

FY20/21 DAGSI Research Topic

1. **Research Title:** Functionalized nucleic acids nanostructures for Airman augmentation
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level**

Chemistry, Biology, Molecular Biology, Microbiology, Biochemistry (MS or PhD level)

4. **Objectives:** 1) Design nucleic acid nanostructures (NAs) functionalized with regulatory elements (aptamers, ribozymes, small interfering RNAs, microRNAs) for biomarker detection-triggered gene regulation; 2) Development of new protocols for low-cost and effective synthesis of NAs nanoparticles based on microbial or cell-free production of NAs nanostructures via bio-programmed folding of single-stranded NAs; 3) Demonstration of biomarker activated NA nanoparticles-mediated gene regulation in different matrices, including mammalian cell-free systems and mammalian cells, on-chip models and others.
5. **Description:** Modern warfare operations often occur in volatile, uncertain, complex and ambiguous environments accompanied by physical exertion, cognitive overload, sleep restriction and caloric deprivation. Therefore, interventions that allow the Airman to perform at high levels over multi-day missions with minimal logistics support are needed. Several studies demonstrated that some individuals are more resilient to physiological and psychological stressors and the nature of such resiliency may be associated with variations in regulation of specific genes. In this case, the ability to temporally regulate expression of performance-associated genes would be beneficial for Airman augmentation. The programmability of nucleic acids at different length scales, the availability of computational tools to optimize the design of complex NA nanostructures and the ability to engineer these nanostructures with functional moieties provide a platform to develop entities that can be programmed to perform controllable regulation of genetic pathways critical for Airman performance.
6. **Research Classification/Restrictions:** Unclassified/Unrestricted
7. **Eligible Research Institutions:** DAGSI (Wright State University, AFIT, Ohio State University, University of Dayton, Miami University, Ohio University, University of Cincinnati and all other Ohio Universities)