Opportunity Title: Engineering Ligand-Binding Proteins for Detection of Chemical Signatures
Opportunity Reference Code: IC-16-04

Organization Office of the Director of National Intelligence (ODNI)

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Complete your application – Enter the rest of the information required for the IC Postdoc Program Research Opportunity. The application itself contains detailed instructions for each one of these components: availability, citizenship, transcripts, dissertation abstract, publication and presentation plan, and information about your Research Advisor co-applicant.

Application Deadline 4/15/2016 6:00:00 PM Eastern Time Zone

Description Sensors are vital tools for monitoring chemical species in the environment, including industrial emissions or accidental chemical releases, such as the 2015 Gold King Mine wastewater spill near Silverton, Colorado or the 2014 Elk River chemical spill in West Virginia. These chemical species may pose threats to the environment, human health, or likely both. High-specificity chemical sensors provide valuable information to help guide decisions regarding public health and environmental stewardship. With the consequences of these decisions, accurate and reliable information is necessary to enable decision makers to rapidly assess and respond to accidental chemical releases.

Conventional detection practices rely on manual environmental sampling and laboratory analysis. While laboratory instrumentation can provide very high specificity in terms of chemical species detection, this practice is insufficient for most large chemical release incidents. Small sampling across large geographical areas is not only laborious but also runs the risk of false negatives due to small sample volumes and human sampling errors. Additionally, the time required to collect and analyze the samples prevents a rapid response and may lead to inaccurate assessment, as environmental contaminates can rapidly disperse with changing weather conditions. To effectively monitor a large environmental area, cheap and robust chemical sensors, which can be widely distributed in the environment, are an ideal solution. However, how can high chemical specificity be achieved without expensive analytical instrumentation?

Biological systems have evolved unparalleled mechanisms of chemical detection, with extraordinary sensitivities and specificities. Moreover, protein-based chemical detection allows for rapid and low-cost production of the ligand-binding protein within cellular hosts. Recent advances in computational protein design and high-throughput mutagenesis screening have demonstrated the potential to mutate natural chemical sensing proteins to recognize man-made chemicals and other small molecules of interest. Furthermore, modified ligand-binding proteins can be integrated with cellular signaling pathways to trigger optical or electrical outputs that

may be readily detected using existing, conventional sensor technology.

Example Approaches

This research could develop engineered ligand-binding proteins for the identification of target chemical species of interest, including organics such as 4-methylcyclohexanemethanol (MCHM) and heavy metals. These engineered ligand-binding proteins could enable discrimination of the target chemical species from close analogs and within complex environmental samples.

There is high interest to versatile approaches that may be applied to multiple derivatives of chemical targets of interest for robust application. Ligand-binding proteins that may be linked to cellular signal transduction pathways should be highly considered.

This research could include:

- Computational design of ligand-binding proteins for target chemical species, including both de novo design and protein redesign.
- Random mutagenesis approaches with high-throughput functional screening that may be readily adapted for a wide range of chemical targets.
- Bioinformatics-based identification of ligand-binding proteins with natural ligands of similar size and chemical properties to the target of interest and subsequent modification of the protein for improved target specificity

Eligibility Requirements

- **Citizenship:** U.S. Citizen Only
- **Degree:** Doctoral Degree.
- **Discipline(s):**
  - **Business** (11 👁)
  - **Chemistry and Materials Sciences** (12 👁)
  - **Communications and Graphics Design** (6 👁)
  - **Computer, Information, and Data Sciences** (16 👁)
  - **Earth and Geosciences** (21 👁)
  - **Engineering** (27 👁)
  - **Environmental and Marine Sciences** (14 👁)
  - **Life Health and Medical Sciences** (45 👁)
  - **Mathematics and Statistics** (10 👁)
  - **Other Non-Science & Engineering** (13 👁)
  - **Physics** (16 👁)
  - **Science & Engineering-related** (1 👁)
  - **Social and Behavioral Sciences** (28 👁)