UCLA Engineering
HENRY SAMUELI SCHOOL OF
ENGINEERING AND APPLIED SCIENCE

BIOENGINEERING

PRESENTS

Cooperativity in bio-sensing: how to enhance specificity without losing sensitivity

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12:00 PM – 1:00 PM
2101 ENGINEERING V

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ABSTRACT:

The sensitivity and specificity of a biosensor is typically dependent on a molecular recognition event such as antibody-antigen binding, enzyme-substrate complexation, DNA-DNA hybridization, etc. Efforts to enhance specificity of a biosensor are often achieved by making this recognition event more selective which usually increases the chances of failing to detect the analyte (false negative). Efforts to enhance sensitivity of a biosensor are often achieved by making this recognition event bind more tightly which usually increases the chance of binding other molecules (false positive). Cooperativity, two or more binding events in combination, has the potential to avoid this trade-off and allow enhancing both specificity and sensitivity at the same time.

Caplan's lab pioneered the development of Tentacle Probes which combine two single-stranded DNA chains: one with a fluorophore and quencher on either end and that self-hybridizes to form a stem-loop structure (known as a Molecular Beacon), and the other is a simple single-stranded DNA sequence that forms no secondary structure on its own. Thermodynamic principles are used to design these probes de novo using mFold software and knowledge of the sequence to be targeted. Probes have been designed and validated for genes known to differ from close relatives by a single base pair, and these can be detected with similar sensitivity to existing tests but with extremely low rates of false positives. New probes are under development for a variety of medical conditions including genetic disorders caused by alleles with single base pair differences from normal genes and cancers mutation analysis.

BIOGRAPHY:

Michael Caplan earned his undergraduate degrees from The University of Texas at Austin and his PhD from the Massachusetts Institute of Technology. Following post-doctoral research at Duke University Medical Center in Cell Biology, Michael joined the faculty of Arizona State University in 2003, and he is now an Associate Professor in Biomedical Engineering.

Dr. Caplan's research focuses on molecular cooperativity in drug targeting, bio-sensing, and cell signaling. Current projects align along three main themes: local drug delivery, endothelial dysfunction in diabetes, and cooperative DNA diagnostics. Recent awards include the Jeanette Wilkins Award for the best basic science paper at the Musculoskeletal Infection Society.

Dr. Caplan teaches several classes including *Biotransport Phenomena*, *Biomedical Product Design and Development II* (alpha prototyping of a blood glucose meter), and co-teaches *Biomedical Capstone Design*. Dr. Caplan also conducts educational research to assess the effectiveness of interactive learning strategies in large classes (~150 students).