Analysis of Complex Biological Problems Using System-Wide Approaches

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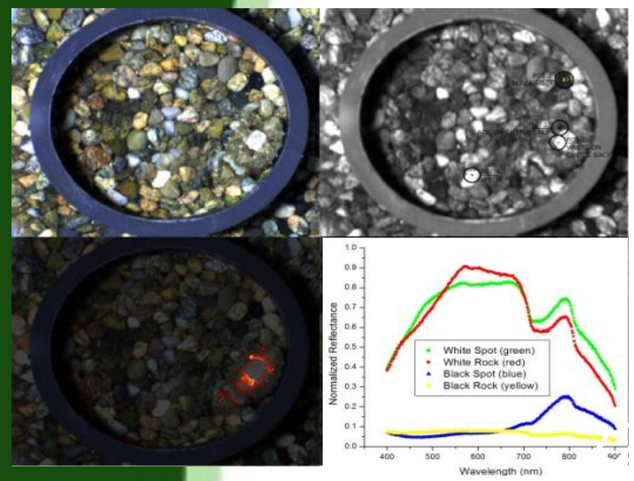
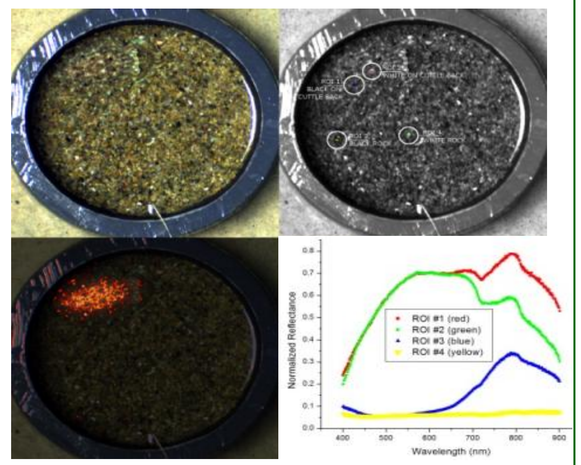
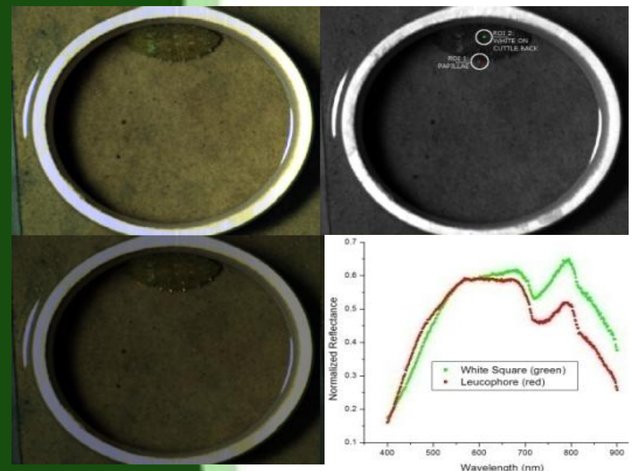
Adaptive Coloration of Marine Animals

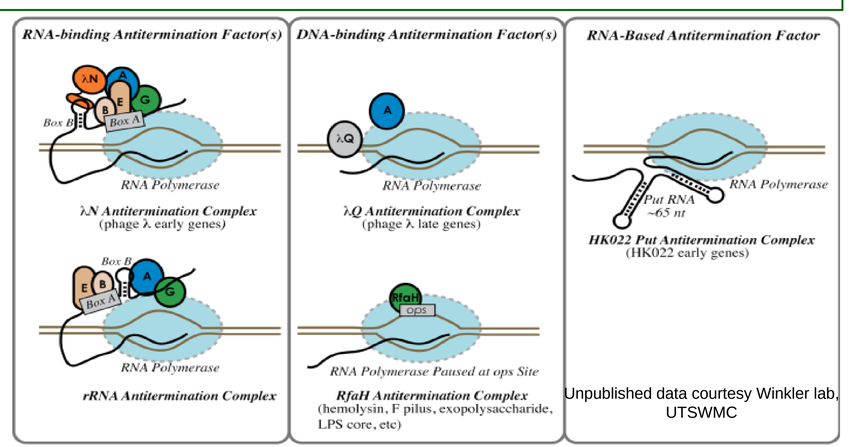






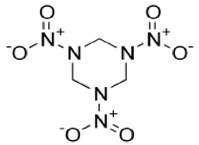
Cuttlefish and other marine animals demonstrate a remarkable ability to conceal themselves in a variety of backgrounds. Using Hyperspectral Imagery Analysis, we are searching for spectral clues, undetected by human eyes and typical RGB cameras, that may provide insight into how these animals achieve such precise adaptive coloration. We hope to use this information to better understand the modes of communication these animals use in groups.

Participants: Cadets Samuel Galima, Woo Do, and Brock Genter; Dr. JK Wickiser, Dr. J. Brockhaus (GENE), LTC Pearman (PRC, C&LS), Dr. Roger Hanlon (MBL), Dr. CC Chiao (MBL), Justine Allen (MBL).

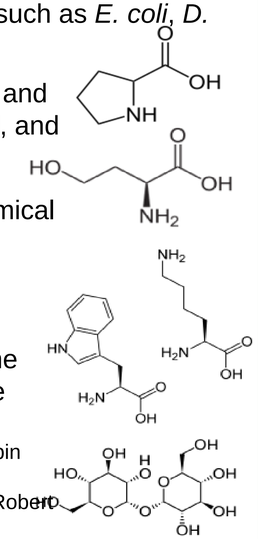


Unpublished data courtesy Winkler lab, UTSWMC

Biological Response to Exposure to Military Explosives Contamination



RDX (Cyclotrimethylenetrinitramine) is a common military explosive that may persist in the environment on ordinance ranges. We are investigating the biological impact this contaminant may have using several animal models such as *E. coli*, *D. discoideum*, and *D. rerio*.



Specifically we are studying the modulation of gene expression (messenger RNA) and metabolite levels in response to the exposure using a variety of physical, chemical, and biological techniques.

In any biological organism, there are a tremendous number of interconnected chemical reactions, the reactants and products of which form circuits involving positive and negative feedback, oscillators, and band pass filters.

The small molecule metabolites are indicative of the nodes while the mRNA of the genes reflect some of the nodes and many of the edges of a graph representing the biological circuitry of an organism. We have found RDX-induced modulation of the levels of several important biomolecules.

Participants: Cadets Alex Ericksen, Adam Kowalski, Danny Harris, Jillian Piaggione, Mike Dolan, and Corbin Helis. From the C&LS Department: MAJ Jason Lauer, MAJ Aaron Owens, MAJ Nate Watson, and Dr. JK Wickiser. From the ARL: Dr. Christian Sund and Dr. Matt Servinsky. From University of Washington, Dr. Robert Synovec.

RNA Methods of Genetic Control in the Biology of Sugar Production in Biofilm Production of Sporulating Bacteria

Understanding the basic biology of spore and biofilm formation is of particular importance to meeting the threat presented by many bacterial pathogens. We are using the gram-positive bacteria, *B. subtilis*, a close relative to *B. anthracis*, in studying the molecular circuitry and RNA-based control mechanisms in the production of the sugars associated with biofilm formation.

We are studying, through *in vivo* methods such as chemical mutagenesis, the messenger RNA structures responsible for ensuring a set of biofilm-associated genes is expressed.

Participants: Cadet Jeremy Smith and Dr. JK Wickiser (USMA). Dr. Wade C. Winkler (University of Texas Southwestern Medical Center)

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