1. **Research Title:** Airman-on-a-Chip for Human Performance
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Bioengineering, Biomedical Engineering, Molecular Biology, Cell Biology (Ph.D. level)
4. **Objectives:**
    a. Develop Gut-Microbiome and Brain-on-a-Chip micro-devices
    b. Characterize host and microbiota responses to Airman Operational Stress (thermal burden)
    c. Conduct molecular techniques to quantify functional and performance-based analyses of Gut and Down-Stream Brain Tissue Responses
5. **Description:** The human gut serves to digest food, deliver and transport nutrients, and cultivate among the most diverse microbiomes on the planet. Host-microbiome interactions play a pivotal role in maintaining a healthy gut barrier, metabolite profiles, and of recent, cognitive performance. Conversely, the lack of competent models, suitable throughput, and dynamic sampling has limited what is known about the human microbiome and its role in modulating stress and cognitive workload. Therefore, to understand the molecular mechanisms, a microengineered gut-brain axis-on-a-chip tissue model was developed to mimic human host-microbiome interactions and predicting the downstream alterations on the brain. Using microfluidic technology, human gut and brain tissue will be cultivated from multicellular primary and induced pluripotent stem cell cultures. Mature gut-microbiome and brain-on-a-chip tissues will be exposed to relevant Airman conditions and molecularly interrogated. Using a systems biology approach, multi-level genomic, epigenomic, proteomic, and metabolomics signatures will be assessed from the connected gut-brain axis-organ-on-a-chip system, and utilized to predict future performance declinations and provide a road-map for countermeasure development.
6. **Research Classification/Restrictions:** No restrictions known
7. **Eligible Research Institutions:** The Ohio State University, Wright State University, University of Dayton, Case Western Reserve University

Case Number: 88ABW-2020-2885 The material was assigned a clearance of CLEARED on 17 Sep 2020.