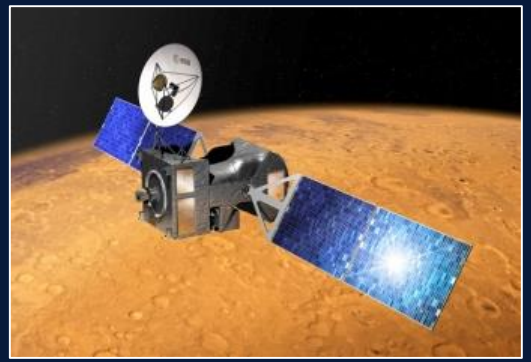
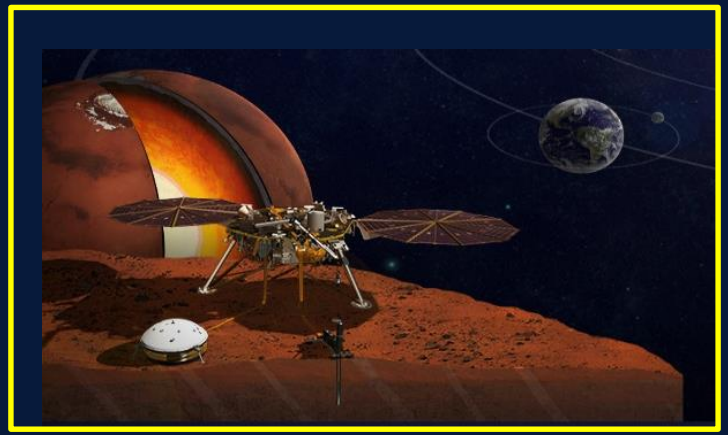
Forum Introduction: Mission Concepts for the next Decadal Survey





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Preparing for the next Planetary Decadal Survey:

Building on discoveries of past/ongoing missions and new technologies

✓ The return of samples prepared by NASA's Mars 2020 rover continues to be a priority

- During the Mars Sample Return (MSR) era (~2023-2032) what are the additional high-priority science questions that could be addressed via mission concepts in all classes?

➢ Forum concept: Provide the community opportunities to discuss…

- High-level science objectives or questions
- Importance of specific types of observations/measurements/analyses
- Science or technology strategies (e.g., multiple small rovers or subsurface access)
- Mission concepts in all classes
  - ❑ Small satellite missions/secondary payloads enabled by strategic mission launch capabilities
  - ❑ Competed missions (Discovery, New Frontiers, Large strategic missions)
  - ❑ Follow-on flagship capabilities

❖ Goal of Forum: Identify concepts and collaboration opportunities for serious consideration by the next Planetary Decadal Survey

➢ Which would most benefit from studies/workshops organized by MEPAG or MEP to facilitate maturation of concepts and/or technological areas?

Preparing for the next Planetary Decadal Survey:

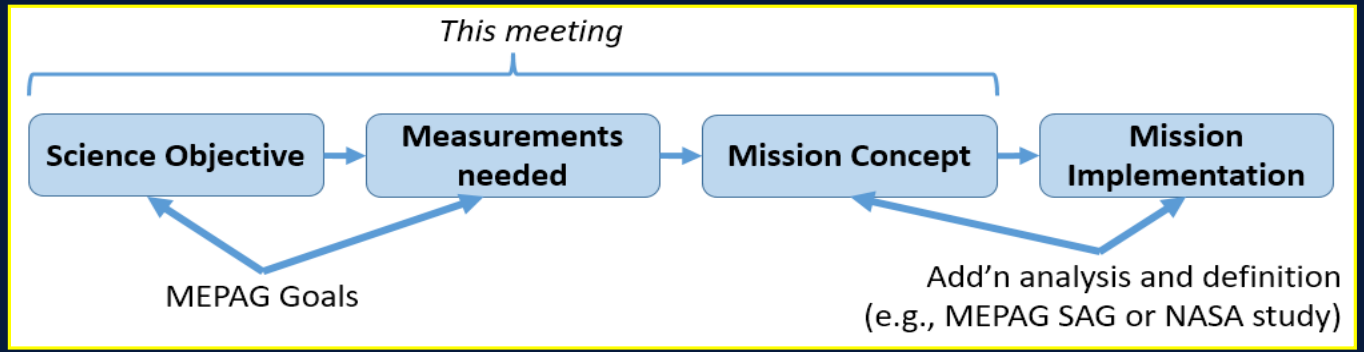
Forum Preparations

- After an initial call for indications of interest, 1-page abstracts were requested by Feb. 22
  - Received 31 abstracts
  - Abstracts posted on MEPAG website: https://mepag.jpl.nasa.gov/meetings.cfm?expand=m36
- Forum presenters were asked to provide 1-slide “lightning talk” and posters
  - Posters can be placed on MEPAG website if desired
- Poster session details
  - Two hours provided to discuss/share concepts with colleagues across multiple disciplines
  - Split into two 1-hour sessions to allow presenters time to read others
  - “Synthesizers” will be taking notes and summarizing discussions
- Following the poster session, there will be a facilitated discussion
- The forum’s key results will be summarized today/tomorrow via presentation/discussion

Preparing for the next Planetary Decadal Survey:

Forum Configuration

- To best facilitate the presentations and discussion, we asked the presenters to:
  - Focus on the science question(s) and measurements that their concept would address, rather than implementation specifics (see Figure below)
  - Provide a zeroth-order mapping to specific portions of the 2015 MEPAG Goals document (or identify a gap in the MEPAG Goals, if you think one exists)
  - Identify the type of information needed to mature the concept for consideration by the next Planetary Science Decadal Survey Committee



Preparing for the next Planetary Decadal Survey:

Questions to be addressed

1) What are the high-priority science questions that could be answered over the next two decades via Mars investigations?

2) What type of mission class(es) could be used to significantly address this science (in part or in full)?

3) Does addressing a particular science question (or a particular mission concept) fall into this next decade (2023-2032), or should we consider it more as a follow-on to MSR (which may still involve some work in the coming decade)?

4) Are there topics/questions that could be addressed by a MEPAG study or workshop, that would better enable a particular concept or class of concepts to be considered by the 2023-2032 Decadal Survey Committee?

Preparing for the next Planetary Decadal Survey:

- Note:
  - This is not the only (or final) opportunity to discuss ideas
    - This forum could be repeated in future meetings, if desired
    - We understand that some may not be able/ready/willing to discuss competition-sensitive ideas
    - The focus for MEPAG is what compelling scientific objectives can be credibly addressed—and thus endorsed—in the next Decadal Survey
- Use the forum as an opportunity to:
  - Learn
    - Think
      - Critique
        - Establish collaborations
          - Prioritize and Advocate

Preparing for the next Planetary Decadal Survey:

Focus Themes based on 31 submitted abstracts

- Ice/Polar studies (6)
- Modern/present surface and climate (10)
- Humans and astrobiology (6)
- Strategies from orbit/surface/subsurface (9)

Comparison of Forum Abstract Topics to Goals Document

Are community interests consistent?

Goal	Obj.	Sub-Obj.
I	A	1
		2
		3
	B	1
		2
		3
II	A	1
		2
		3
		4
	B	1
		2
		3
	C	1
		2
		3
III	A	1
		2
		3
	B	1
		2
	C	1
		2
IV	A	1
		2
	B	1
		2
		3
		4
		5
		6
		7
	C	1
		2
	D	1

Comparison of Forum Abstract Topics to Goals Document

Categorization by abstract (D. Banfield)

Goal	Obj.	Sub-Obj.	NUMBERED INVESTIGATIONS ADDRESSED BY EACH ABSTRACT																																	
I	A	1			1,5		1,2,3,4,5															1,2,3,4,5	1,2,3,4		2	1				1,2,3,4,5	1	1,2,3,4,5
		2																				1,2,3	1,2,3							1,2,3		1,2,3
		3			1,3		1,2,3															1,2,3								1,2,3		1,2,3
	B	1	1,2,3,4,5,6		1,2,3,4,6							1	1,3,5							1	1,2,3,4,5	1,2,3,4,5,6	1,2,3,4,5		2,5	1,2,3				2,3,4,5,6	1,3	1,2,3,4,5
		2	1,2,3		3		1,2,3						1,2								1,2	1,2,3	1,2							1,2,3		2
		3	1,2,3	1,2,3	1,2		1,2,3														1	1,2,3								1,2,3		1,2,3
II	A	1				1,2,3	1,2,3	1,2,3		1,2,3					1,2,3	1,2	1,2,3	1,2,3	1,2,3	1,2	1,2,3	1,2,3								2		2
		2																																		
		3													1,2		1,2	1,2	1,2															
		4				1,2,3	1,2,3	1,2,3		1,2,3		1,2,3	2		3		2,3			2,3		1,2,3							1,2,3			3	
	B	1				1	1	1		1												1		1										
		2				1,2	1,2	2	1	1,2	1						1				1	2		1,2		1	1						1,2	
		3							1	1	1						1				1					1	1						1	
	C	1																						1		1								
		2										1												1,2		2	2							
		3																										1,2						
III	A	1	2,3,5			4	4	4	4,5,6	1,4	4,5,6	1,4,6	1,4				4			4	1,2,4	1,4	1,2,4	1,2		4,5,6				4	1,4,6	2,4
		2	1,3						2		2										3		1	1		1,3	2,3				2,3		
		3				2,3	2,3	2,3	3	2,3	3	2	2,3				2,3	2,3	2,3	2,3	3	2	3	1		1			2		2		
	B	1				1,2	1,2	1,2														2		1,2	2								
		2																				1	2	1,2					3				
	C	1																								1	1,2						
		2																								2							
IV	A	1													1,2		1,2,3	1,2,3	3														
		2																															
	B	1													1	1	1	1			1	2,3,5,6								1			
		2		1	1		1															1	1										1
		3			1		1					1	1								1	1						1					1
		4																															
		5																				1,2	2					1					1
		6		3,4,5																		1,2,3,4,5											
		7																				1,2	2										
	C	1																									1,2,3						
		2																										2					
	D	1							1,2		1,2						1,2				1,2		3				1,2					2	1,2

Comparison of Forum Abstract Topics to Goals Document

Categorization by abstract (D. Banfield)

| Goal | Obj. | Sub-Obj. | NUMBERED INVESTIGATIONS ADDRESSED BY EACH ABSTRACT | | |

Goal	Obj.	Sub-Obj.	SUM
I	A	1	29
		2	12
		3	14
	B	1	50
		2	21
		3	21
II	A	1	36
		2	0
		3	8
		4	28
	B	1	7
		2	18
		3	8
	C	1	2
		2	5
		3	2
III	A	1	40
		2	13
		3	28
	B	1	10
		2	5
	C	1	3
		2	1
IV	A	1	9
		2	0
	B	1	10
		2	6
		3	8
		4	0
		5	5
		6	8
		7	3
	C	1	3
		2	1
	D	1	14

Most Sub-Objectives (>25)

- Goal I.A1. Identify environments that were habitable in the past, and characterize conditions and processes that may have influenced the degree or nature of habitability therein.
- Goal I.B1. Identify environments that are presently habitable, and characterize conditions and processes that may influence the nature or degree of habitability therein.
- Goal II.A1. Constrain the processes that control the present distributions of dust, water, and carbon dioxide in the lower atmosphere, at daily, seasonal and multi-annual timescales.
- Goal II.A4. Constrain the processes by which volatiles and dust exchange between surface and atmospheric reservoir.
- Goal III.A1. Identify and characterize past and present geologic environments and processes relevant to the crust.
- Goal III.A3. Constrain the magnitude, nature, timing, and origin of past planet-wide climate change.

Least Sub-Objectives (<1)

- Goal II.A2. Constrain the processes that control the dynamics and thermal structure of the upper atmosphere and surrounding plasma environment.
- Goal III.C2. Determine the material and impactor flux within the Mars neighborhood, throughout Mars' history, as recorded on the Mars moons.
- Goal IV.B4. Understand the resilience of atmospheric In Situ Resource Utilization (ISRU) processing systems to variations in Martian near-surface environmental conditions.
- Goal IV.C2. Understand the conditions at the surface and the low orbital environment for P/D sufficiently well so as to be able to design an operations plan, including close proximity and surface interactions.

Mars Exploration Program Analysis Group (MEPAG)

Goal	Obj	Sub-Obj.	Investigation Any	Investigation 1	Investigation 2	Investigation 3	Investigation 4	Investigation 5	Investigation 6
I	A	1	9	6	5	5	5	5	
		2	4	4	4	4			
		3	5	5	4	5			
	B	1	13	9	9	10	7	8	5
		2	10	7	7	4			
		3	8	7	7	6			
II	A	1	14	12	12	10			
		2	0	0	0	0	0		
		3	4	4	4	0	0		
		4	12	7	9	9			
	B	1	7	0					
		2	13	5	5				
		3	8	0					
	C	1	2	0					
		2	4	1	1	0			
		3	1	1	1				
III	A	1	19	8	5	1	11	4	5
		2	9	2	2	4			
		3	19	0	9	9			
	B	1	6	4	4				
		2	4	1	1	0			
	C	1	2	1	1	0			
		2	1	0	0				
IV	A	1	4	3	3	2			
		2	0	0					
	B	1	7	0	1	1	0	1	1
		2	6	0					
		3	8	0					
		4	0	0					
		5	4	1	1				
		6	2	1	1	2	2	2	0
		7	2	1	1	0			
	C	1	1	1	1	1			
		2	1	0	0	0	0		

Mars Exploration Program Analysis Group (MEPAG)

Goal	Obj	Sub-Obj.	Investigation Any	Investigation 1	Investigation 2	Investigation 3	Investigation 4	Investigation 5	Investigation 6
I	A	1	9	6	5	5	5	5	
		2	4	4	4	4			
		3	5	5	4	5			
	B	1	13	9	9	10	7	8	5
		2	10	7	7	4			
		3	8	7	7	6			
II	A	1	14	12	12	10			
		2	0	0	0	0	0		
		3	4	4	4	0	0		
		4	12	7	9	9			
	B	1	7	0					
		2	13	5	5				
		3	8	0					
	C	1	2	0					
		2	4	1	1	0			
		3	1	1	1				
III	A	1	19	8	5	1	11	4	5
		2	9	2	2	4			
		3	19	0	9	9			
	B	1	6	4	4				
		2	4	1	1	0			
	C	1	2	1	1	0			
		2	1	0	0				
IV	A	1	4	3	3	2			
		2	0	0					
	B	1	7	0	1	1	0	1	1
		2	6	0					
		3	8	0					
		4	0	0					
		5	4	1	1				
		6	2	1	1	2	2	2	0
		7	2	1	1	0			
	C	1	1	1	1	1			
		2	1	0	0	0	0		

Most Sub-Objectives' Investigations

Goal I.A1. **1. Establish overall geological context.**
Goal I.B1. **3. Establish general geological context (such as rock-hosted aquifer or sub-ice reservoir; host rock type).**

Goal II.A1.

1. Measure the state and variability of the lower atmosphere from turbulent scales to global scales.
2. Characterize dust, water vapor, and clouds in the lower atmosphere.

Goal II.A4.

2. Determine how the exchange of volatiles and dust between surface and atmospheric reservoirs has affected the present distribution of surface and subsurface water and CO2 ice.
3. Determine how the exchange of volatiles and dust between surface and atmospheric reservoirs has affected the Polar Layered Deposits (PLD).

Goal III.A1. **4. Identify ice-related processes and characterize when and how they have modified the Martian surface.**

Goal III.A3.

2. Characterize surface-atmosphere interactions as recorded by aeolian, glacial/periglacial, fluvial, lacustrine, chemical and mechanical erosion, cratering and other processes.
3. Determine the present state, 3-dimensional distribution, and cycling of water on Mars including the cryosphere and possible deep aquifers.

Mars Exploration Program Analysis Group (MEPAG)

Topic-grouping:
Ice / polar
Modern / present day surface & climate
Strategies from orbit, surface, subsurface
Humans & astrobiology

D. Ab#3 / Byrne
C. Ab#12 / Hayne

B. Ab#18 / Osinski
A. Ab#5 / Campbell

E. Ab#27 / Titus
F. Ab#21 / Smith

G. Ab#22 / Smith
H. Ab#4 / Calvin

L. Ab#15 / Kleinboehl
K. Ab#17 / Montabone

J. Ab#25 / Tamppari
I. Ab#26 / Tamppari

M. Ab#6 / Dundas
N. Ab#2 / Aye

O. Ab#13 / Justh
P. Ab#14 / Kerber

Q. Ab#16 / McKay
R. Ab#30 / Eigenbrode

V. Ab#19 / Rogers
U. Ab#24 / Stamenkovic

T. Ab#9 / Fraeman
S. Ab#11 / Harrington

W. Ab#23 / Staehle
X. Ab#7 / Ehlmann

Y. Ab#31 / Spry
Z. Ab#28 / Rummel

AD. Ab#29 / McEwen
AC. Ab#8 / Espley

AB. Ab#1 / Anderson
AA. Ab#20 / Skinner

AE. Ab#10 / Freund

Potomac / Salon D
< Salon E / rest of the meeting room (i.e., screens & chairs)>

Wall >