Ústav živočišné fyziologie a genetiky AV ČR, Centrum Pigmod

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Sekce reprodukční a vývojové biologie Československé biologické společnosti

si Vás dovolují pozvat na přednášku konanou dne 10.6.2013, od 14. hod.
na Přírodovědecké fakultě UK, v posluchárně Fotochemie, Viničná 7, Praha 2

Cell Cycle Control: Revisit to MPF

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The cell cycle is a molecular system that ensures faithful duplication of the cell, and hence underlies wide range of life science from basic biology to various diseases, particularly cancer and genetic disorders. Cell cycle studies at the end of the last century established a concept that in eukaryotic cells, the cell cycle control system is composed of two major elements, the cell cycle engine and the checkpoint. The cell cycle engine consists of various cyclin-Cdk (cyclin-dependent kinase) complexes that accomplish progression of particular phase in the cell cycle, while the checkpoint is negative feedbacks that ensure correct replication and segregation of chromosomes.

The concept of cell cycle engine has emerged from the convergence around 1990 of three independent studies, MPF (maturation or M-phase promoting factor), Cdc2 (renamed Cdk1) and cyclin B. It is currently well accepted that MPF and the kinase cyclin B-Cdk1 complex are synonymous. Originally, however, MPF was described first in frog and then in starfish oocytes as a cytoplasmic activity contained in hormone-treated maturing oocytes that upon transfer causes recipient immature oocytes to undergo the meiotic resumption without hormonal stimulus. Based on the original functional assay in oocyte system, we have recently found that MPF is not identical to cyclin B-Cdk1. Instead, MPF consists of two separate kinases, cyclin B-Cdk1 that directs mitotic entry and Greatwall kinase (Gwl) that suppresses the protein phosphatase PP2A-B55 which opposes cyclin B-Cdk1. We propose to reconsider the molecular identity of MPF, a prototype of the cell cycle engine.

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