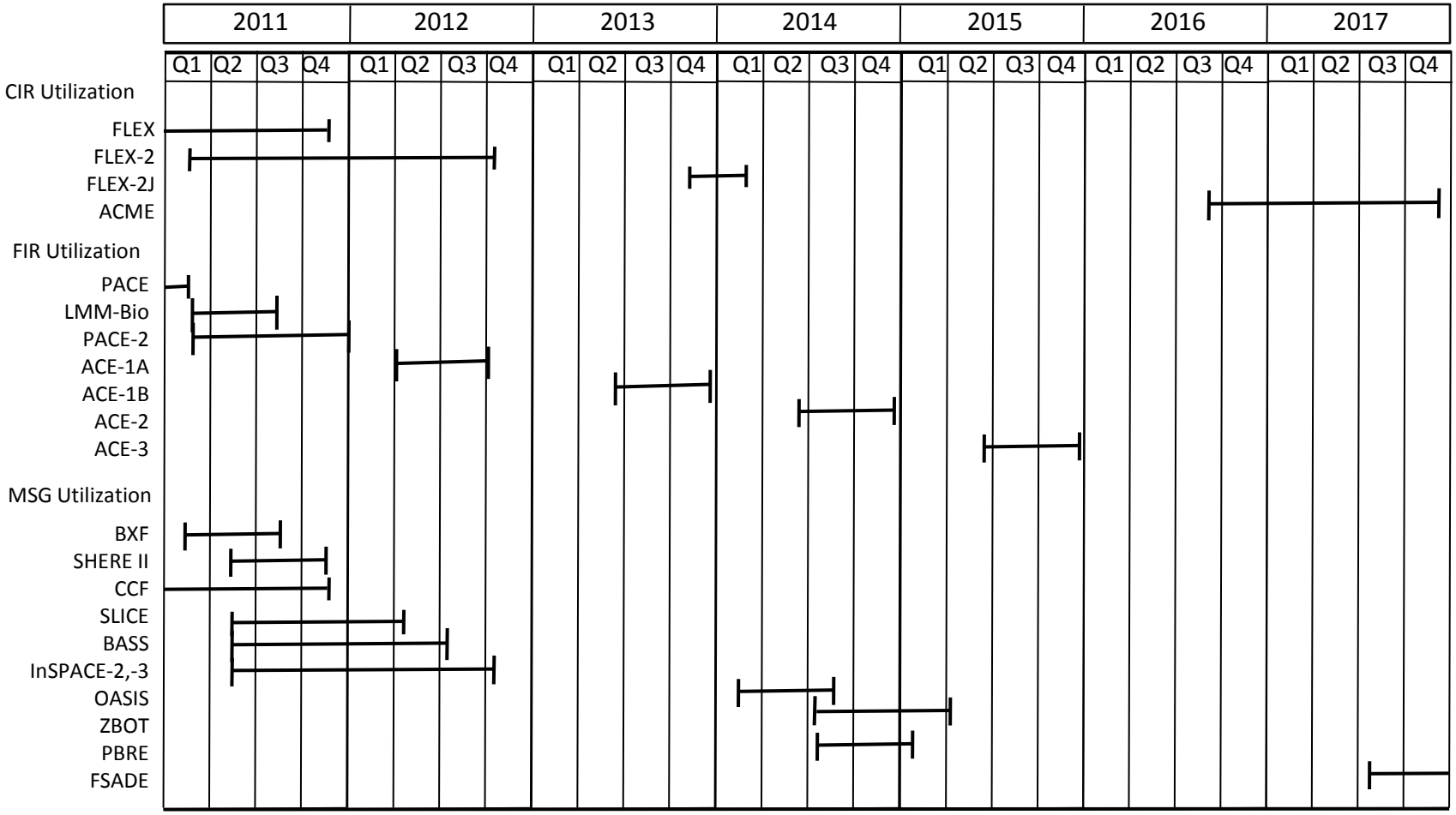
NRC Decadal Recommendations

TABLE 13.2 Highest-Priority Recommendations That Provide **High** Support in Meeting Each of Eight Specific Prioritization Criteria

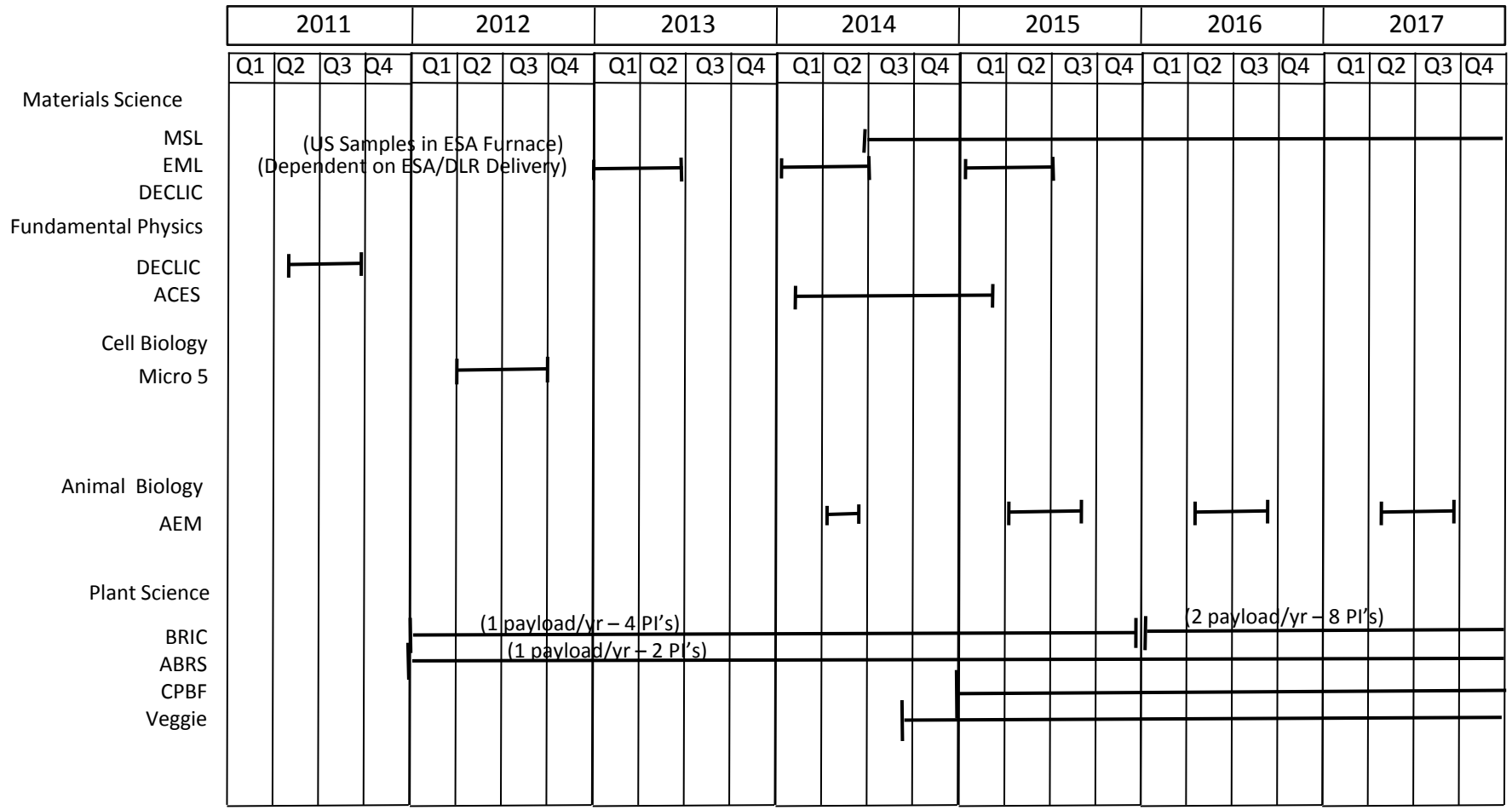
	<----------Prioritization Criteria---------->							
	(1) Positive Impact on Exploration Efforts, Improved Access to Data or to Samples, Risk Reduction	**(2)** Potential to Enhance Mission Options or to Reduce Mission Costs	**(3)** Positive Impact on Exploration Efforts, Improved Access to Data or to Samples	**(4)** Relative Impact Within Research Field	**(5)** Needs Unique to NASA Exploration Programs	**(6)** Research Programs That Could Be Dual-Use	**(7)** Research Value of Using Reduced-Gravity Environment	**(8)** Ability to Translate Results to Terrestrial Needs
Life Sciences	P2, P3, B1, B2, B3, B4, AH1, AH2, AH3, AH5, AH6, AH7, AH8, AH9, AH10, AH11	P3, B1, B2, B3, B4, AH6, AH9, AH10, AH11	P3, B4, AH1, AH2, AH3, AH5, AH6, AH7, AH8, AH9, AH10, AH11	P1, P2, B3, B4, AH9, AH10, AH11, AH16	P1, P2, P3, AH1, AH2, AH3, AH4, AH5, AH6, AH7, AH8, AH9, AH10, AH11, AH16	B1, B2, B3, B4, AH1, AH2, AH3, AH4, AH5, AH6, AH7, AH9, AH10	P1, B1, B4, AH12, AH16	B1, B2, B3, B4, AH1, AH2, AH3, AH4, AH5, AH6, AH7
Translational Life Sciences	CCH2, CCH4, CCH7	CCH2, CCH4, CCH6, CCH7	CCH2, CCH4, CCH6, CCH7, CCH8	CCH2, CCH6	CCH1, CCH2, CHH3, CCH6, CCH7, CCH8		CCH1, CHH2, CHH3, CCH7, CCH11	
Physical Sciences	AP1, AP4, AP6, AP8, AP11	AP1, AP2, AP10, AP11	AP1, AP2, AP3, AP10, AP11	FP1, FP2, FP3, AP5, AP7, AP8, AP9	AP1, AP2, AP3, AP4, AP6, AP11	AP7, AP8, AP9, AP10	FP1, FP2, FP3, FP4, AP1, AP2, AP5, AP6, AP7, AP9	AP1, AP2, AP7, AP8, AP9
Translational Physical Sciences	TSES1, TSES2, TSES3, TSES14	TSES1, TSES3, TSES5, TSES10	TSES14		TSES2, TSES3, TSES4, TSES5, TSES6, TSES7, TSES12, TSES13, TSES14, TSES 16	TSES10, TSES11, TSES12	TSES1, TSES2, TSES3, TSES4, TSES5, TSES12, TSES13, TSES14, TSES15, TSES16	TSES10

NOTE: Identifiers are as listed in Table 13.1 and correspond with the recommendations listed there and also presented with clarifying discussion in Chapters 4 through 10.

ISS Utilization Strategy- 1



ISS Utilization Strategy -2



CASIS

Center for the Advancement of Science in Space has been awarded a cooperative agreement valued at $15M per year for 10 years. The primary office will be in the Space Life Sciences Laboratory building adjacent to KSC.

Dr. Jeanne Becker is the Executive Director of CASIS. She has been a NASA PI on several projects, has worked for NSBRI, and has held several academic positions.

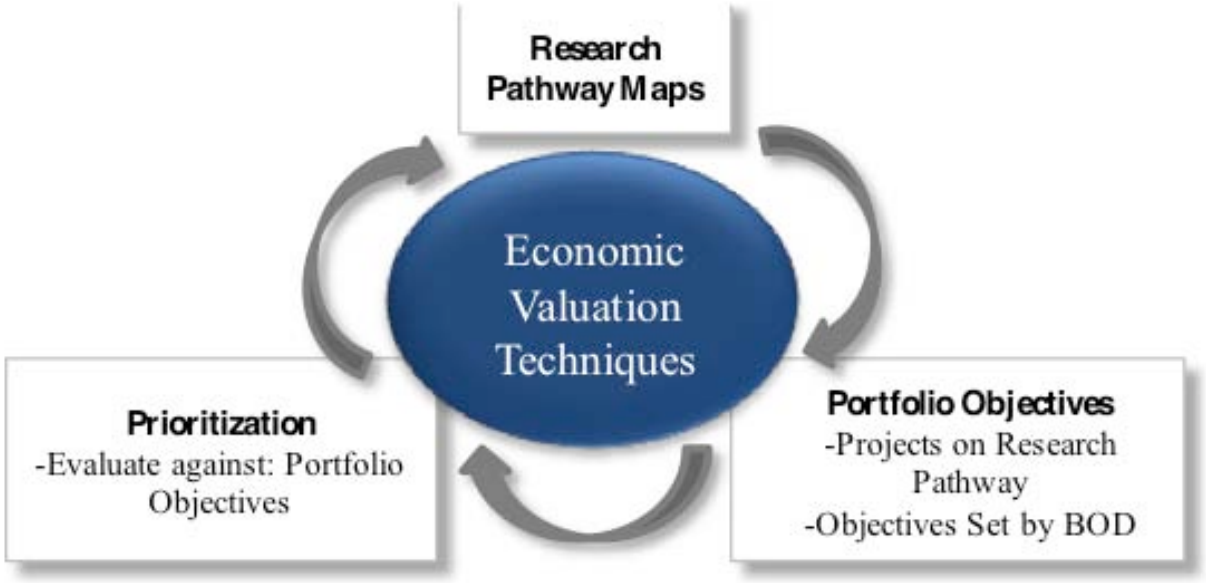
CASIS is an important step in the evolution of space development – CASIS will explicitly seek external funding for space research.

Economic valuation of potential projects through research pathway definition and supply chain analysis are key management tools. The economic valuation will estimate impacts including social value, e.g. inspirational influence on children in school.

CASIS's first research solicitation is expected in late 2012. CASIS's achievement of its first brokered investment in ISS research is a performance milestone for 2013.

CASIS

Research Pathway Map

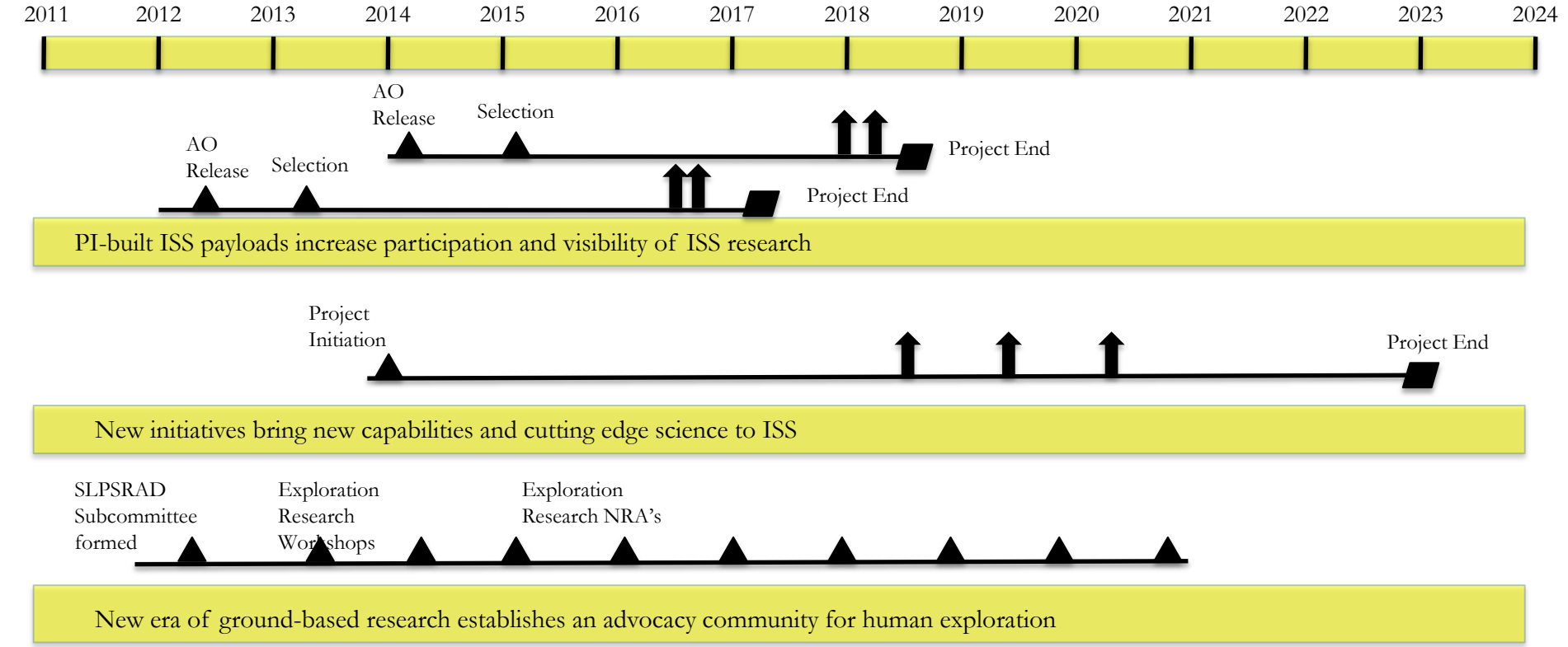


Economic Valuation of Research Projects

CASIS

CASIS Marketplace Concept

Proposed Long Term Strategy for Space Biology and Physical Sciences



Proposed SLPSRA Advisory Subcommittee

Near-term objective will be to advise on the tactical implementation of strategic guidance, e.g. from the NRC

Primary long-term function will be to advise HEOMD on the development of a stable research community and research program that will effectively support future exploration missions in multiple dimensions

Recommended composition of the committee would support long-range exploration and research objectives – individuals who understand SLPSRA content, but who represent a breadth of perspectives on exploration, research, and higher education rather than specific discipline interests