Small Bodies Science Institute
White Paper
White Paper Purpose

To articulate the need for and value of a Small Bodies Science Institute and describe how such an institute would be optimized for the study of small bodies.

Challenge: we have a huge number of targets with time variable characteristics, spanning the entire solar system.
NASA Interest

SBs sample all reaches of the solar system and can be found in their formation locations with some transported to accessible locations near Earth's orbit.

SBs have been/are the targets of sixteen missions and have been observed by thirteen other missions and space-based observatories, fundamentally changing our understanding of the Solar System, its origin and evolution.

Congress has specifically directed NASA to improve our knowledge of the NEO population, because of their potential hazard to life on Earth.

Goal of sending a crewed mission to an asteroid by 2025.
SBSI Mission Statement

SBSI fosters collaborations within and among competitively selected domestic teams, the broader small bodies community, and multiple international partners, as well as educational institutions and the amateur astronomer community in order to:

• Provide scientific and technical data and perspectives to NASA in support of its small bodies research programs and missions, its human exploration programs, and planetary protection,

• Conduct collaborative, cross-disciplinary research in all areas of small bodies science and enhance communication among geographically disparate researchers,
SBSI Mission Statement

Engage the broader domestic and international small bodies science community through in-person conferences, virtual seminars, and community-driven focus groups,

Attract the next generation of small bodies scientists and expand a scientifically literate public by giving them research experiences at the secondary and undergraduate level.

Train the next generation of small bodies scientists with research experiences and leadership roles at the graduate and post-doctoral level, while supporting early and later career scientists by facilitating collaborative opportunities across generations for funding and by providing conferences focusing on their needs.

Encourage Education and Public Outreach (EPO) and Science, Technology, Engineering, and Mathematics (STEM) interest through formal education content development, informal student programs and participatory public events.
Research Teams

Competitively selected to address:

- What is the inventory of small bodies in the solar system and what processes are active in and among them?
- How did small bodies originate and evolve and what was their role in the origin and evolution of the Sun’s family of planets and satellites?
- What are the characteristics of small bodies that lead to habitable environments in the solar system?
- How and where could life begin and evolve in the solar system?
- What are characteristics of small bodies that pose hazards and/or provide resources?
Cornerstone Projects

Addresses the issue of hundreds of thousands of known asteroids and thousands of known comets, which are highly diverse in their composition, physical properties, and evolutionary histories.

Significant science return and mission cost savings can be realized by greatly increasing our detailed knowledge of large numbers of these individual objects. This is a challenge unique to small bodies.

Increases our ability to design cost-effective robotic and human missions to these targets.
Cornerstone Projects

• Multi-decade research programs.
• Provide research experiences to attract and train the next generation of small bodies scientists, give them leadership experience, and expand a scientifically literate public.
• Create consortia of a large number of underutilized observatory facilities primarily at educational institutions, providing standard methods to acquire, archive and analyze desired data focused on specific populations of small bodies.
• Consortia membership dynamic, subject to an open call.
• Engage the community of amateur astronomers.
• Flexible in response to NASA needs (e.g., priority targets)
Cornerstone Projects

CP1: Visible (expandable to near-infrared) spectra of > 100,000 asteroids from NEOs to TNOs.

CP2: Johnson V-band (expandable to other bands) light-curves (expandable to all available phases) of > 100,000 asteroids from NEOs to TNOs. Occultation measurements as Targets of Opportunity.

CP3: Imaging of > 400 comets over their entire orbit (if short-period) or apparition (if long-period or parabolic). Large and small spatial scale, at wavelengths dominated by dust and specific emission bands.

CP4: Monitoring the spectra of > 400 comets over their entire orbits (if short-period) or apparition (if long-period or parabolic).

More: Could a meteorite analysis CP be formulated?
Management

• Efficient administration of geographically distributed organizations and projects is increasingly common by universities and private businesses.
• SBSI should be managed by a competitively selected institution and oversee CP consortia operations as well as selected research teams and international partners.
• Selected research teams could be funded through a direct NASA award or via subcontract with the SBSI managing institution.
• Competition of administration would ensure efficiency and cost-effectiveness, thereby maximizing resources devoted to directly addressing SBSI goals.
• Small bodies science expertise would be required within SBSI management in order for it to effectively perform its duties.