'Omic' Technologies in Science and Medicine

Fall Semester 2016

Tuesday & Thursday, 10:00 – 11:20 am

Course No: MEDS4032 Course Director: Dr. Paul R Rosevear

Textbook: TBA

Lecture	Title
1	Biomarker Basics: Measuring biological molecules
2	Introduction to 'Omic' Technologies: Genomics (DNA), Transcriptomics (RNA), Proteomics (proteins) and Metabolomics (metabolites)
3	Hypothesis-Driven or Targeted versus Non-Targeted Research
4	Data Integration, Modeling, and Formulation of Biological Hypotheses
5	Use of 'Omic' Information in the Diagnosis of Disease
6	**EXAM**
7	Genome and Genomics: Gene expression levels and SNPs, predisposition genetics and associated ethics
8	Genomic Biomarkers: Karyotype analysis, FISH, amination and methylation
9	Transcriptome and Transcriptomics: mRNAs produced from the genome
10	Transcriptomic Biomarkers: mRNA and microarrays
11	Proteome and Proteomics: Proteins produced under a given set of conditions
12	Proteomic Biomarkers: Complement of proteins and modifications to these proteins produced by the organism or cellular system
13	**EXAM**
14	Metabolome and Metabolomics: Metabolism occurring in the organism: Environmental, nutraceutical, and drug effects
15	Metabolomic Biomarkers: Small Molecules & Metabolites
16	Tools and Resources for Research in –OMICS: The Role of Data
17	Data Processing and Analysis Methods in –OMICS: Big Data versus Small Data

18	Analysis of –OMICS Data: Model-Based, Statistical, and Probabilistic an Overview
19	**EXAM**
20	**SPRING BREAK**
21	**SPRING BREAK**
22	Analytical Techniques: Gene Expression Microarrays and Chips
23	Analytical Techniques: Separation Techniques & Mass Spectroscopy
24	Analytical Techniques: Lipidomics
25	Analytical Techniques: Nuclear Magnetic Resonance
26	Analytical Techniques: Nuclear Magnetic Resonance
27	Medical and Research Applications: Diabetes & Cardiovascular
28	Medical and Research Applications: Cancer
29	Medical and Research Applications: Osteoarthritis & Fertility
30	**EXAM**
31	**EAXM WEEK**

Course Description

This course is a survey of the application and interpretation of high-throughput molecular biology methods (-OMIC technologies) used to produce high-volume biological data. The new 'omic' technologies allow the components of a living organism to be analyzed in their entirety and provide new insights into the complexities of organism function. Technologies covered include genomics, transcriptomic, proteomics, and metabolomics. Genomics and transcriptomics describe the structure and expression of the genome, proteomics provides information about the proteins expressed in cells under a certain set of conditions and metabolomics seeks to identify and quantify the diversity of metabolites and metabolic networks within an organism. Key to understanding scientific and medical data resulting from applications of these technologies is an understanding of experimental design, data collection and analysis and interpretation. Relationships between the individual technologies will be explored and strategies for integrating –OMIC information will be discussed.

In this course the student will learn how the 'omics' technologies work and about aspects of experimental design, analysis and interpretation (bioinformatics). A series of case studies will be used to illustrate how these technologies engender a better understanding of complex biological systems and processes.

Pre-Requisites

- Introduction to Medical Biochemistry (MEDS3020)
  or equivalent Biochemistry course

Learning Objectives:

- To learn about the various –OMIC disciplines and the types information they provide the user
- To appreciate the –OMIC experiment from study design and sample preparation through data collection and analysis
- To gain a brief overview of the applications of these approaches in research and medicine.
- To discuss the ethical issues in the use of –OMIC technologies including predisposition testing, sample storage and associated clinical data.
- To understand and describe modern high-throughput molecular techniques used to produce high-volume biological data.
- To understand computational biology methods for interpretation of data from high-throughput experiments.
- To explore recent advances in the use of –OMIC methodologies in various diseases.