SCIENCE OF THE EUROPA MISSION, EXPLORING THE HABITABILITY OF A UNIQUE ICY WORLD. D. A. Senske[1], R. T. Pappalardo[1], H. Korth[2], R. Klima[2], S. D. Vance[1], K. Craft[2], and the Europa Science Team. [1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, [2]Johns Hopkins University Applied Physics Laboratory, 11100 Johns Hopkins Rd., Laurel, MD.

Introduction: A key driver of planetary exploration is to understand the processes that lead to potential habitability across the solar system [1]. In the forefront of this goal is evaluating the astrobiological potential of the icy outer planet satellites. It is in this context that a mission to Europa is currently being formulated [1,2].

Europa Mission Goal, Objectives, and Investigations: The overarching science goal of the Europa mission is to explore Europa to investigate its habitability. Following from this goal are three Mission Objectives (bold roman numerals), from each of which flow several Mission Investigations (numbered items), as listed below. Also, listed (abbreviations) are each of the instruments, plus Gravity and Radiation science, that synergistically address these Investigations and Objectives. Folded into these three objectives is the desire to search for and characterize any current activity, notably plumes [3] and thermal anomalies.

I. Ice Shell & Ocean – Characterize the ice shell and any subsurface water, including their heterogeneity, ocean properties, and the nature of surface-ice-ocean exchange.

1. Characterize the distribution of any shallow subsurface water and the structure of the icy shell *(EIS, REASON)*;
2. Determine ocean salinity and thickness *(ICEMAG, MISE, PIMS, SUDA)*;
3. Constrain the regional and global thickness, heat-flow, and dynamics of the ice shell *(E-THEMIS, EIS, Gravity, ICEMAG, PIMS, REASON)*;
4. Investigate processes governing material exchange among the ocean, ice shell, surface, and atmosphere *(EIS, ICEMAG, MASPEX, MISE, REASON, SUDA)*.

II. Composition – Understand the habitability of Europa's ocean through composition and chemistry.

1. Characterize the composition and chemistry of endogenic materials on the surface and in the atmosphere, including potential plumes *(EIS, Europa-UVS, ICEMAG, MASPEX, MISE, PIMS, REASON, SUDA)*;
2. Determine the role of the radiation and plasma environment in creating and processing the atmosphere and surface materials *(EIS, Europa-UVS, MASPEX, MISE, PIMS, Radiation, REASON, SUDA)*;
3. Characterize the chemical and compositional pathways in the ocean *(EIS, ICEMAG, MASPEX, MISE, SUDA)*.

III. Geology – Understand the formation of surface features, including sites of recent or current activity, and characterize high science interest localities.

1. Determine sites of most recent geological activity, including potential plumes, and characterize localities of high science interest and potential future landing sites *(E-THEMIS, EIS, Europa-UVS, MASPEX, MISE, PIMS, Radiation, REASON, SUDA)*;
2. Determine the formation and three-dimensional characteristics of magmatic, tectonic, and impact landforms *(EIS, REASON)*;
3. Investigate processes of erosion and deposition and their effects on the physical properties of the surface *(E-THEMIS, EIS, Europa-UVS, PIMS, Radiation, REASON, SUDA)*.

Exploring Europa Through Synergistic Investigations: To address the Europa science objectives, a highly capable suite of nine instruments was selected by NASA to comprise the mission's scientific payload. This payload includes five remote-sensing instruments that observe the wavelength range from ultraviolet through radar, *Europa Ultraviolet Spectrograph (Europa-UVS)*, *Europa Imaging System (EIS), Mapping Imaging Spectrometer for Europa (MISE), Europa Thermal Imaging System (E-THEMIS), and Radar for Europa Assessment and Sounding: Ocean to Near-surface (REASON)* and four *in situ* instruments that measure fields and particles, *Interior Characterization of Europa using Magnetometry (ICEMAG), Plasma Instrument for Magnetic Sounding (PIMS), MAss Spectrometer for Planetary Exploration (MASPEX)*, and *SUrface Dust Analyzer (SUDA)*. In addition, gravity science can be achieved via the spacecraft's telecommunication system in combination with radar altimetry. Moreover, valuable scientific data could come from the spacecraft's planned radiation monitoring system. Working together, the Europa mission's instrument payload has the potential to test hypotheses relevant to the composition, interior, and geology of Europa, in order to address the potential habitability of this intriguing moon.

References: [1] Space Studies Board, (2011) The National Academies Press, Washington, DC. [2] Europa Study Team, (2012) JPL Internal Document D-71990. [3] Roth, L. *et al.*, (2014) *Science*, 343, 171-174.