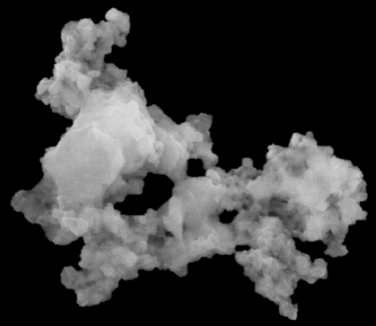
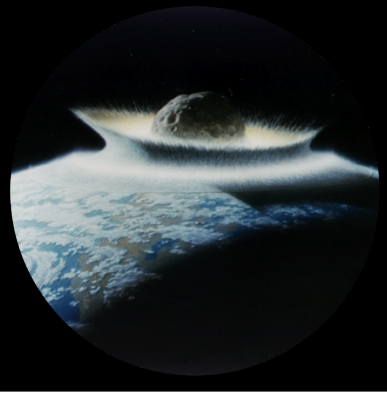



SBAG
SMALL BODIES ASSESSMENT GROUP

Bonnie J. Buratti, SBAG Steering Committee Chair

August 18, 2020 NASA Planetary Science Advisory Committee (PAC)
Virtual Meeting

www.lpi.usra.edu/sbag/

The Steering Committee

Present Steering Committee

Elena Adams (APL), Technology Lead
Maitrayee Bose (Arizona State Univ.)
Bonnie Buratti (NASA JPL/Caltech), Chair
Michael Busch (SETI Inst.) New
Terik Daly (APL), Early Career Secretary
Mike DiSanti (NASA Goddard)
Jessie Dotson (NASA Ames) Planetary Defense Lead
David Gerdes (U. of Michigan) New
Mihaly Horanyi (UC Boulder) New
Stefanie Milam (NASA GSFC) New
William O'Hara (Sierra Nevada Corp.) Human Exploration Lead New
Jennifer Scully (NASA JPL/Caltech)

Members who rotated off in July:

Dan Adamo (independent consultant), Human Exploration Lead
Carolyn Ernst (APL)
Patrick Taylor (LPI)
Andy Rivkin (APL)
Tim Swindle (U. of Arizona), Past Chair

Steering Committee selects Chair and Steering Committee members from among nominations, applications. General membership open.

SBAG Representatives

Thomas Statler NASA Headquarters Liaison

Jake Bleacher Human Exploration and Operations Mission Directorate (HEOMD) Liaison

Paul Abell (JSC) HEOMD Observer

What does SBAG do?

- Seeks broad planetary science community input on small bodies and missions to small bodies.
- SBAG TOR (updated this year) includes in SBAG's charter human and robotic exploration, fundamental research and analysis, resource utilization, and planetary defense; and lists all of the following as being in SBAG's bag: Main Belt Asteroids, Comets, Near-Earth Objects, Meteoroids, Interplanetary Dust and Meteors, Trojans (of all the planets), Centaurs, Trans-Neptunian Objects (TNOs), Dwarf Planets, small planetary satellites (including Phobos, Deimos, and the irregular satellites of the Giant Planets), and Meteorites and returned samples from any of these objects
- Holds open meetings twice each year for community participation.
- Maintains a Goals Document.
- Makes findings: community-based concerns and issues and transmits them to NASA

The SBAG goals document

https://www.lpi.usra.edu/sbag/goals/

- New goals document posted February 2020
- New document preserves the three goals listed on the right.
- Technology and human exploration sections are included
- ISRU section will be updated in the next goals document

Goal 1: Small Bodies, Big Science.

Investigate the Solar System's formation & evolution & advance our knowledge about the early Solar System conditions necessary for the origin of life through research & exploration uniquely enabled by small bodies.

Goal 2: Defend Planet Earth.

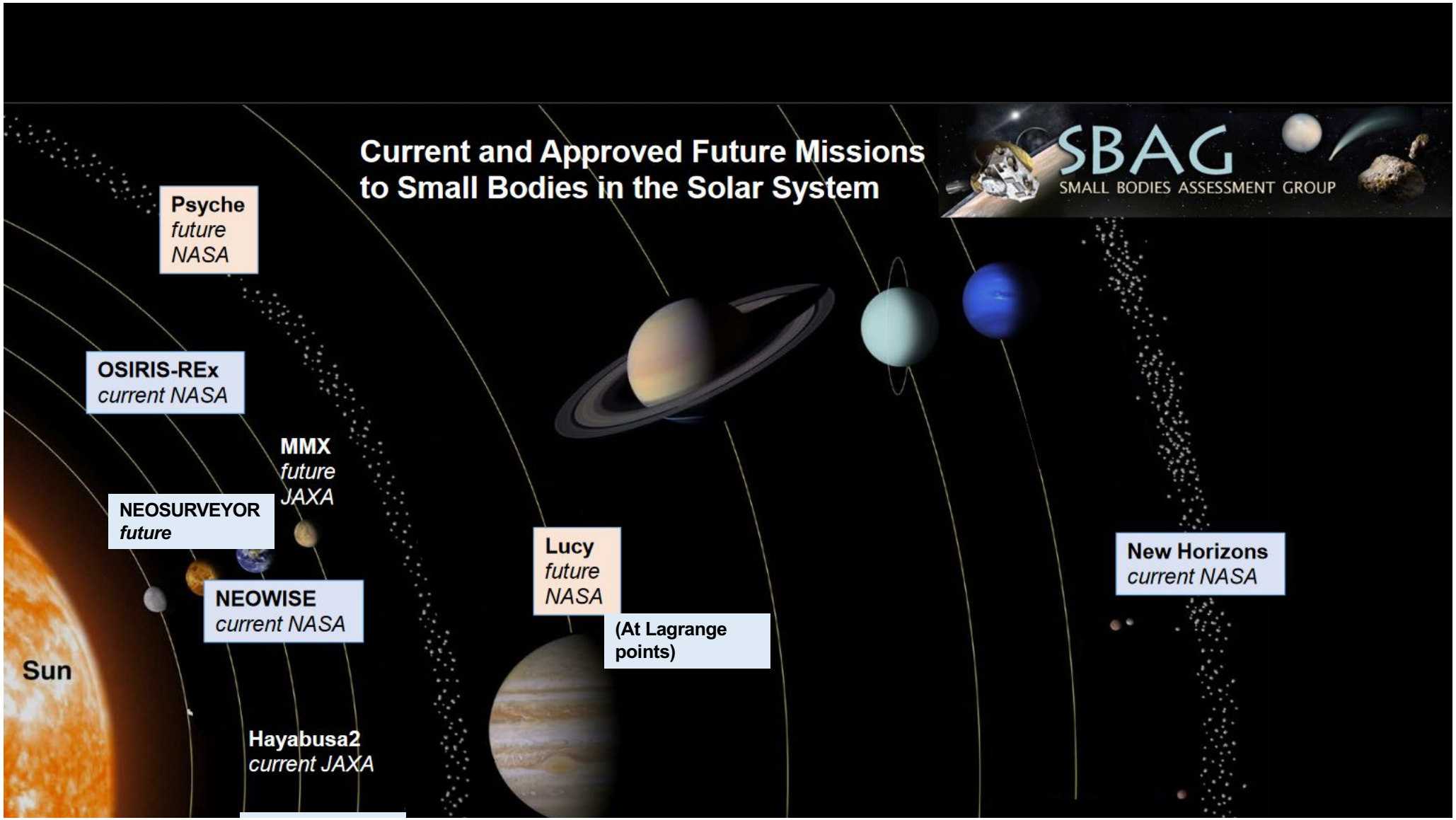
Understand the population of small bodies that may impact our planet & develop ways to defend the Earth against any potential hazards.

Goal 3: Enable Human Exploration.

Advance our knowledge of potential destinations for human exploration within the small body population & develop an understanding of the physical properties of these objects that would enable a sustainable human presence beyond the Earth-Moon system.

Small bodies missions

- Two asteroid sample return missions arrived at targets: OSIRIS-REx (NASA), Hayabusa2 (JAXA; sample collected). Hayabusa2 is on its way to Woomera, Australia (Dec. 6, 2020) and OSIRIS-REx just completed its Matchpoint Rehearsal on Aug. 11 with sampling scheduled for Oct. 20. 2020.
- New Horizons: Series of *Science* papers over the past year; extended mission to study KBOs remotely.
- NEOWISE: sizes and albedos of NEOs.
- DART (kinetic impactor planetary defense demo to Didymos; launch 2021)
- Psyche and Lucy (selected in Discovery 2014 and in development; launches 2022 and 2021): investigate different stages in Solar System development from study of a metallic asteroid (16 Psyche) and primitive planetesimals (Jupiter Trojans), respectively.
- NEO Surveillance Mission: proposed directed mission to discover and characterize the orbits of 90% (goal) the potentially hazardous asteroids larger than 140 meters
- Other missions: Hera (ESA; Didymos B, 2024 launch), Destiny+ (JAXA; dust mission, 3200 Phaeton, parent of Geminid meteor shower; launch 2022) and MMX (JAXA; Mars moons; launch 2024), Comet Interceptor (ESA; 2028 Launch),
- Overlap: Trident Discovery Mission down select February 2020 to explore Triton, capture a flyby of a Centaur on the way, and accomplish an extended mission into the Kuiper Belt.


Current and Approved Future Missions
to Small Bodies in the Solar System
SBAG
SMALL BODIES ASSESSMENT GROUP
Psyche
future
NASA
OSIRIS-REx
current NASA
MMX
future
JAXA
NEOSURVEYOR
future
NEOWISE
current NASA
Sun
Hayabusa2
current JAXA
Lucy
future
NASA
(At Lagrange
points)
New Horizons
current NASA

Agenda for June 1-2, 2020

Monday June 1

8:00am	11:00am	Welcome and Introduction of Steering Committee (including new members)	Bonnie Buratti
8:15am	11:15am	Planetary Science Division overview	Tom Statler
9:00am	12:00pm	Response to SBAG 22 findings	Tom Statler
9:15am	12:15pm	Planetary Mission Concept Studies: Assessing Dwarf Planet Ceres Past and Present Habitability Potential	Julie Castillo-Rogez
9:30am	12:30pm	Planetary Mission Concept Studies: Pluto Orbiter and Kuiper Belt Exploration Mission	Carly Howett
9:45am	12:45pm	Break/East Coast Midwest Lunch	
10:30am	1:30pm	Updates on Conferences (ACM status; anything more from PMCS meeting, etc.)	
10:45am	1:45pm	Early career talks	
		Margaret Landis: "Ceres' Exosphere and Future Prospects for Ice-Rich asteroids"	
		Jupiter Cheng: "The large-scale troughs on Asteroid 4 Vesta are opening-mode fractures"	
11:15am	2:15pm	Open Microphone	
12:15pm	3:15pm	Break/Western Lunch	
1:00pm	4:00pm	NEOO Program	Kelly Fast
1:10pm	4:10pm	NEO Surveillance update	Amy Mainzer
1:30pm	4:30pm	DART	Andy Rivkin
1:50pm	4:50pm	OSIRIS-REx	Dante Lauretta
2:05pm	5:05pm	Open Microphone	
2:45pm	5:45pm	Hayabusa2	Makoto Yoshikawa
3:00pm	6:00pm	Adjourn	

Tuesday June 2

8:00am	11:00am	Workshop on White Papers curated by SBAG	
10:00am	1:00pm	Break, East Coast/ Midwest lunch	
10:45am	1:45pm	Minor Planet Center, plus small bodies subnode of the PDS	James Bauer
11:00am	2:00pm	Trident Discovery Mission: small body enhancements	Carly Howett
11:15am	2:15pm	IVO Discovery Mission: small bodies enhancements	Alfred McEwen
11:30am	2:30pm	Open Microphone	
12:15pm	3:15pm	Break/Western Lunch	
1:00pm.	4:00pm	Findings	
1:45pm	4:45pm	Steering committee executive session	
2:30pm	5:30pm	Adjourn	

Small Bodies Assessment Group (SBAG)

Highlights of of June 2020 findings (key ones that keep coming up)

(**Full text at https://www.lpi.usra.edu/sbag/findings/**)

- SBAG urges NASA to include Ceres as an "Ocean World" when considering missions to that category of Solar System bodies, including the upcoming New Frontiers round if applicable.
- SBAG encourages NASA to develop a process that would permit US scientists to participate in missions led by non-US space exploration agencies (e.g., ESA, JAXA, CSA, etc.), including during the early stages of these missions
- SBAG is concerned that the current global pandemic is producing unprecedented obstacles to community participation in the Planetary Decadal Survey, and that these obstacles may be particularly onerous for under-represented portions of our community. (NASA Responded)
- The SBAG community reaffirms its awareness of the unique observational capabilities supplied by planetary radar and urges NASA to apply continued effort toward achieving at least one operational planetary radar facility at all times and particularly at scheduled high-priority observation events. [Note: currently there is no radar capability, due to the August 10th broken cable event at Arecibo; and Goldstone is still offline.]

Overview of June 2020 findings, cont.'d

- **As discussed at the most recent meeting of the PAC, the SBAG and LEAG communities have grave concerns about aspects of the most recent Discovery selection process.** The Discovery selection statement appeared to rule out both small body and lunar missions as selectable due to considerations of programmatic balance. These considerations should have been known to NASA prior to the release of the Discovery 2019 Announcement of Opportunity. In addition, a FAQ document, which was promised to the planetary science community at public meetings several months ago, has not yet been released.

Decadal Survey, summary of SBAG actions

- SBAG curated five broadly supported white papers based on five “Big Questions” (next viewgraph, which in turn were based on our goals document.
- The January 2020 meeting included a workshop in which the community signed up for individual papers that covered the major small body targets.
- Specific mission white papers or technology white papers were not organized by SBAG
- SBAG sent out a questionnaire to the community on science and mission priorities that was turned into a white paper.
- SBAG intends to endorse a Diversity, Inclusivity, Equity paper, or other workforce or climate papers if asked. MAPSIT White Paper already endorsed

Big questions for the Decadal Survey (based on goals document) that formed the basis of five SBAG-intiated White Papers

- What do small bodies tell us about the formation of the Solar System and the conditions in the early solar nebula?
- What does the distribution, composition, and sizes of small bodies tell us about the evolution of the Solar System, including its dynamical history, cratering processes, and the influx of volatiles and organics into the inner Solar System?
- Do sustainable habitable environments exist on any of the small bodies?
- What are the main geological processes that determined the evolution and current state of the small bodies and are they similar to those on larger bodies?
- What threat do Near-Earth Objects pose to civilization and life on Earth, and how can we quantify and mitigate that threat?

Summary of white papers, cont.'d (see https://www.lpi.usra.edu/decadal/sbag/)

Main White Papers Based on Scientifc Goals	Relevant Targets	Lead Author
What do small bodies tell us about the formation of the Solar System and the conditions in the early solar nebula?	KBOs; Small satellites; Comets; Asteroids; Interstellar bodies	Bjorn Davidsson (JPL)
The Evolution of Small Body Populations: from Planet Migration to Thermal Drift Forces What does the distribution, composition, and sizes of small bodies tell us about the evolution of the Solar System, including its dynamical history, cratering processes, and the influx of volatiles and organics into the inner Solar System?	All	Bill Bottke (SWRI), JJ Kavelaars (Dominion Astrophysical Observatory)
Do sustainable habitable environments exist on any of the small bodies?	Ceres; large KBOs	Julie Castillo-Rogez (JPL)
What are the main geological processes that determined the evolution and current state of the small bodies and are they similar to those on larger bodies?	All	Carol Raymond (JPL)
The Future of Planetary Defense in the Era of Advanced Surveys. What threat do Near-Earth Objects pose to civilization and life on Earth, and how can we quantify and mitigate that threat?	NEOs	Amy Mainzer (LPL)

Most of the other small body white papers, including ones on Main Belt asteroids, comets, dust, KBOs, interstellar objects, Centaurs, Pluto, and small moons, are also listed and linked at the above web site. Many were encouraged by SBAG during the January 2020 workshop. Copies of the submitted white papers are on the Academy website: https://www.nationalacademies.org/our-work/planetary-science-and-astrobiology-decadal-survey-2023-2032

The Questionnaire

Mark Sykes commissioned a SBAG-led questionnaire for the previous Survey. The questions covered missions and research priorities. The questions were updated by the current SBAG Steering Committee and distributed to the community. The results were submitted as a white paper.

Summary: SBAG surveyed the small bodies community for input to the Planetary Decadal Report. Seventeen questions on science and mission priorities were answered by 121 respondents. The highest priority scientific issues for small bodies were population identification and physical/compositional characterization; understanding the characteristics and evolution of individual objects; determination of the early conditions in the Solar System; and completion of the catalogue of PHAs. The highest priority flagship mission was a comet sample return followed by a Pluto orbiter/KBO mission. A comet sample return was also the highest priority New Frontiers mission, followed by a Ceres lander and a Main Belt multiple asteroid mission. Emphasis was also placed on the importance of ground-based and Earth orbiting telescopes (including radar), laboratory studies, and theory. The group also advocated preserving research funding over missions in the event of budget pressures.

Summary and future

- Next Meeting: January 26-27, 2021, virtual
- SBAG Findings are based on broad community input, represent the consensus of the community, and pinpoint persistent problems that need attention at the highest levels.
- SBAG Decadal White Paper work
  - Oversaw a collection of Decadal White Papers that represent broad science questions and community input.
  - Distributed and analyzed a questionnaire on research and mission priorities that was produced as a white paper.
  - “Supervised” (lightly) target papers, but not mission papers or technology
  - The Steering Committee is prepared to endorse the Decadal papers on Diversity, Inclusion, and Equity, and workforce and climate issues.
  - Prepared to assist the Decadal Committees in any way we are asked.