NASA plans to perform sample return missions from a variety of targets including Mars, outer planet moons, and small bodies such as asteroids and comets. In terms of spacecraft technology, these types of targets present a variety of challenges. Some targets, such as Mars and some moons, have relatively large gravity wells and will require ascent propulsion. Other targets are small bodies with very complex geography and very little gravity, factors that present difficult navigation and maneuvering challenges. In addition, the spacecraft will be subject to extreme environmental conditions including low temperatures (-270 °C), dust, and ice particles. Technology innovations should either enhance vehicle capabilities (e.g., increase performance, decrease risk, and improve environmental operational margins) or ease mission implementation (e.g., reduce size, mass, power, cost, increase reliability, or increase autonomy). Specific areas of interest are listed below. SMD’s In-space Propulsion technology program is a direct customer of this subtopic, and the solicitation is coordinated with the ISPT program each year. The ISPT program views this subtopic as a fertile area for providing possible Phase III efforts. Many of the Planetary Decadal Survey white papers/studies evaluating technologies needed for various planetary, small body, and sample return missions refer to the need for sample return spacecraft technologies.

Small Body Missions:

- Autonomous operation.
- Terrain based navigation.
- Guidance and control technology for landing and touch-and-go.
- Anchoring concepts for asteroids.
- Propulsion technology for proximity or landed operations.
- Low-power, long-life cryogenic sample storage.
- Earth Entry Vehicles for Sample Return Missions.

Proposals should show an understanding of one or more relevant science needs, and present a feasible plan to fully develop a technology and infuse it into a NASA program.