Exploration Pathways for Europa after initial In Situ Analyses for Biosignatures. K. P. Hand[1], A. E. Murray[2], J. Garvin[3], S. Horst[4], W. Brinkerhoff[3], K. Edgett[5], T. Hoehler[6], M. Russell[1], A. Rhoden[7], A. Yingst[8], C. German[9], B. Schmidt[10], C. Paranicas[11], D. Smith[12], P. Willis[1], A. Hayes[13], B. Ehlmann[1,14], J. Lunine[13], A. Templeton[15], K. Nealson[16], M. Cable[1], K. Craft[11], R. Pappalardo[1], C. Phillips[1], [1]Jet Propulsion Laboratory, Caltech (khand@jpl.nasa.gov, [2]Desert Research Institute & Univerity of NV, Reno, [3]Goddard Space Flight Center, [4]Johns Hopkins University, [5]Malin Space Science Systems, [6]NASA Ames Research Center, [7]Arizona State University, [8]Planetary Science Institute, [9]Woods Hole Oceanographic Institute, [10]Georgia Tech., [11]Applied Physics Laboratory, Johns Hopkins, [12]Massachusetts Institute of Technology, [13]Cornell University, [14]Caltech, [15]CU Boulder, [16]University of Southern California.

Introduction: The 2016 Europa Lander Science Defintion Team has recently completed its report on the science goals, objectives, and investigations to be conducted by a robotic lander on Europa's surface. The highest priority goal is to search for signs of life through in situ analyses of Europa's surface and near-surface material. The second and third goals focus on assessing Europa's habitability, and conducting analyses that will make subsequent missions possible.

Several possible futures exist for the exploration of Europa, contingent on the outcome of of the search for signs of life. Were biosignatures to be found in the surface material, direct access to, and exploration of, Europa's ocean and liquid water environments would be a high priority goal for the astrobiological investigation of our solar system. Europa's ocean would harbor the potential for the study of an extant ecosystem, likely representing a second, independent origin of life in our own solar system. Subsequent exploration would require robotic vehicles and instrumentation capable of accessing the habitable liquid water regions in Europa to enable the study of the ecosystem and organisms. Planetary protection and forward contamination of Europa would be a driving design requirement. Much of this exporation would be targeted along the z-axis, moving into Europa ice and ocean.

Absent any signs of life discovered during the initial landed mission, the question of Europa's habitability and comparative oceanography would be key motivating questions for the future exploration of Europa. Subsequent missions would potentially be designed to enable lateral (x-y plane) exploration to better understand fundamental geological and geophysical process on Europa, and how they modulate exchange of material with Europa's ocean. The definive determination of no life on Europa would be difficult to prove, but a null-result for life on Europa would potentially be as scientifically important as the discovery of life on that world. Both answers have profound implication for understanding life on Earth and our place in the universe.