

NUTR 225

SYLLABUS

FALL 2015

Course Instructor

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Overall Goals

To become familiar with biochemical, molecular and information science techniques commonly used in nutrition research: Five broad classes of techniques and approaches will be covered: The course will emphasize how these different classes of techniques are used in a complementary and mutually-enforcing manner to address a research question.

1. Partitioning techniques for the separation and analysis of complex biomaterials
1. Physical separation of cell constituents and biomolecules
2. Analysis of these using antibody-based techniques in conjunction with...
3. Fluorescence and Bioluminescence
4. Gene Expression: Analysis and Manipulation
5. Data Science (Informatics, Computational Biology); Bioengineering

General Approach The intent of this intensive, short course is to familiarize you with fundamental techniques used to study biology at the molecular, cell, tissue and whole organism level. The techniques that are covered in this course will be referred to in classes and seminars throughout your training at the Friedman School of Nutrition.

The basic theory for individual laboratory techniques is standardized across many disciplines, and can be learned in the form of self-study. An additional goal of this course is to familiarize you with the “virtual” communities of scientists and the vast resources available to you in public domain websites managed by scientific consortia. For each technique or group of techniques we have provided initial web-based materials describing particular techniques. You are expected to complete these and the assignments designated by **** before class. **Class time will be devoted to a 30 minute quiz, discussion of the answers to the quiz and expanded discussion of techniques covered in your reading.** Yes, there *will* be a quiz at the first class.

Prerequisites Undergraduate biochemistry course

Grading This 0.5 credit course is graded S/U and is required of all Biochemical and Molecular Nutrition (BMN) students. Grading is based on the average of the quizzes (75%) and classroom participation (25%). A grade of “S” requires an overall average of 70% or above.

2014 Course Schedule Class will meet Tuesday September 8th, 15th, 22nd, 29th and October 6th from 1:30-3:00. Classes meet in the HNRCA mezzanine conference room. You will be granted access to the HNRCA as ‘guests’ and will be escorted from the security desk to the mezzanine conference room. Foreign students must in addition have completed the ARS230 form and received approval (Lauren.Bailey@Tufts.edu).

Office Hours: Fridays, 2:30-4:30.

Class #1. September 5 Lab Basics; Partitioning Techniques; Mass Spectrometry

A. Levels of Biological Organization; Lab Books; On-LineTools; ISI

- I. <http://staff.jccc.net/PDECELL/lifeis/biorgnew.html>
- II. <http://www.currentprotocols.com/> (Invaluable resource of on-line methods and protocols; explore)
- III. <http://www.scientistsolutions.com/> (get answers to your direct posts concerning techniques)
- IV. <http://physics.nist.gov/cuu/Units/index.html> - (ISI; understand difference between *base units* and derived units and be facile with ISI prefixes). A guide for use and conversion of ISI units is:
- V. <http://physics.nist.gov/cuu/Reference/unitconversions.html>

B. Separation / Partitioning Techniques: Gas and Liquid Chromatography:

- I. <http://elchem.kaist.ac.kr/vt/chem-ed/sep/chromato.htm> - *please read introduction and links to "separations", "partitioning", "gas chromatography", "liquid" and "high-performance liquid chromatography*
- II. <http://www.youtube.com/watch?v=dffeiLgeKx8&NR=1>
- III. http://www.youtube.com/watch?v=kz_egMtdnL4&feature=related
- IV. <http://www.youtube.com/watch?v=q0pM-k0SvOO&feature=related>
- V. <http://www.youtube.com/watch?v=xXkOte0dPfg&feature=related>

C. Mass Spectrometry

- I. <http://www.chemguide.co.uk/analysis/masspec/howitworks.html>
- II. <http://www.chemguide.co.uk/analysis/questions/q-mshowitworks.pdf>
- III. <https://www.youtube.com/watch?v=NuIH9-6Fm6U>
- IV. <http://www.youtube.com/watch?v=rBymrFzcaPM&feature=fvwrel> (lectures 1 and 2)

Class #2: September 12: Working With Mammalian Cells; Electrophoresis of Proteins and Nucleic Acids

A. Cell Culture, Cell Fractionation

- I. http://www.youtube.com/watch?v=yJ_acpKglto&feature=related
- II. <http://www.promega.com/resources/multimedia/drug-discovery/cell-culture-video/>
- III. <http://www.freewebs.com/ltaing/>
- IV. <http://wn.com/ultracentrifugation>
- V. <http://www.sumanasinc.com/webcontent/anisamples/microbiology/cellfractionation.html>
- VI. <http://wn.com/ultracentrifugation>
- VII. <http://homepages.gac.edu/~cellab/chpts/chpt3/table3-2.html> (no need to memorize- only understand the principle)
- VIII. <http://homepages.gac.edu/~cellab/chpts/chpt3/table3-1.html> (no need to memorize- only appreciate the principle.
- IX. http://nobelprize.org/educational/medicine/dna/a/translation/svedberg_unit.html
- X. <http://homepages.gac.edu/~cellab/chpts/chpt3/figure3-5.html> (no need to memorize- only appreciate the principle)

- XI. <http://www1.qiagen.com/products/protein/proteomics/Qproteome/QproteomeCellCompartmentKit.aspx?ShowInfo=1#flow> (select USA, click and scroll through “Product Details”)

B. Separation and Initial Characterization of Proteins and Nucleic Acids

- I. <https://www.youtube.com/watch?v=3CrzY7jb9fQ>
- II. <https://www.youtube.com/watch?v=p0ZxmVBkayo>
- III. <https://www.youtube.com/watch?v=HqmxLsHKxZE>
- IV. <https://www.youtube.com/watch?v=bdBXwuuwSBo>
- V. <http://www.dnalc.org/resources/animations/gelectrophoresis.html>
- VI. http://www.youtube.com/watch?v=6_4AY3lYRgo&feature=related
- VII. <https://www.youtube.com/watch?v=vq759wKCCUQ>

VIII. Putting units A and B together

<http://www.jove.com/video/3788/isolation-soluble-insoluble-prp-oligomers-normal-human> (video sections “Preparation of Brain Homogenate” and “Velocity Sedimentation”).

Class #3. September 19. Antibody and Fluorescence-Based Techniques

A. Measuring Antigens in Biological Samples (blood, tissue homogenates, etc)

- I. http://www.youtube.com/watch?v=Ys_V6FcYD5I&feature=related
- II. <http://www.youtube.com/watch?v=hQmaPwP0KRI&feature=BFa&list=PL12D59D28513CA093&index=1>
- III. <http://www.dnatube.com/video/2220/Antibodies>
- IV. <http://www.dnatube.com/video/280/ELISA-Enzyme-Linked-ImmunoabSorbant-Assay>
- V. <http://www.sumanasinc.com/webcontent/animations/content/ELISA.html>

B. Fluorescence and Flow Cytometry

<http://www.invitrogen.com/site/us/en/home/support/Tutorials.html> (complete tutorials 1 and 4)

C. Imaging Techniques (Immunofluorescence, Confocal Microscopy and *In Vivo* Imaging)

- I. http://media.pearsoncmg.com/bc/bc_campbell_genomics_2/medialib/method/IMF.html
- II. <http://www.youtube.com/watch?v=OH2GFeaGV6w>
- III. <http://www.olympusconfocal.com/theory/confocalintro.html> (First 3 paragraphs)
- IV. <http://www.microscopy.fsu.edu/primer/virtual/confocal/index.html> (note difference between widefield and confocal; practice optical sectioning).
- V. <http://www.youtube.com/watch?v=g5U-n4Toq60&feature=related>
- VI. <http://www2.healthsci.tufts.edu/saif/mods.htm>
- VII. <http://circ.ahajournals.org/content/117/3/379.full.pdf+html> (introduction and figures)

Class #4. September 26: Measuring and Manipulating Gene Expression

A. PCR-based approaches: PCR, RT-PCR and Real-Time PCR;

- I. <http://www.dnalc.org/ddnalc/resources/pcr.html>
- II. <http://www.dnalc.org/view/15475-The-cycles-of-the-polymerase-chain-reaction-PCR-3D-animation-with-no-audio.html>

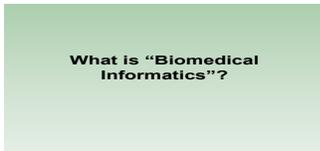
- III. <http://www.bio.davidson.edu/people/kabernd/seminar/2002/method/lowry/RTPCR.htm>
- IV. http://www.bio.davidson.edu/courses/immunology/Flash/RT_PCR.html
- V. <http://pathmicro.med.sc.edu/pcr/realtime-home.htm>
- VI. <http://media.invitrogen.com.edgesuite.net/ab/applications-technologies/real-time-pcr/taqman-genex-assays/index.html> (select “Taqman Chemistry”)

B. Cell Transfection, Reporter (Promoter) Assays and RNA Interference

- I. <http://www.promega.com/multimedia/> (view animation on transfection and reporter assays)
- II. <http://www.jove.com/index/details.stp?ID=240>
- III. <http://www.cellbiolabs.com/viral-expression>
- IV. <http://video.google.com/videoplay?docid=-7104884525024111858&q=Google+EngEdu>
- V. <http://www.nature.com/focus/rnai/animations/animation/animation.html> (modules 1 and 2)
- VI. <http://www.promega.com/resources/multimedia/rna-analysis/introduction-to-rna-interference/>
- VII. <http://www.jove.com/details.php?id=1499>
http://www.youtube.com/watch?v=QA67v4vSg00&feature=player_embedded

Class 5. October 3 Data Science; Bioengineering

A. Databases, Data Mining, Informatics and Systems Biology



- <http://onlinelibrary.wiley.com/doi/10.1002/0471250953.bi0101s34/pdf>
- <http://ase.tufts.edu/biology/bioinformatics/exercise1.asp>
- <http://www.ploscompbiol.org/article/info:doi%2F10.1371%2Fjournal.pcbi.1002202>
- <http://stm.sciencemag.org/content/6/234/234ra57.full.pdf>
- <http://www.flavourjournal.com/content/pdf/2044-7248-2-4.pdf>
- <http://www.techrepublic.com/article/how-big-data-is-going-to-help-feed-9-billion-people-by-2050/>
- <http://www.foodnavigator-usa.com/Regulation/Big-Data-and-Big-Food-Where-to-draw-the-line>
- <http://betterexplained.com/articles/an-intuitive-and-short-explanation-of-bayes-theorem/>

B. Bioengineering

- I. https://www.ted.com/talks/geraldine_hamilton_body_parts_on_a_chip#

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