Seminars in Biotechnology BTEC 591 & BTEC 691

"Synthetic Biology and Minimal Genome Concept"

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13:30

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Işıl Tulum completed her undergraduate studies in 2006 at the Department of Biology at Marmara University. In 2008, she started her master's studies under supervision of Dr. Gül Cevahir Öz at the Department of Botany at Istanbul University on a joint project with Dr. Halil İ. Kavakli at Department of Chemistry at Koç University. After getting her master's degree, in 2010, she was awarded with MEXT- Monbukagakusho PhD Course Scholarship from the Embassy of Japan. She joined the Cell Function Lab for her PhD studies under the supervision of Dr. Makoto Miyata at the Department of Biology, Osaka City University, Japan. After receiving her PhD in 2014, she continued her research career at the same lab as a postdoctoral research fellow and as a specially appointed lecturer to give "Trends in Biology 101" lecture at the Department of Medicine at Osaka City University. In 2018, she moved to the University of Tokyo where she joined the Bioenergetics Lab of Dr. Hiroyuki Noji at the Department of Biophysics as a project PI. At the end of 2019, she was awarded with TUBITAK-2232, the International Outstanding Researchers Fellowship and moved back to Turkey to start her independent research career at the Department of Botany at Istanbul University as an Assistant Professor. Her main research interests are elucidating the pathogenicity mechanism of genome reduced bacteria, host-pathogen interactions, minimal genome concept and application of synthetic biology to understand bacterial infections.

Abstract
The fundamental biological functions of a living cell are stored within the DNA sequence of its genome. Classical genetic approaches dissect the functioning of biological systems by analyzing individual genes, yet uncovering the essential gene set of an organism has remained very challenging. An obvious way to start this endeavor is to study minimal cells, natural or synthetic organisms that contain only the bare minimum of genetic information needed to survive. By building and studying these very simplified cells – so simple they have been described as the 'hydrogen atoms of biology' by Harold Morowitz– we may be able to dissect all the molecular mechanisms required to sustain cellular life (1). In this talk, the audience will learn how rewriting of entire genomes through the process of chemical synthesis provides a powerful and complementary research concept to understand how essential functions are programed into genomes. The talk will mention the naturally occurring bacteria that had gone through "reductive evolution" and that are good models for genome reduction and thus "minimal genomes" such as *Phytoplasmas*, *Mycoplasmas* and *Spiroplasmas* (2, 3, 4). The talk will explain all the steps to achieve the first ever artificially recreated genome of *Mycoplasma laboratorium.* The steps will include physical and functional mapping with complete sequencing of the mycoplasma, determining the open reading frames (ORFs), determining the encoded amino acids, understanding the functions of genes and finally reassembling mycoplasma's cellular machinery (5, 6). The ability to design cells in which the function of every gene is known should facilitate complete computational modeling of the cell. This would make it possible to calculate the consequences of adding pathways for the production of useful products, such as drugs or industrial chemicals, and would lead to greater efficiency in development.

References:

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