

Division of Medical Sciences

Ph.D. Programs at Harvard Medical School

Nanocourses
Fall Semester
2015 - 2016

Full listings available at:

<https://nanosandothercourses.hms.harvard.edu/>

For information call: 617-432-0162

Division of Medical Sciences (DMS) Nanocourse Policy

Read below to learn how to receive course credit and register for a nanocourse:

Course Credit:

Although students are encouraged to take as many nanocourses as they please, official credit will be granted for up to six nanocourses only. Students must participate in all sessions of a nanocourse and complete all the assignments in order to qualify for credit. Completion of three nanocourses will be equivalent to a quarter course credit.

Course Registration:

Nanocourse enrollment is required only for students who wish to accrue credit. Students are required to enroll on the web site in advance of the course (as specified per course on the web site). Students may drop a course using the web site, up to one week prior to the first session of the course. Failure to attend or complete the course will result in an incomplete grade for students who do not drop the course one week before the course date. An incomplete grade will also be given to students who do not attend both days of a nanocourse for which they have enrolled if they do not drop the course as specified above.

Intellectual Unit:

Next Generation Sequencing Technologies: Principles and Applications

Nanocourse Director(s): Fred Winston

Curriculum Fellow: Emily Gleason & Megan Mittelstadt

Lecturers: Chad Nusbaum, Peter Park, Robert Steen

Traditional capillary sequencing technology using base-specific chain termination by fluorescent di-deoxy nucleotides represents modifications to the original sequencing methodology devised by Sanger and colleagues in the 1970s. Recent years have seen the development of next generation parallel sequencing technologies that are rapidly replacing older methodologies. Sequencing by synthesis enables the simultaneous sequence analysis of millions of DNA templates at the same time, or in parallel. These new approaches allow for DNA sequencing at a markedly faster pace, and often at a much cheaper price, making sequencing projects feasible for an ever-expanding number of researchers. This nanocourse will explore the methodology and principles behind parallel sequencing technology, and how it measures up to traditional sequencing methods. A discussion of the services available at the Department of Genetics Biopolymers core facility, including order placement, data output, and turnaround times, will also be included for researchers interested in utilizing these resources.

Assignment- Registered students should prepare a one-page document detailing a research question that could be at least partially answered by next-generation sequencing methods, and how you would propose to use them. Please send your documents (either Word files or pdf files) to Megan Mittelstadt (megan_mittelstadt@hms.harvard.edu) by 5:00 p.m. on Sunday, October 25th. Your proposals will be sent to the course lecturers and registered students prior to the session so everyone can look them over and prepare to discuss them with you. Please bring a copy of the proposals to the session for your own reference.

DROP DEADLINE: Tuesday, October 13, 2015

First Session: Tuesday, October 20, 2015, 10 AM - 1:30 PM

Location: NRB 350

Second Session: Tuesday, October 27, 2015, 10 AM - 12:30 PM

Location: TMEC 448

Intellectual Unit:

Advanced Flow Cytometry

Nanocourse Director(s): Timothy Mitchison

Curriculum Fellow: Kevin Bonham & Emily Gleason

Lecturers: Jodene Moore, Fabien Depis

Flow cytometry is a technology that can be used for a wide range of both clinical and research-based applications. It offers qualitative and quantitative data, describing cellular phenotypes and functional properties. Recent advances in hardware, instrumentation and reagents have now made it possible to use higher-order polychromatic assays of complex design that measure up to 27 parameters. These multicolor assays offer great potential to ask new questions, or provide new answers to old questions. This nanocourse will introduce you to the principles of polychromatic experimental design and cover the relevant controls required for troubleshooting protocols or instrumentation, facilitating accurate gating, compensation and providing a biological comparison.

First Session Schedule:

- How To Think About Flow Cytometry Experiments
 - o Hypothesis
 - o Identification
 - o End Point
- Basic Tenets of Experimental Design in Flow Cytometry
- Panel Design
- Flow Cytometry Controls
 - o Instrument Calibration/QC
 - o Compensation
 - o Gating/FMOs
 - o Biological

BREAK-15 minutes

- Flow Cytometry Applications - Fabien Depis, PhD

Assignment: Design a multicolor flow cytometry experiment based on your current field of study (can include sorting). Your proposal should include the following information:

1. HYPOTHESIS,
2. RATIONALE,
3. EXPERIMENTAL DESIGN,
4. WORKFLOW (Sample Processing Steps), and
5. CONTROLS.
6. YOUR GATING STRATEGY
7. PLOTS with parameter labels demonstrating what your data would look like under conditions where your hypothesis is proven true and proven false.

OR

If your experimentation just takes you up to a sorting step, show those plot(s).

You may add a final experimental technique(s) (i.e. RNA seq, PCR etc.) section. Student completed the

Introductory Flow Cytometry Nanocourse may reuse their hypothesis and rationale for this assignment.

Please email your proposals to Kevin Bonham (kevin_bonham@hms.harvard.edu) by 5pm Sunday, October 25th. Kevin will compile all of the assignments and share them with the class. Please come to the second session prepared to discuss your proposal and those of your classmates.

DROP DEADLINE: Monday, October 12, 2015

First Session: Monday, October 19, 2015, 1:30 - 4 PM

Location: Systems Biology Conference Room - Armenise 506

Second Session: Wednesday, October 28, 2015, 12:30 - 3 PM

Location: Countway Library, Minot Room

Intellectual Unit:

Introductory Flow Cytometry

Nanocourse Director(s): Timothy Mitchison

Curriculum Fellow: Kevin Bonham & Emily Gleason

Lecturers: Jodene Moore

Flow cytometry is a technology that can be used for a wide range of both clinical and research-based applications. It offers qualitative and quantitative data, describing cellular phenotypes and functional properties. Recent advances in hardware, instrumentation and reagents have now made it possible to use higher-order polychromatic assays of complex design that measure up to 27 parameters. These multicolor assays offer great potential to ask new questions, or provide new answers to old questions. This nanocourse will introduce you to the subsystems of the instrument, measurements in flow cytometry and some of the complications that are prevalent in this technique. In addition, the course will cover sample preparation and give brief examples of common applications including sorting.

First Session Schedule:

- Introduction to Flow Cytometry
- Flow Cytometer Subsystems:
 - o Fluidics
 - o Optics
 - o Electronics
- Measurements in Flow Cytometry
- Spectral Bleed/Compensation

BREAK-15 minutes

- Core Instrumentation/Configurations
- Antibodies/Epitopes
- Sample Prep/Applications
- Mass Cytometry

Assignment: Propose a hypothesis related to your current field of study that could be tested using flow cytometry. Please provide both your hypothesis and a rationale and discuss other experimental options that could be utilized to prove or disprove your hypothesis. Please email your assignments to Kevin Bonham (kevin_bonham@hms.harvard.edu) by 5pm Sunday, October 11th. Kevin will compile all of the assignments and share them with the class. Please come to the second session prepared to discuss your hypothesis and those of your classmates and bring any questions you might have about flow cytometry.

DROP DEADLINE: Monday, September 28, 2015

First Session: Monday, October 5, 2015, 12:30 – 4 PM

Location: Systems Biology Conference Room - Armenise 506

Second Session: Wednesday, October 14, 2015, 12:30 – 3 PM

Location: Countway Library, Ballard Room

Intellectual Unit:

The CRISPR-Cas9 System and the Future of Genome Editing

Nanocourse Director(s): Jae Joung

Curriculum Fellow: Catherine Dubreuil & Emily Gleason

Lecturers: Kiran Musunuru, Stephanie Mohr

Clustered regularly interspaced short palindromic repeats (CRISPRs) and their associated endonuclease, Cas9, are an important part of the immune systems of many prokaryotes. CRISPR-Cas systems act as RNA-directed endonucleases that target nucleic acids in a sequence-specific manner. Importantly, CRISPR-Cas9 systems have been shown to be highly adaptable. In 2012, it was demonstrated that Cas9 could be directed to different target sites simply by changing the sequence of an associated RNA, leading to speculation that the system could be used as a genome-editing tool. This discovery kicked off the rapid development and refinement of CRISPR-based genome-editing tools as well as advances in using this technology both to further basic research and to develop potential therapies for a number of human diseases. In this course, we will provide an introduction to genome editing and the development of CRISPR-Cas systems. We will also highlight some potential applications of CRISPR-Cas9 towards both basic research and human therapeutics. Finally, we will provide an overview of some of the resources available at Harvard for researchers interested in using CRISPR-Cas9 genome editing to further their projects.

Assignment: For the second session of the course, we will be holding a 'grant panel'. Students will consider how they might apply the CRISPR-Cas9 system to their own research projects or interests. Students will write a 1-page single-spaced proposal (maximum 500 words) describing a project applying some of the concepts and tools discussed in the first session.

Proposals should contain the following elements:

- A title
- A brief introductory paragraph that describes the question you are asking, your hypothesis and introduces the model system you are working with.
- 2 or 3 specific aims
- A synopsis of the experiments you plan to conduct to address those aims.
- Typically, specific aims pages do not contain figures.

Additionally, proposals are expected to describe experiments that go beyond simply using CRISPR-Cas9 to knock out a gene either by proposing supporting experiments or by exploring issues related to the creation of the knockout model such as off-target effects.

Proposals must be e-mailed to Cat (Catherine_Dubreuil@hms.harvard.edu) no later than 3pm on Monday, November 9th and be submitted in either .doc, .docx, or .pdf formats with your last name included in the file name. Cat will compile the proposals and email them to the class and to the teaching staff. You are expected to read your classmates' proposals and come to class prepared to discuss them.

DROP DEADLINE: Thursday, October 29, 2015

First Session: Thursday, November 5, 2015, 9:30 AM – 1 PM

Location: TBD

Second Session: Thursday, November 12, 2015, 10 AM – 12:30 PM

Location: TBD

Intellectual Unit:

Genomic Instability and Cancer

Nanocourse Director(s): Andrew Murray

Curriculum Fellow: Meg Mittelstadt

Lecturers: David Pellman, David Nelson

High fidelity DNA replication, coupled with effective DNA-maintenance machinery, is fundamental to cell growth and division. Inherent to many human cancer cells, when this process becomes dysregulated, genetic alterations ranging from nucleotide-level changes to chromosomal translocations and aneuploidy can occur. This nanocourse will begin by exploring the history of two lines of research and the intersection between them that informs modern cancer biology. The first are studies of genetic instability in model organisms, starting with the work of Boveri and ending with the discovery and analysis of DNA repair pathways and cell cycle checkpoints. The second is the gradual appreciation that genetic instability plays a major role in cancer, beginning with the realization that cancer required multiple mutations, moving on to Nowell's seminal work on cancer progression, and finishing with a description of the biology of tumor suppressor genes. We will continue with a discussion of the mechanisms leading to the evolution of karyotypes with implications for cancer, congenital disease, and likely organismal evolution. The focus will be on newly discovered mutational processes that can generate massive chromosome rearrangements "all-at-once" and are curiously localized to one or occasionally a few chromosomes. A review of recent technical progress in combining cellular imaging with single cell genomics, enabling mechanistic studies of these phenomena, will be included. Finally, we will explore the interplay between evolutionary and spatial dynamics at the surfaces of evolving three-dimensional cell masses, such as tumors. A crucial aspect is the effect of "inflation" on gene fixation at the frontier of expanding tumors. Key dimensionless parameters controlling the survival probability in the limit of small selective advantage will be identified, showing that inflating spherical cell masses can enhance mutant survival probabilities by factors of 100 or more, compared to cell masses which are merely "treadmilling", i.e. those where the radius remains constant in time.

DROP DEADLINE: Tuesday, November 3, 2015

First Session: Tuesday, November 10, 2015, 3 – 6 PM

Location: Emerson Hall, Room 210 (Cambridge campus)

Second Session: Thursday, November 12, 2015, 3 – 5 PM

Location: Sever Hall, Room 206 (Cambridge campus)

Intellectual Unit:

Public Health 101: Introduction to Public Health

Nanocourse Director(s): Eric Rubin

Curriculum Fellow: Bradley Coleman

Lecturers: Morteza Asgarzadeh, Catherine Kreamsoulas, Courtney Carignan, Jin Lee

Course Instructors: Morteza Asgarzadeh, MS, MPH, PhD (Public health history and anthropology), Catherine Kreamsoulas, MSc, PhD (Epidemiology and statistical reasoning), Courtney Carignan, PhD (Environmental health and safety), Jin Lee, MA, PhD (Social and behavioral health), Christian Suharlim, MD, MPH (Health systems, policy, and management)

Graduate students, fellows, staff, and faculty without direct training in public health often have limited opportunities to gain a basic understanding of the multiple areas of study within public health and the role each plays in improving health. Many want to learn more about areas of public health but are unable to devote the 30 to 40 hours of classroom time required for a full-length course. To provide a succinct overview and introduction to the field of public health, we have developed the “Public Health 101” nanocourse.

The nanocourse will give an overview of the five core areas of public health:

- Public health history and anthropology
- Epidemiology and statistical reasoning
- Environmental health and safety
- Social and behavioral health
- Health systems, policy, and management

During session 1, attendees will learn about various epidemiologic study designs (epidemiology and biostatistics), calamities, chemicals in consumer care products, gene-environment interactions (environmental health), safety climate research (social and behavioral sciences), and health financing (health policy and management). In the second session, attendees will use a case-based approach to integrate the skills and knowledge gained in the first session in the context of an exercise related to public policy.

DEADLINE: Tuesday, September 29, 2015

First Session: Tuesday, October 6, 2015, 1:00 – 4:00 PM

Location: TMEC Auditorium, Harvard Medical School

Second Session: Tuesday, October 13, 2015, 1:00 – 4:00 PM

Location: TMEC L-007, Harvard Medical School

Intellectual Unit:

Public Health 101: Fundamentals of data analysis and data visualization in R

Nanocourse Director(s): Lauren Childs

Curriculum Fellow: Bradley Coleman

Lecturers: Xiaoxue Li, Jin Lee

Statistics is the study of collecting, organizing, analyzing, interpreting and communicating data with techniques that can be applied to a wide range of fields including basic science, economics, social science, medical research and public health. Statistics are a powerful tool for understanding and analyzing data, and computer programs are indispensable for many analyses. R is one of the most commonly used statistical programming language and software environments in the field, and it excels in data analysis and data visualization. It is free and easy to manage with extensive references available online. This course reviews basic concepts in statistics, introduces basic programming in R and gives hands-on examples for implementing these analyses and data visualization in R. In this course, we focus on a dataset of lung cancer in patients at a hospital as an example of how to use descriptive and inferential statistics in analysis and how to visualize them in R. Note: computers will not be provided so please bring a laptop. You will also need to install R from (<https://cran.r-project.org/>) and RStudio from (<https://www.rstudio.com/products/RStudio/>) prior to the workshop.

DROP DEADLINE: Thursday, October 29, 2015

First Session: Thursday, November 5, 2015, 1:00 - 4:00 PM

Location: TMEC Building, Room 227

Second Session: Thursday, November 12, 2015, 1:00 - 4:00 PM

Location: TMEC Building, Room 333

Intellectual Unit:

Environmental Health Nanocourse

Nanocourse Director(s): Eric Rubin

Curriculum Fellow: Bradley Coleman

Lecturers: Morteza Asgarzadeh, Courtney Carignan, Oliver Gruebner, Carmen Messerlian

Course Instructors: Morteza Asgarzadeh, MS, MPH, PhD (Urban health), Courtney Carignan, PhD (Exposure science), Oliver Gruebner, PhD (Spatial epidemiology), Carmen Messerlian, PhD (Reproductive epidemiology), Sandra Pirela, ScD (Nanotoxicology), Mahsa Yazdy, PhD (Perinatal epidemiology)

Have you ever wondered how chemicals and other stressors in the environment affect human health? Then you may be interested in attending the Environmental Health Nanocourse, which is being offered by the Harvard T.H. Chan School of Public Health Postdoctoral Association. The course is free and everyone is welcome to attend!

Nanocourses are short courses given in two 3-hour sessions. The nanocourse format provides the opportunity for graduate students, fellows, staff, and faculty without direct training in a discipline to gain a basic understanding through a shortened course format.

The first session will provide an introduction to core concepts and disciplines of environmental health including exposure science, human biomonitoring, toxicology, environmental epidemiology and urban planning. The second session uses a case study format for students to apply concepts learned during the first session.

DROP DEADLINE: Tuesday, October 20, 2015

First Session: Tuesday, October 27, 2015, 1:30 PM - 4:30 PM

Location: FXB 301 (Harvard School of Public Health, Longwood Campus)

Second Session: Tuesday, November 3, 2015, 1:00 PM - 4:00 PM

Location: Armenise Building, Amphitheater D (Harvard Medical School, Longwood Campus)

Intellectual Unit:

Public Health 101: Introduction to Occupational Health and Injuries

Nanocourse Director(s): Eric Rubin

Curriculum Fellow: Bradley Coleman

Lecturers: Morteza Asgarzadeh, Dorothee Fischer, Philippe Dixon, Jin Lee

Day 1 interest form: <https://goo.gl/YjD2GP>

The science of Occupational Health and Injuries is concerned with the number of work-related injuries, illnesses and fatalities, and how these statistics vary by incident, industry, geography, occupation and other characteristics. The study of Occupational Health and Injuries seeks to help employers find and fix workplace hazards before workers are hurt. This field provides the foundation for breakthrough changes in the ways employers identify and control hazards, leading to a significantly improved workplace health and safety environment. For example, adoption of injury and illness prevention guidelines result in workers suffering fewer injuries, illnesses and fatalities. In addition, employers will improve their compliance with existing regulations, and will experience many of the financial benefits of a safer and healthier workplace cited in published studies and reports by individual companies, including significant reductions in workers' compensation premiums. Thirty-four states and many nations around the world already require or encourage employers to implement work place safety guidelines that are results of research in this field. This course introduces various fields within Occupational Health and Injuries such as biomechanics, chronobiology, the built environment, and occupational health psychology.

In Session 2 we will work together to perform a hands-on occupational risk/hazard analysis of an actual workplace scenario. This analysis will be based on the Haddon matrix and will consider biomechanics, chronobiology, the built environment and psychology.

DROP DEADLINE: Tuesday, November 10, 2015

First Session: Tuesday, November 17, 2015, 1-4 PM

Location: New Research Building, Room 350

Second Session: Thursday, November 19, 2015, 1-4 PM

Location: TMEC Building, Room 328