

Lecture 1

Linking Cancer and Metabolism via Isotope Labeling and Network Analysis

September 25, Tuesday / 4:30 PM

The metabolic engineer's toolbox, comprising, among others, stable isotope tracers, flux estimation and analysis, pathway identification, and pathway kinetics and regulation, has long been used to elucidate and quantify pathways primarily in the context of engineering microbes for product overproduction. These tools are also well-suited for analyzing the physiology of tumor cells as they commonly undergo metabolic transformations during oncogenesis to meet the biosynthetic needs required for aggressive growth. As metabolism is now emerging as a new arena of potential therapeutic interest in cancer, it is important to identify critical targets through fundamental understanding of the metabolic pathways preferentially used by tumor cells. To this end, these tools are increasingly finding use in cancer biology due to their unparalleled capacity for quantifying intracellular metabolism of mammalian cells and in particular the role of glucose and glutamine that must be efficiently directed to contribute carbon and nitrogen for biomass and cofactor production. An overview of this approach, highlighting a systems-theoretic analysis of pathways and bioreaction networks will be presented. In particular, we will focus on implications of the Warburg effect, the M2 isoform of pyruvate kinase, the role of reductive carboxylation and IDH activity and the interplay between glucose and glutamine uptake as sources of carbon skeletons, energy and reducing equivalents required for tumor cell growth. These results suggest new targets for cancer therapy some of which will be addressed in the presentation.

Lecture 2

Metabolic Engineering: synthetic chemistry of the 21st century

September 26, Wednesday / 4:30 PM

Metabolic engineering is a maturing field, just about 20 years old. During this period, it has developed new concepts, a well-defined methodology and a focused research portfolio of rich intellectual content and particular relevance to biotechnology and biological engineering. Its goal is to harness the immense potential of microorganisms for the production of useful products, in particular from renewable resources. This it does by engineering the cellular metabolism such as to favor product-forming pathways while maintaining normal cellular functions. Having been founded on modern genetic methods and concepts of chemical reaction engineering, Metabolic Engineering is now adapting itself to rapid changes to take advantage of genome sequencing and avalanches of cell- and genome-wide data.

In this talk I will review the foundations of metabolic engineering, its key technologies and how it has evolved in its short life span. Particular emphasis will be placed on the new and diverse types of chemistry that can be carried out with the use of microbial catalysts that are extremely challenging for synthetic chemistry. As such, metabolic engineering emerges as the enabling science for the production of chemical and pharmaceutical products in the 21st century. Examples from the production of biofuels, pharmaceuticals and materials from renewable resources will be used to illustrate the above points.



Dr. GREGORY STEPHANPOULOS

Greg Stephanopoulos is the W.H. Dow Professor of Chemical Engineering and Biotechnology at MIT, and Taplin Professor of HST (2001-) and Instructor of Bioengineering at Harvard Medical School (1997-). He received his degrees in Chemical Engineering, taught at Caltech between 1978-85, after which he was appointed Professor of ChE at MIT. His current research focuses on

metabolic engineering, the engineering of microbes for the production of fuels and chemicals. He has co-authored or -edited 5 books, more than 330 papers and 50 patents and supervised more than 110 graduate and post-doctoral students. He is presently the editor-in-chief of Metabolic Engineering and Current Opinion in Biotechnology and serves on the Editorial Boards of 7 scientific journals and the Advisory Boards of 5 ChE departments. For his research and educational contributions, Prof. Stephanopoulos has been recognized with numerous awards, such as: Dreyfus award, Excellence in Teaching Award-Caltech, AIChE Technical Achievement Award, PYI from NSF, AIChE-FPBE Division Award, M.J. Johnson Award of ACS, Merck Award in Metabolic Engineering, the R.H. Wilhelm Award in Chemical Reaction Engineering of AIChE, Amgen Award in Biochemical Engineering. In 2002 he was elected to the AIChE Board of Directors, in 2003 to the National Academy of Engineering (NAE) and in 2005 he was awarded an honorary doctorate degree (doctor technices honoris causa) by the Technical University of Denmark. In 2007 he won the C. Thom Award from SIM and the Founders Award from AIChE and in 2010 the ACS E. V. Murphree Award in Industrial and Engineering Chemistry and the George Washington Carver Award of BIO. In 2011 he was selected as the Eni Prize winner for Renewable and non-Conventional Energy and was also elected as Corresponding Member of the Academy of Athens.

Professor Stephanopoulos has taught undergraduate and graduate courses of the core of Chemical Engineering and Biotechnology at Caltech and MIT and co-authored the first textbook on Metabolic Engineering. He is presently directing a research group of approximately 25 researchers.

September 25-26, 2012 /

4:30 PM

W1-3 Building /

Multimedia Hall

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About “The KAIST CBE Global Distinguished Lectureship”

The Department of Chemical and Biomolecular Engineering at KAIST proudly presents the 2nd KAIST CBE Global Distinguished Lectureship series. The lectureship is an annual event in which an internationally leading researcher in chemical and biomolecular engineering at a foreign institution is selected and invited to give a series of lectures. The lectures are open to our students and faculty as well as alumni and friends. The visiting lecturer, in addition to giving the seminars on recent trends and advances in his / her field is asked to participate in informal discussions with KAIST faculty and students. The seminar series is already becoming a marquee event and a proud tradition for our department.

The KAIST CBE Global Distinguished Lectureship is initiated with generous gifts from our faculty and alumni. The department is currently looking for a corporate sponsor to make it a fully endowed lectureship.

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