NASA Astrobiology Institute has supported the Gordon Research Conference on Molecular Mechanisms in Evolution, which took place at Stonehill College (Easton, MA, USA) from June 11th to 16th, 2017. The goal of this GRC was to provide conditions for the major advancement in our understanding of fundamental questions in evolutionary biology. Most of the researchers in the fields of molecular biology, medicine and astrobiology are unacquainted with all aspects of evolutionary theory, and hence overlook the critical role of evolutionary processes in the phenomena they are studying. Likewise, many of the assumptions and predictions of the evolutionary biology have to be modified by taking into account new discoveries at the level of molecular biology, such as non-genetic, protein and RNA-based inheritance, horizontal gene transfer, interaction between phenotypic and genotypic fluctuations. These new discoveries affect biological phenomena at all scales from the molecular, up through the cell, to populations and the biosphere itself. The associated conceptual advances are forcing a drastic revision of our understanding of the rapidity with which evolution can occur and spread through populations. The newly-emerging recognition that evolution can occur orders of magnitude faster than previously thought has dramatic implications for such apparently disparate topics as the emergence of cellular life on Earth around 4 billion years ago and the rapid spread of antibiotic resistance amongst contemporary pathogenic bacteria.

This year's conference lived up to this mission by bringing together scientists from different disciplines, which created an intellectual environment which catalysed original thought, and initated collaborations that go beyond the means and competencies of individual groups. The keynote speakers have been chosen because they are engaged in the most exciting research in their fields. Dr Nigel Goldenfeld, a physicist from the Institute for Universal Biology, the NASA Astrobiology Institute team based at the University of Illinois at Urbana-Champaign, gave a talk about evolutionary transitions in the first billion years of life. Dr Tom Kirkwood, a biologist from the Newcastle University Institute for Ageing, and the University of Copenhagen Center for Healthy Aging, gave a talk about the evolution of aging. Their keynote lectures set the tone for the entire meeting.

The session titles illustrate both the diversity and interconnectedness of the topics covered: origins of life and aging, evolution of mutation and recombination rates, stress-inducible genetic variation, non-genetic variation and inheritance, phenotypic noise, evolution of novelty, evolution of complexity, cancer, aging, experimental evolution and evolutionary contingency. The themes of the GRC have been selected based on their relevance, timeliness, and impact on future studies. The GRC had oral presentations by established and young scientists who play leading roles in fields of relevance for the GRC topic. Discussion leaders who are also leaders in their fields stimulated open and thought-provoking dialogue after each talk. Much of the vibrancy and excitement of the meeting reflected the strong participation of graduate students and postdoctoral fellows who accounted for 50% of all attendees. Students and postdoctoral fellows presented extremely high-quality posters and short talks. Participants had an opportunity to provide feedback at the end of the Conference. The feedback collected from the meeting was extremely positive. Evaluations included numerous positive remarks regarding the dynamic poster sessions, the informal discussion periods, and the chance for early career scientists to talk with more established ones.