Fall 2012

Project title : Mathematical Modeling of Heat Shock Protein Synthesis of Barley Aleurone Cells in Response to Temperature Changes

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MATH 3338: Mathematical Modeling (Fall 2012)

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Student group:……..

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Project description:
One of the most important questions in cell biology is how cells cope with rapid changes in their environment. When heat shocked or stressed, the secretory cells of barley aleurone layers reallocate cellular resources by combining heat shock and endoplasmic reticulum stress responses. A set of proteins that are commonly known as heat shock proteins (HSP) is synthesized. The synthesis of HSPs appears to be due to the increased transcription of HSP genes but it is not known how the tissue senses the increase in temperature. It has been suggested that a primary signal of HSP synthesis may result from a change in the cellular membranes and that the resulting HSPs may exert a protective effect on the membranes. In other words, inductions of HSPs increases cell survival under stress conditions.
In this project, students are required to propose a mathematical model of HSP synthesis induced by an external temperature stimulus. Computational simulations of the model will be compared with experimental data for different temperature schemes (plunge [heat shock], slow and fast ramps [heat stresses]). After validation, the model predictions will be used to describe HSP synthesis up to a different final temperature and form hypotheses concerning the molecular response to stress.

Guidelines:
Aug 22 – Aug 31: learn the cell biology (HSP synthesis) of the project and read related papers.
Sep 1 – Sep 16: analyze experimental data.
Sep 17: present project progress.
Sep 18 – Sep 30: form a diagram to describe different reactions within the process of HSP synthesis.
Oct 1 – Oct 7: build a mathematical model for HSP synthesis in response to temperature stimulus.
Oct 8: present project progress.
Oct 9 – Oct 28: write a Matlab program to solve the proposed model and produce simulations that match the experimental data or literature.
Oct 29: present project progress.
Oct 30 – Nov 18: do equilibrium and sensitivity analysis.
Nov 19: present project progress.
Nov 20 – Dec 2: prepare slides and results for final presentation.
Dec 3: FINAL presentation.

Technologies:

- For the literature search, you should use the internet, books, journals, and other media as appropriate. Michael Hughes will show you how to search scientific articles in databases (such as *MathSciNet* and *JSTOR* for math articles).
- You will learn how to use *LaTeX/LaTeX beamer* to prepare presentations.
- Jeremy Donald is the faculty technology liaison. He will show you two important technologies: how to use *GoogleDocs* to create and share work online and access the documents from anywhere, and take advantage of *Google Sites* to easily create a free website to "publish" the final presentation so that everyone can access.
- You will need to use *ImageJ* to analyze experimental data.
- You will learn how to program in *Matlab* and *Maple*.