

FY19/20 Student Research Topic

1. **Research Title:** Development of Gene Regulatory Elements for Biosensing Applications

2. **Individual Sponsor:**

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

Biology, Molecular Biology, Microbiology, Biochemistry (BA/BS, MS or PhD level)

4. **Objectives:** The objectives of this research include: 1) identification or selection of gene regulatory elements (riboswitches) for detection of USAF relevant small molecule analytes; 2) characterization of the selected gene regulatory elements; 2) study and performance optimization of specific gene regulatory elements coupled with a variety of different reporters in bacterial cells and cell-free systems.

5. **Description:** Regulation of gene expression is an essential feature of all living organisms. RNA-based regulatory elements, known as riboswitches, are predominantly located in the 5'-untranslated region of mRNA, and can serve as molecular switches able to regulate the level of gene expression. This occurs through the conformational changes caused by binding to a specific metabolite. Riboswitches contain two structural domains: an aptamer domain that senses and binds to a metabolite; and an expression platform that undergoes a conformational change in response to aptamer-ligand binding resulting in regulation of expression of downstream gene. In addition to natural riboswitches found in living organisms, a variety of synthetic riboswitches that respond to non-natural small molecules have been developed. Synthetic riboswitches can be engineered to regulate expression of any gene in response to any non-natural molecule that is capable of being bound by RNA and is not toxic to cells. This feature demonstrates a strong possibility for RNA switches to serve as sensor entities for design and development of cell-based or cell-free biosensors with a variety of different applications. This research will focus on development of new synthetic riboswitches for detection of human performance biomarkers.

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)

Approved for public release. Case Number: 88ABW-2018-3309.