SBAG ROADM AP
Aligning with NASA Science Plan
The 2010 Science Plan for NASA’s Science Mission Directorate gives five fundamental science questions that guide NASA’s solar system exploration program:

- **What is the inventory of solar system objects and what processes are active in and among them?**
- **How did the Sun’s family of planets, satellites, and minor bodies originate and evolve?**
- **What are the characteristics of the solar system that lead to habitable environments?**
- **How and where could life begin and evolve in the solar system?**
- **What are characteristics of small bodies and planetary environments that pose hazards and/or provide resources?**

Small bodies exploration addresses ALL of these questions!
What is the inventory of small bodies in the solar system and what processes are active in and among them?

This motivates the need to determine the population of small bodies throughout the solar system over all sizes, identify their characteristics (e.g., physical, compositional, dynamical), and to understand the various processes that are active internally (e.g., thermal, chemical, mechanical) and via interactions with their environment (e.g., radiation processing, impacts).

Science Questions
Population Identification and Characterization
In-Situ Study
Sample Return
Laboratory Study
Theoretical Study
Human Exploration
Technology Capabilities and Needs
Data Archiving and Access
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?

This is related to the first question inasmuch as understanding the origin and evolution of small bodies requires knowledge of their location and state today. Understanding how they evolved also requires the same techniques applied to understanding the processes in and among them today: in-situ studies, the return of samples, laboratory studies of small bodies material and their analogs, and theoretical studies.
What are the characteristics of small bodies that lead to habitable environments in the solar system?

Small bodies may have played an important role in the establishment of a habitable environment on Earth and perhaps elsewhere through the transport of water to objects that might have otherwise been too dry to allow for life as we understand it. They may have also carried with them other materials necessary to support life once it arises. Insight into the role of small bodies in the establishment of a habitable environment requires an understanding of their detailed composition from returned samples and laboratory studies of meteorites and interplanetary dust, with theoretical studies providing an understanding of the transport of material. Small bodies, such as dwarf planets, may themselves contain habitable environments beneath their surfaces, requiring in-situ investigations to determine.
How and where could life begin and evolve in the solar system?

One of NASA’s strategic goals for planetary science is to ascertain the “potential for life elsewhere.” This involves an understanding of how life began and evolved on the Earth, our single data point. Small bodies may not only contain materials, such as water, supporting habitable environments, but may contain prebiotic materials necessary for life to arise in the first place. Further, if life arose in liquid water oceans beneath the surfaces of dwarf planets, these small bodies may have served as incubators that seeded life elsewhere. All of our approaches in determining the characteristics of small bodies leading to the habitable environments would be applicable to understanding the role of small bodies in the rise and evolution of life.

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What are characteristics of small bodies that pose hazards and/or provide resources?

Small bodies, specifically NEOs and interplanetary dust, pose a hazard to humans on Earth and in space. Assessing that hazard and developing mitigation strategies requires population identification and characterization, its sources and sinks, in addition to an understanding of physical properties and composition from in-situ study, sample return and laboratory studies. At the same time, NEOs may afford an opportunity for expanding human activity on space and other worlds by providing resources that make possible that activity, requiring the same approaches used in assessing NEO hazard, with assessment of resource extraction and utilization methods requiring laboratory work in space.

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Addressing all these questions require:

Their breakdown into more detailed queries and an assessment of their applicability to the various types of objects that we group together into “small bodies”.

A determination of the various technologies needed to address these questions effectively and efficiently and identify areas to be pursued for development.

The acquisition of data, which results in the need to ensure its archiving and accessibility so that the information needed to answer these questions are available to everyone now and in the future.

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