

Division of Medical Sciences
Ph.D. Programs at Harvard Medical School

Nanocourses

Spring Semester 2008

For Information Call Meg Bentley (617-432-6698)

What is a Nanocourse?

Nanocourses represent a dynamic way of teaching specific subjects at an advanced level in a condensed fashion. These courses are an educational tool meant to bring students and other interested individuals in the Harvard community up to date on a particular field, to provide insight into the current problems in that field, and to, in general, define a solid basis for further study in that field, in a short time period. The idea behind creating such a teaching tool, is to develop a curriculum that will stay fresh, will be easily updated in response to the changing nature of the field and the needs of the students, will take maximum advantage of the scientific potential of the faculty across the Harvard campus, and will appeal to a wide-variety of students, post-docs, fellows and faculty who don't traditionally participate in classes.

For credit purposes, 3 nanocourses are equivalent to one quarter course. Therefore, the following guidelines for classroom hours are recommended. Nanocourses should meet for 5 hours over a period of 2 days. The first session is lecture-based and is taught by 2 or more faculty members over 3-4 hours. The lectures should be contiguous with one another and aim to provide an advanced level of knowledge on current research areas, specific experimental approaches and new technologies. This lecture-based session is open to the entire Harvard community. The second session is discussion-based and is intended only for students taking the nanocourse for credit. The format of this second session, which lasts for 1-2 hours, is flexible. It can include discussion of relevant papers, brainstorming about future research, or whatever is deemed appropriate by the course director to assess student progress.

Given the focused theme of each nanocourse topic, we anticipate that the first lecture-based meeting of each nanocourse will attract a sizeable audience. The second discussion-based meeting will likely have a smaller audience, which is practical for discussions and exploring the topic more in depth.

For didactic purposes and in order to provide students with a framework for a course of study, nanocourses will be grouped into thematically related groups. Groups of complimentary nanocourses will be classified as intellectual units to provide students with a framework for a course of study. Students can take 3 nanocourses from the same intellectual unit or can choose courses from different units, allowing them to tailor their course-load to their own interests. Although students can take as few as one nanocourse in any semester, students cannot register on their study cards for the nanocourses they have taken until they have taken six nanocourses, or 3 nanocourses and one quarter course. See the "Guidelines for Students" for more information.

For additional information, please visit the IDB website at <http://idb.med.harvard.edu/>.

Guidelines for Students

Traditionally, students stop taking classes after their preliminary exams. Part of the reason for designing the nanocourse format is to attract senior graduate students. We hope that the up-to-date nature of the science presented in the courses and the relatively modest time investment required would prove attractive for students who are immersed in their thesis research. We encourage the participation of all students.

Credit

- 1) 3 nanocourses are the equivalent of one quarter course.
- 2) Students register for credit on their study cards in the semester that they plan to complete their sixth nanocourse, or when they plan to complete a combination of 3 nanocourses and one quarter course.
- 3) To receive credit for a nanocourse, students must attend both meetings of the nanocourse and complete all assignments.
- 4) Nanocourses need not be taken in the same semester to count for credit.
- 5) All nanocourses are graded on a pass/fail basis.
- 6) Nanocourse attendance and participation is monitored by the iDB Teaching Fellow and the DMS office, so that students receive proper credit for the courses taken throughout their graduate tenure.

Registration

- 1) Registration is not required to attend the first lecture-based meeting of a nanocourse.
- 2) Registration is required to attend the second discussion-based meeting of a nanocourse and to receive credit. In addition, each student must submit all necessary assignments in order to participate in this session and to receive nanocourse credit.

Other Guidelines

- 1) If you are registered to attend a nanocourse, but are no longer interested or have a scheduling conflict, you must un-register by calling Meg Bentley at 617-432-6698.
- 2) If you are registered for a nanocourse and fail to show up for either meeting or fail to turn in the required assignments, an unsatisfactory or failing grade will be submitted to the DMS office.

Online Registration for Nanocourses this Spring!

If you are planning on taking **any** nanocourses this Spring semester, you should register online at <http://idb.med.harvard.edu/>. Even if you are only considering taking a nanocourse for credit, please register (you can always cancel your registration later). Registration is required only if you want to participate in **both** sessions of a nanocourse.

To register for nanocourses, go to <http://idb.med.harvard.edu/>. Follow the link on the sidebar that says "Nanocourse Registration for Students". Complete the information and hit submit. You should come to a screen that says you have submitted successfully. You will also receive a confirmation email telling you which nanocourses you successfully registered for on Sunday, January 20th. One week before the first session of each nanocourse, Meg Bentley will contact registered students with information specific to participation in that particular nanocourse. All online registration will be reported to DMS.

Registration helps us keep track of students taking nanocourses and makes it easier to correctly award credit at the end of the semester. Plus, it gives everyone accurate confirmation of their registration. **If you are not registered for a nanocourse, you cannot attend the second session or receive credit.**

If you intend to complete 6 nanocourses or 3 nanocourses plus a quarter course in the Spring semester, you should register for that credit on study card day.

Important Dates for Students to Remember!

Schedule Information:

Study Card Day: Monday, February 4th & Tuesday, February 5th, 2008

First Day of Classes: Wednesday, January 30th, 2008

President's Day: Monday, February 18th, 2008

Spring Break: Monday, March 24th through Friday, March 28th, 2008

Last Day of Classes: Friday, May 23rd, 2008

Nanocourse Organization

Nanocourses are grouped into intellectual units. Frequently, a nanocourse topic can fit into multiple intellectual units, but below we provide some organization to help you make decisions. Bold indicates that a course will be offered in the Spring 2008 semester. Non-bolded course titles have been offered in previous semesters and are included to give students an idea of other courses within intellectual units. See full nanocourse descriptions on the subsequent pages.

Intellectual Unit: Neural Development and Regeneration

Neural Cell Identity

Neuron Migration and Axon Guidance

Neural Survival and Regeneration

Intellectual Unit: Tissue Development

Formation and Regeneration of Skeletal Muscle

Epithelia: Tissue Regeneration and Wound Healing

Development and Disease of Cardiac Muscle

Stem Cells and Development

Mechanotransduction Mechanisms in Development

How to build a Blood Vessel?

Intellectual Unit: Cell Fate Decisions

Autophagy in Cell Death and Survival

B Cells: A Model for Studying Development

Apoptotic and Non-Apoptotic Mechanisms of Cell Death

Epithelia to Mesenchyme and back again: Cell Transitions in Organogenesis and Disease

Mechanisms of microRNA Silencing

Intellectual Unit: Experimental Tools for Biological Discovery

Fluorescence Live Cell Imaging

Live Cell Imaging of Membrane Trafficking

Analytical Approaches: Mass Spectrometry

From Chemical Biology to Drug Discovery

Single Molecule Biophysics
Quantitative Microscopy Part I: Quantitative Image acquisition and Processing
Quantitative Microscopy Part II: Image Segmentation and Analysis
Synthetic Biology: Cellular and Molecular Engineering
Using Immunohistochemistry Correctly and Effectively
Genetic Interactions: Principles, Measurements and Interpretation

Intellectual Unit: Structural Biology Computing

Molecular Visualization
Introduction to Protein Crystallography I
Introduction to Protein Crystallography II

Intellectual Unit: Signaling Molecules in Development and Disease Progression

Notch Signaling in Vascular Biology and Disease
Nitric Oxide: Biochemistry and Clinical Correlations
Wnt Signaling in Development and Disease
mTOR in Development and Disease

Intellectual Unit: Mechanisms of Disease

Spinal Muscular Atrophy: A pathological link between RNA processing and neurodegeneration
Fetal Programming of Type 2 Diabetes and Metabolic Syndrome

Intellectual Unit: Toward Understanding the Complexity of Cancer

The Molecular Pathology of Cancer
Viruses and Cancer

Intellectual Unit: Building a Better Scientist

Experimental Design for Biologists
Advanced Genome Browsing/BLAST
Positive Psychology: The Science of Happiness

Intellectual Unit: Molecular Machines

Vesicular Transport: Mechanisms, model systems and physiology
The Ubiquitin-Proteasome Pathway, Part I
The Ubiquitin-Proteasome Pathway, Part II
Chromatin Dynamics: A Molecular View

The Ubiquitin-Proteasome Pathway: Part I

Nanocourse Director: Wade Harper

Nanocourse Lecturers: Wade Harper and Randall King

The ubiquitin-proteasome pathway (UPP) is widely used to control flux through signaling pathways. Virtually every aspect of eukaryotic biology is linked in one way or another to the UPP. In addition to ubiquitin (Ub) itself, several additional ubiquitin-like proteins (Ulps) are also known to be conjugated to other proteins to regulate their activities. The ubiquitin and Ulp system in mammals is predicted to encompass more than 900 genes which are involved in 5 major processes: 1) Ub/Ulp activation, 2) Ub/Ulp conjugation, 3) Ub/Ulp removal (deubiquitination), 4) Ub/Ulp binding, and 5) substrate degradation by the proteasome. This nanocourse seeks to provide a detailed look at the status of the ubiquitin field and its role in coordinating signaling systems. Parts 1 and 2 are logically separated into the two major aspects of the pathway: 1) Ub/Ulp conjugation and 2) Ub/Ulp removal and proteasome function. Parts 1 and 2 individually make up independent nanocourses.

The goal of this course is to introduce students to the ubiquitin-proteasome system with a special emphasis on mechanisms and pathways promote ubiquitin conjugation. Lectures will cover several topics: **1) Genes in the ubiquitin-proteasome system.** The various classes of proteins involved in ubiquitin conjugation will be examined, including Ub/Ulp activation, ubiquitin conjugations, and ubiquitin ligation to substrates. This section will also focus on their structures and mechanisms of action. **2) Classes of E3s and mechanism of substrate recognition.** The 4 major classes of E3 ubiquitin ligases will be examined in detail, especially with regards to substrate recognition. In addition, aspects of assembly and regulation of multi-subunit E3 ubiquitin ligases will also be examined. **3) Function of the Ubiquitin Pathway in major signaling systems.** The UPP is used to control the activity of many different types of signaling pathways. We will explore several of the best understood signaling networks which employ the UPP, including the NFκB, Wnt/Wingless, and Hedgehog pathways as well as the role of E3s in progression through the cell cycle.

First Meeting: Monday, February 11th, 1:30-4:30pm

Location: TBD

Second Meeting: Thursday, February 14th, 2-4pm

Location: TBD

To sign up for this course, please register online at idb.med.harvard.edu beginning Monday, December 10th

Intellectual Unit: Molecular Machines

The Ubiquitin-Proteasome Pathway: Part II

Nanocourse Director: Wade Harper

Nanocourse Lecturers: Alan D'Andrea, Dan Finley and Alfred Goldberg

The goal of Part II of this course is to understand mechanisms that control protein degradation by the proteasome, reversal of substrate ubiquitination by deubiquitinating enzymes, and the recognition of ubiquitin and Ulp1 by ubiquitin binding proteins.

Lectures will cover several topics: **1) Structure, function, and mechanism of the proteasome.** The proteasome will be discussed from the point of view of its structure and major components. The various enzymatic functions associated with the proteasome will be discussed. The gated channel which controls the translocation of substrates through the proteasome will be discussed. The relationship between the proteasome and the COP9 signalosome complex will be presented. **2) Ubiquitin recognition.** More than a dozen different classes of ubiquitin-binding proteins have been identified. These are involved in targeting different ubiquitination substrates and sorting them to their proper destination, making these proteins the primary interpreters of the ubiquitin signal. The different structural modes of ubiquitin recognition will be emphasized, as well as how multiple ubiquitin receptors function to link substrates to the proteasome. **3) Deubiquitination.** Removal of ubiquitin is becoming widely recognized as being a critical component of the ubiquitin-proteasome pathway. The enzymes involved (DUBs) can promote removal of ubiquitin from ubiquitination substrates, thereby reversing the destructive process or otherwise reversing a signaling system. Their mechanisms of activation and of substrate recognition will be discussed, as well as their involvement in diseases.

First Meeting: Monday, February 25th, 1:30-4:30pm

Location: TBD

Second Meeting: Thursday, February 28th, 2-4pm

Location: TBD

To sign up for this course, please register online at idb.med.harvard.edu beginning Monday, December 10th

Intellectual Unit: Building a Better Scientist

Positive Psychology: The Science of Happiness

Nanocourse Director: Junying Yuan

Nanocourse Lecturers: Tal Ben-Shahar

Positive Psychology, "the scientific study of optimal human functioning," provides practical tools for better living. This new subfield within psychology is unique in that it creates a bridge between the Ivory Tower and Main Street--making rigorous academic ideas accessible. In this course Tal Ben-Shahar will discuss current research related to the science of happiness and introduces ideas and tools that can contribute to the well-being of the practitioner as well as the patient.

First Meeting: Wednesday, March 5th, 3:30-6:30pm

Location: TBD

Second Meeting: Wednesday, March 12th, 3:30-6:30pm

Location: TBD

**To sign up for this course, please register online at
idb.med.harvard.edu beginning Monday, December 10th**

Intellectual Unit: Experimental Tools for Biological Discovery

Fluorescence Live Cell Imaging

Nanocourse Director and Lecturer: Jennifer Waters

Fluorescence microscopy has become increasingly important in biological research as novel fluorescent probes and increasingly sensitive detectors allow us to visualize subcellular entities in live specimens with unprecedented speed and resolution. The aim of this practical course is to introduce students to the wide range of fluorescent probes and fluorescence microscopy techniques available for imaging live specimens (including optical sectioning techniques such as confocal and total internal reflection fluorescence).

First Meeting: Tuesday, March 18th from 1-4pm
Location: TBD

Second Meeting: Wednesday, March 19th from 1-6pm
Location: Nikon Imaging Center (LHRRB 113)

To sign up for this course, please register online at idb.med.harvard.edu beginning Monday, December 10th.

Space for this nanocourse will be limited to 8. Please register early on December 10th to increase your chances of participating in this nanocourse.

Intellectual Unit: Molecular Machines

Chromatin Dynamics: A Molecular Approach

Nanocourse Director: Raul Mostoslavsky

Nanocourse Lecturers: Kami Ahmad, Danesh Moazed and Raul Mostoslavsky

The genetic information encoded in our DNA is organized in a defined set of chromosomes, which are condensed about 10,000 fold in order to fit in the cell nucleus. This compaction occurs through packaging of the DNA around histone proteins, a structure known as chromatin. In what was thought to be a rigid structure, today we know that chromatin is an amazingly dynamic folding that plays a crucial role in controlling accessibility of factors to the DNA, and as such, it regulates a vast number of critical biological functions, including gene transcription, DNA replication, DNA repair and cellular identity. In this course we will attempt to cover some of the basic molecular mechanisms that play a role in regulating chromatin dynamics. We will discuss the role of DNA methylation, histone modifications and nucleosome dynamics in the context of different biological processes for which chromatin accessibility plays a crucial role.

First Meeting: Wednesday, April 16th, 1-4:30pm

Location: TBD

Second Meeting: Friday, April 18th, 2-4pm

Location: TBD

To sign up for this course, please register online at idb.med.harvard.edu beginning Monday, December 10th.

Intellectual Unit: Cell Fate Decisions

Mechanisms of microRNA Silencing

Nanocourse Director: Carl Novina

Student Nanocourse Director: Adrienne Yanez

Nanocourse Lecturers: David Bartel, Carl Novina and Gary Ruvkun

First Meeting: Monday, April 21st, 2-5pm

Location: TBD

Second Meeting: Tuesday, April 22nd, 3-5pm

Location: TBD

**To sign up for this course, please register online at
idb.med.harvard.edu beginning Monday, December 10th**

Intellectual Unit: Signaling Molecules in Development and Disease Progression

mTOR in Development and Disease

Nanocourse Directors: John Blenis

Nanocourse Lecturers: John Blenis and David Sabatini

First Meeting: Friday, May 2nd, 1-4:30pm

Location: TBD

Second Meeting: Friday, May 9th, 2-4pm

Location: TBD

To sign up for this course, please register online at idb.med.harvard.edu beginning Monday, December 10th.

Intellectual Unit: Tissue Development

How to build a Blood Vessel?

Nanocourse Director: Joanne Chan

Nanocourse Lecturers: Laura Benjamin, Joyce Bischoff and Joanne Chan

This nanocourse will focus on the cellular events and signaling pathways used in making blood vessels during development and in physiological conditions, as well as in pathological states. As blood vessels line all organs and tissues, defects in their formation underlie human diseases including cancer, diabetes and macular degeneration. We will begin with how embryonic blood vessels are formed using zebrafish, mice and culture cells as model systems. The role of vascular progenitor cells in vessel development and the potential of these cells for therapeutic angiogenesis and tissue repair will be examined. Finally, we will discuss how misregulation of signaling pathways contributes to pathological states.

First Session: Wednesday, May 7th, 1-4:30pm

Location: TBD

Second Session: Tuesday, May 13th, 2-5pm

Location: Karp Building, 12th floor conference room

To sign up for this course, please register online at idb.med.harvard.edu beginning Monday, December 10th.

Intellectual Unit: Toward Understanding the Complexity of Cancer

Viruses and Cancer

Nanocourse Director: Peter Howley

Nanocourse Lecturers: Peter Howley, Karl Munger, James Decaprio and Fred Wang

The theory that viruses contribute to the development of certain types of cancers was originally proposed by the Nobel winning scientist Peyton Roués in the early 20th century. Since then, both DNA and RNA viruses have been implicated in the development of colon, cervical, skin and liver cancers. Ultimately, viral infection can lead to the disruption of many cell cycle regulators, including pRb and p53. The mechanisms by which viruses are thought to promote carcinogenesis include insertion of viral proteins that disrupt normal host cell function and those that increase expression of proto-oncogenes. Lecturers will discuss current experimental efforts to identify the mechanisms by which HPV, EPV and SV40 viruses promote carcinogenesis and useful strategies for preventing viral infection and associated disease.

First Meeting: Thursday, May 8th, 1-5pm

Location: TBD

Second Meeting: Wednesday, May 14th, 2-4pm

Location: TBD

To sign up for this course, please register online at idb.med.harvard.edu beginning Monday, December 10th.

Intellectual Unit: Molecular Machines

Vesicular Transport: Mechanisms, model systems and physiology

Nanocourse Directors: Victor Hsu and Thomas Schwarz

Nanocourse Lecturers: Victor Hsu and Thomas Schwarz

Reliable and robust vesicular transport is required for many cellular processes including protein maturation, internalization of membrane proteins, transport, endocytosis and exocytosis. Despite the diversity of processes that utilize vesicular transport, many of the mechanisms that govern this process follow the same general rules; including coating and uncoating of vesicles, and docking and fusion of vesicles. In this nanocourse, lecturers will discuss transport factors that act in these major mechanistic steps of vesicular transport, and their studies that contribute to our understanding of physiological events, including neuronal function. Both biochemical and genetic approaches will be presented. Both biochemical and genetic approaches will be presented.

First Meeting: Thursday, May 15th from 1-4pm

Location: TBD

Second Meeting: Thursday, May 22nd from 2-4pm

Location: TBD

To sign up for this course, please register online at idb.med.harvard.edu beginning Monday, December 10th.

Intellectual Unit: Tissue Development

Mechanisms of Mechanotransduction in Development

Nanocourse Directors: Don Ingber

Nanocourse Lecturers: Guillermo Garcia-Cardena, Don Ingber, and Kit Parker

When considering the mechanisms that govern developmental progression, we tend to focus our attention on the intrinsic molecular interactions that establish or modulate these processes. However, mechanisms of mechanotransduction are an equally essential component of any developmental hierarchy in both multicellular and unicellular organisms. Mechanotransduction refers to the mechanisms that translate a mechanical or physical stimulus into a chemical action. Mechanotransduction mechanisms have been shown to be critical in the vascular system, bone growth, hearing, and inflation and deflation of the lung. Also, defects in mechanotransduction can contribute to cancer. In this nanocourse, lecturers will present an introduction to the importance of physical forces in development and maintenance of tissues through adult life, the molecular basis of mechanotransduction, how these mechanisms operate in vertebrate vascular development and heart function, and finally the importance of considering mechanotransduction in the development of artificial tissues.

First Meeting: Monday, May 19th from 1:30-5pm

Location: TBD

Second Meeting: Friday, May 23rd from 1-3pm

Location: TBD

To sign up for this course, please register online at idb.med.harvard.edu beginning Monday, December 10th.

**Additional nanocourses may be added to the Spring 2008 schedule.
Please check the iDB website often to take full advantage of the
nanocourse offerings!**

**The topics and details of additional nanocourses offered during the
Spring 2008 semester will be clearly posted in the DMS office and
registration locations on study card days. Also, please refer to the
iDB website frequently for updates to the nanocourse listings.**

idb.med.harvard.edu