

## The Twins Study: NASA's First Foray into 21<sup>st</sup> Century Omics Research

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The full array of 21<sup>st</sup> century omics-based research methods should be intelligently employed to reduce the health and performance risks that astronauts will be exposed to during exploration missions beyond low Earth Orbit. In March of 2015, US Astronaut Scott Kelly will launch to the International Space Station for a one year mission while his twin brother, Mark Kelly, a retired US Astronaut, remains on the ground. This situation presents an extremely rare flight opportunity to perform an integrated omics-based demonstration pilot study involving identical twin astronauts. A group of 10 principal investigators has been competitively selected, funded, and teamed together to form the Twins Study. A very broad range of biological function are being examined including the genome, epigenome, transcriptome, proteome, metabolome, gut microbiome, immunological response to vaccinations, indicators of atherosclerosis, physiological fluid shifts, and cognition. The plans for the Twins Study and an overview of initial results will be described as well as the technological and ethical issues raised for such spaceflight studies. An anticipated outcome of the Twins Study is that it will place NASA on a trajectory of using omics-based information to develop precision countermeasures for individual astronauts.