PLB 524: Gene Regulatory Networks
Course Syllabus Spring 2016

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Office hours: Monday, Tuesday, Thursday, Friday 9am Life Science II 403A

Lectures: Tuesday and Thursday 10:00am to 11:50am, Faner Hall 3514

Labs: Tuesday or Thursday 3pm-5pm, Life Science II 449

Pre-requisites: PLB471 Introduction to Systems Biology (recommended). PLB419 plant molecular biology or MICR480 microbial molecular biology or MBMB451 structural molecular cell biology or equivalent (recommended). BIOL 305 Genetics (required).

Textbooks: 1) An introduction to Systems Biology: Design principles of biological circuits. By Uri Alon / CRC press 1st or 2nd edition
1st edition| ISBN-10: **1584886420**
2nd edition| ISBN-10: **1439837171**

2) Papers and handouts online

Course Goals and Objectives:

Advances in Bottom-up (one gene at a time) and Top-down (bioinformatic) approaches have converged in the field of Systems Biology. This course will show students both methods and how they predict and describe the networks which regulate gene expression in living cells. We will examine canonical connections such as transcription factor complexes and *cis*-regulatory elements of the basal promoter, post-transcriptional processing, protein degradation and modification, as well as emerging mechanisms such as chromatin remodeling, DNA methylation, nucleosome positioning and micro-RNAs. We will also consider the medium picture, circuitry and wiring of many genes in a given pathway, such as abiotic stress response, pathogen resistance, and the regulation of metabolic homeostasis. Finally we look at the big picture, of how the whole genome is interconnected through regulatory circuitry, and how these connections have evolved.

On Lectures:

The Tuesday lecture will consist of a formal lecture prepared from the material presented in Uri Alon's book. Thursday will be a review and discussions of a paper (linked online in the D2L course website). After a brief introduction to the paper, the floor will then open for all students to ask question and offer opinions on the paper. All students must participate. Students are each required to each of the papers before class and vigorously join the discussion.

Paper Review:

Each student will select one paper (from the ones discussed in class or the supplementary papers linked in D2L) and prepare a 200 word summary of all major points of that paper. This summary should be carefully edited and of publication quality, and will be worth 100 points towards the final grade.

On Labs:

This is the first year a lab is being offered for this course. The lab will be self-directed from instructions on worksheets and walkthroughs, and the lecturer will be present to answer questions and help overcome problems. Answers to questions on worksheets will be recorded by students in a document (MS Word or Libre Office) with complete answers and screenshot(s) of the relevant data including figure legends for each screenshot.

On plagiarism: *In the era of web information, cutting and pasting, and word processing it is very tempting and easy to plagiarize. This includes lifting whole paragraphs, or even a single sentence. Plagiarism inhibits learning. You need to be able to express your own thoughts and ideas in writing, which is part of the educational experience at SIUC and in this course. Your answers on worksheets and exams must be your own, and may be subject to electronic comparison to other work. If you have difficulty writing, please visit me at office hours or after class for additional help.*

Exams: Lecture exams will be given twice, one mid-term and one in finals week. These exams consist of definitions, short answer and essay questions. You will be evaluated on the content, clarity, and creativity of your responses.

Grading: Your grade for this course will be based on both laboratory exercises and exams. The point breakdown is as follows

Lecture Exams (2) x 100pts	200 points
Labs (5) x 20 pts	100 points
Paper Review	100 points
	Total 400 points

Lectures PLB524 Spring 2016

Lecture #	Topic	Chapters	Labs
1	Introduction / Overview	Alon-1	
2	Paper 1: The protein interactome		
3	Review of transcription networks	Alon-2	1
4	Paper 2: Top down GRN discovery		
5	Autoregulation and FFL circuts	Alon-3&4	
6	Paper 3: A feed forward loop in Yeast		
7	Bottom-up approaches		
8	Paper 4: The Arabidopsis cold stress signaling network		2
9	Top-down approaches		
10	Paper 5: The Wnt signaling pathway in Humans		
11	Evolutionary analysis of transcription factor families		
12	Paper 6:A family of transcription factors		
13	Review discussion		3
	Midterm examination		
14	SIMs and MOFFLs = FILO or FIFO	Alon-5	
15	Paper 7: Regulation of a metabolic pathway in E.coli		
	FALL BREAK		
16	DORs and complexity	Alon-5	
17	Paper 8: Gene networks		
18	Computation and memory in networks	Alon-6	
19	Paper 9: Comparison of circadian rhythm networks		4
20	Bacterial chemotaxis network	Alon-7	
21	Paper 10: Signaling from sensory input		
22	Identification of cis-regulatory elements		
23	Paper 11: Cis-regulatory elements		
24	Structural biochemistry of mechanisms of regulation		
25	Paper 12: Gene Regulation at the promoter		5
26	Patterning in development	Alon-8	
27	Paper 13: Composite network in development of drosophila		
28	Optimal circuit design	Alon-9&10	
	Final review		
Dec 9	**Final Exam**		

Labs PLB524 Spring 2016

Lab#	Topic
1	**Introduction to Cytoscape:** analysis of network properties
2	Construction of a subnetwork and hypothesis generation, discovery of network motifs
3	**Introduction to R:** Large data manipulation of Transcriptomic time series
4	Causal prediction of GRN: GeneNet and TD-Arachne
5	**Introduction to MySQL:** Identification of cis regulatory elements