M&IM 351

Functional Genomics and Proteomics: Applications to Immunobiology

Overview
An interdisciplinary course designed to train predoctoral students and postdoctoral fellows in biological applications of functional genomics and proteomics in immunobiology. The course combines didactic lectures with student-driven critical evaluations of high impact publications.

Course structure
Each week, a preceptor will give a short didactic lecture to the class (Monday@3:00pm) providing background on the functional genomics/proteomics and immunology topics. On Wednesday, the preceptor will moderate the discussion of a seminal primary publication(s) that applies the functional genomic approach (Wednesday@9:00am). The students are expected to lead the discussion of publication. Students will be graded each week based on their participation and knowledge that is demonstrated in the discussion.

Grades
Each week, preceptors will give each student a grade based on their participation and knowledge during the Wednesdays’ discussion. At the end of the course, each student will select a publication from the literature that applies functional genomics or proteomics to immunobiology and present the publication in the class. The students will be graded based on their presentation and knowledge of the publication, evaluation of the functional genomics approach, biological insights, and conclusions.

Topics
The field of functional genomics and proteomics uses the vast wealth of data produced by genomic projects to describe gene and protein functions and their interactions. It typically focuses on dynamic aspects of gene transcription, translation, and interactions. It includes function-related aspects of the genome itself such as mutations and polymorphisms (e.g. SNP analysis).

I have listed below the functional genomics and proteomics approaches that I think should be covered in M&MI351. Because functional genomics and proteomics fields are highly dynamics and constantly changing, there are other approaches that could also be considered.

To help in your selection of a topic and publication, I have attached list of recent reviews and primary publications that describe and apply functional genomics and proteomics to immunobiology. The publications are sorted by the approaches that I have selected. Some of the publications are seminal publications and outstanding examples of functional genomics being applied to biology. However, it is nowhere near a comprehensive list of relevant publications.
Common Functional Genomics and Proteomics Approaches that should be covered in M&MI351

- **DNA microarrays** or **SAGE** to identify and quantify global changes in gene expression (e.g. mRNAs, siRNAs, etc.) to model immune response or cellular activity.
- **Two-dimensional gel electrophoresis** and **mass spectrometry** to identify and quantify global changes in proteins to model immune response or cellular activity.
- **siRNA** and **cDNA transfections** at a global scale into cells or an organism to test the function of individual genes or libraries of genomic reagents in cell-based experiments. The goal is to identify new genes associated with immunity or inflammation.
- **Protein-protein interaction** studies to map the global network of protein interactions in a cell or in a signaling pathway involved in immunity or inflammation.
- **Genome-wide association studies (GWAS)** to identify common genetic factors that influence immunity, inflammation, or disease. A genome-wide association study is defined as any study of genetic variation (e.g. duplications, deletions, SNPs, etc.) across the entire human genome that is designed to identify genetic associations with observable traits (such as immune response or the presence or absence of a disease or condition (increase susceptibility to autoimmune disease).
- **System biology** approaches that focuses on the systematic study of complex interactions that focus on immunity or inflammation.
- **Large-scale mutagenesis** strategies to identify new genes involved in immunity or inflammation.
- **Chromatin Immunoprecipitations (Chip)** to globally map Protein-DNA Interactions by chromatin immunoprecipitation and DNA microarray hybridization or next generation DNA sequencing.
- **Large-scale DNA Sequencing** to identify new genes and genome variation associated with immunity or inflammation.

Possible Publications:

**GWAS studies to identify new genetic factors associated with immunology and disease**


**RNAi screens identify new genes associated with immunology and disease**


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**Large-scale mutagenesis to identify new genetic factors associated with immunology and disease**


**System Biology approaches to immunobiology**


M&MI351 course
2/3/2009


**DNA Microarrays applied to immunology and disease**


Protein Arrays for epitope discovery and immunobiology


Phosphoproteomics applied to immunology and disease


High-throughput DNA sequence analysis applied to immunology and disease


**Chip analysis applied to immunology and disease**


**Two-dimensional gel analysis applied to immunology and disease**


**Protein-Protein interactions networks applied to immunology**