Introduction to Biology for BMI

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Course Website: http://www.ruggleslab.org/introduction-to-biology-for-bmi.html

I. Course Description:
This course serves as an introduction to biology and biochemistry for biomedical informatics (BMI) students. We will cover basic concepts in genetics, cellular biology, and human health with an emphasis on understanding the literature and lab methodology. The goal of this course is to familiarize students with basic biological systems to allow for better understanding integration into bioinformatics based projects.

II. General Course Format and Procedure
A combination of textbook chapters, reviews and scientific papers will be assigned for each weekly topic. The first half of each session will be completely lecture-based, focusing on basic biology within that field. The second half will be discussion. During the first half we will review frequently used methods in each field. The discussion session will be spent discussing the readings assigned for that week. A main goal of the discussion sessions is to understand the biology from an informatics perspective and to brainstorm ways to efficiently use computation techniques to analyze these data.

III. Course Readings/Materials
Books from which select chapters will electronically supplied to you
- Campbell Biology (9th Edition)
- The Processes of Life by Lawrence E. Hunter

IV. Grade Distribution
The grades will be calculated according to the table below. Although attendance is not included, in class participation is a portion of your grade. If distribution of grades necessitates it, the final grades will be curved. However if all students do well, there will not be a forced distribution (or lowering of grades based on a bell curve).

<table>
<thead>
<tr>
<th>Course Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Assignments</td>
<td>40%</td>
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<tr>
<td>Presentation</td>
<td>30%</td>
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<tr>
<td>Participation</td>
<td>30%</td>
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Week 1: Introduction to Cellular Biology
- Topics covered: Macromolecules, cell organization, membrane structure, Cell cycle, DNA to protein synthesis, cell differentiation.
- Methodology: Microscopy (light, confocal, EM), Model organisms, PCR, gel electrophoresis, Northern blots, Western blots.
- Reading List:
  - Campbell Biology, Chapter II (6-8), Chapter 12-13
  - The Processes of Life, Chapter 5-7

Week 2: Genetics and Genomics
- Topics covered: DNA structure, replication and genetic inheritance, single gene disorders, Genomic sequencing, epigenetics and genetic variation.
- Methodology: Quantitative PCR, microarrays, ChIP, Whole genome sequencing and assembly, methylation studies, genome annotation.
- Reading List:
  - Campbell Biology, Chapter 15-16
  - Radiolab Antibodies Part 1: CRISPR
  - Discussion Readings:

Week 3: Transcriptomics and Gene Biomarkers
- Topics covered: Eukaryotic transcription, transcriptional regulation, RNA splicing, miRNA, cancer genetics, personalized medicine, genome-wide association studies.
- Methodology: RNA-sequencing and alignment, RNA interference, transcriptome annotation
- Reading List:
  - Campbell Biology, Chapter 17-18
  - Discussion Readings:
Week 4: Proteins and proteomics

− Topics covered: Protein synthesis and structure, protein complexes, global and phospho proteomics.
− Methodology: Antibody-based quantitation, immunoprecipitation, fluorescence and super-resolution microscopy, mass Spectrometry and downstream analysis.
− Reading List:
  o **Biochemistry**: Chapter 3 (41-55), Chapter 4 (77-89)
  o **Discussion Readings**:

Week 5: Post-translational modifications and cell signaling

− Topics covered: Protein folding, post-translational modifications, network biology, cell signaling pathways.
− Methodology: Basic structural proteomics, enzyme activity assays, network analysis and available tools
− Reading List:
  o **Biochemistry**: Chapter 15 (395-403, 416-424)
  o **Discussion Readings**:

Week 6: Lipidomics and biomarker discovery

− Methodology: Lipid imaging, lipid extraction and mass spectrometry.
− Reading List:
  o **Biochemistry**: Chapter 12 (319-334)
  o **Discussion Readings**: