

Introduction to Systems Biology and Systems Medicine: Part 1

CHEG 660, Fall 2019

(three credit course, also offered as MATH-CHEG 460)

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Meeting time: Monday and Wednesday 5:30 to 6:45pm in eCalc1 Room 046 Colburn

The purpose of the course is to introduce students to modeling of biological and medical systems. This project-based course is primarily designed for chemical engineers, mathematicians, and life scientists with a strong quantitative background. An understanding of calculus, differential equations, and computer programming are all very desirable for the course, but the course has no formal prerequisites. Anyone with the right background and motivation can register with permission of instructor. The course is project-based, and students learn by building models throughout the course.

Topics

1. What is a System? What is Systems Biology and Systems Medicine?
2. Why do we model? How can we evaluate the utility of a model?
3. How do we generate models?
4. What are the different types of models that we can develop?
5. How can we think of the human body in terms of engineering principles?
6. What is the human microbiome and how has it revolutionized medical thinking?
7. Example: The Gut-Brain Connection and Autism Spectrum Disorders (ASD)
8. How can we use Netlogo to make rules-based models?
9. How can we use Matlab to make an ODE model?
10. How can I use Simulink to make a process control model?
11. What is a connectivity map and how can I create using domain knowledge?
12. Physiologically-based pharmaco-kinetic (PBPK) models
13. How can I validate my model or perform a reality check?
14. What is "big data" and how does it drive systems biology and systems medicine?

Recent links to news items about research publications resulting from course projects

Newsweek Op-Ed: <https://www.newsweek.com/termite-guts-clean-coal-energy-environment-methane-1293710>

Termite Guts: <https://www.udel.edu/udaily/2019/january/termite-gut-microbes-extract-clean-energy-from-coal/>

Virtual Gut Model: <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0207072>

Brain Cancer: <http://www.udel.edu/udaily/2018/february/glioblastoma-cancer-tumor-computer-models/>

Osteoporosis: <http://www.udel.edu/udaily/2017/march/modeling-osteoporosis-treatment/>

Gut-Brain Axis: <http://www.udel.edu/udmessenger/vol23no2/stories/faculty-dhurjati.html>

Autism: <http://www.delawareonline.com/story/money/business/2015/09/13/autism-linked-gut-microbiome/72225448/>