

Division of Medical Sciences

Ph.D. Programs at Harvard Medical School

# First Meeting of Courses

## Fall Term 2016-2017

**Classes Start: Wednesday, August 31, 2016**

**Online Check-In (formerly known as registration):**

Monday, August 15, 2016 – Tuesday, August 30, 2016

Please visit the [Harvard University Knowledge Center](#) website for more information

**Deadlines and Holidays:** Please visit the [GSAS Calendar](#) to view deadlines and holidays for the 16-17 academic year

*For information:* Call **617-432-4134** or email [dms\\_courses@hms.harvard.edu](mailto:dms_courses@hms.harvard.edu)

DIVISION OF MEDICAL SCIENCES  
Ph.D. Programs at Harvard Medical School  
2016-2017 Fall Term Course Offerings

**BBS 230. Analysis of the Biological Literature**

Jesse Gray, Peter Hammerman, Dipanjan Chowdhury, Stephen Elledge, Radhika Subramanian Roberto Chiarle, Scott Kennedy, Andrew Lassar, Kevin Haigis, Alex Soukas, Frank Slack, Julie-Aurore Losman, Steve Haggarty, Jeff Dvorin and Mike Blower

**BBS 301. Embedded Teaching Practicum (for Graduate Teaching Assistants)**

Johanna Gutlerner and Ronald Jason Heustis

**BBS 330. Critical Thinking and Research Proposal Writing**

Monica P. Colaiácovo

Teaching Assistant: Doris Lui

**BCMP 200. Principles of Molecular Biology**

Joseph Loparo, Melissa Leger-Abraham, Timur Yusufzai, Johannes Walter, Stirling Churchman and Dipanjan Chowdhury

Curriculum Fellow: Jason Heustis

**BCMP 218. Molecular Medicine**

Irving London, George Daley, and Vijay Sankaran

**BCMP 228. Macromolecular NMR**

Gerhard Wagner, James Chou and Haribabu Arthanari

**BCMP 230. Principles and Practice of Drug Development**

Stan Neil Finkelstein

**Cell Biology 226. Concepts in Development, Self-Renewal, and Repair**

Iain A. Drummond and Amar Sahay

**Genetics 201. Principles of Genetics**

Fred Winston, Thomas Bernhardt, Maxwell Heiman, Mitzi Kuroda, Steven McCarroll and Jenna Galloway

Curriculum Fellow: Emily Gleason

**Genetics 229. Computational Statistics for Biomedical Sciences**

Peter Park and Vincent Carey

**HBTM 235. Principles of Human Disease: Physiology and Pathology**

Constance L. Cepko

**Immunology 201. Principles of Immunology**

Thorsten Mempel, Michael Carroll, Ulrich H. Von Andrian and members of the Program in Immunology

**Immunology 301. Immunology Seminar**

Michael C. Carroll, William Nicholas Haining and Galit Alter

**Medical Sciences 250ab. Human Functional Anatomy**

Lee Gehrke, Trudy Van Houten, Breda Zimkus, Mohini Lutchman and Sabine Hildebrandt

**Microbiology 205. Mechanisms of Microbial Pathogenesis**

Clyde S. Crumpacker II and members of the Department

**Microbiology 214. Mechanisms of Bacterial Pathogenesis and Host Immune Response**

Marcia Goldberg, Jonathan Kagan, Michael Starnbach and Cammie Lesser  
Curriculum Fellow: Bradley Coleman

**Neurobiology 200. Neurobiology**

John A. Assad and Matthew P. Frosch

**Neurobiology 220. Cellular Neurophysiology**

Bruce P. Bean, Wade G. Regehr, Bernardo L. Sabatini, and Gary I. Yellen

**Neurobiology 230. Visual Recognition: Computational and biophysical perspective**

Gabriel Kreiman

**SGBT 200. Acoustics of Speech and Hearing**

Satrajit Ghosh and Hideko Heidi Nakajima

**SGBT 201. Biology of the Inner Ear**

M. Charles Liberman and Stephane Maison

**Virology 200. Introduction to Virology**

Max L. Nibert, David M. Knipe and Priscilla L. Yang

**Virology 202. Proposal Writing**

Benjamin Gewurz, James DeCaprio, Daniel Lingwood, Sylvie LeGall and Molly Mclaughlin

**OTHER COURSES OF INTEREST**

**OEB 115. The Developmental Basis for Evolutionary Change**

Mansi Srivastava

## Biological and Biomedical Sciences (BBS)

### **BBS 230. Analysis of the Biological Literature**

**Jesse Gray, Peter Hammerman, Dipanjan Chowdhury, Stephen Elledge, Radhika Subramanian, Roberto Chiarle, Scott Kennedy, Andrew Lassar, Kevin Haigis, Alex Soukas, Frank Slack, Julie-Aurore Losman, Steve Haggarty, Jeff Dvorin and Mike Blower**

4 units

(Fall term). Tu., Th., 3:00 – 6:00

Students participate in intensive small group discussions focused on the critical analysis of basic research papers from a wide range of fields including biochemistry, cell and developmental biology, genetics, and microbiology. Papers are discussed in terms of their background, significance, hypothesis, experimental methods, data quality, and interpretation of results. Students will be asked to propose future research directions, to generate new hypotheses and to design experiments aimed at testing them. For the midterm exam, the students will have to submit written critiques of recent papers from the literature, with an emphasis on proposing new experimental directions to test the models proposed in the papers.

*Note:* This course is required for first year BBS students, and is open only to BBS students.

### **Fall 2016**

**First Meeting Date:** Thursday, September 8, 2016

**Meeting Dates:** Thursday, September 8 through Thursday, December 8

**First Meeting Location:** TMEC 250

**Course Heads:** Jesse Gray, [gray@genetics.med.harvard.edu](mailto:gray@genetics.med.harvard.edu) and Peter Hammerman, [peter\\_hammerman@dfci.harvard.edu](mailto:peter_hammerman@dfci.harvard.edu)

## **BBS 301. Embedded Teaching Practicum (for Graduate Teaching Assistants)**

**Johanna Gutlerner and Ronald Jason Heustis**

4 units

(Fall term). M., W., F., with different times

The Embedded Teaching Practicum aims to enhance the teaching experience for TAs and the learning experience for enrollees in the core BBS courses. While TAs serve different functions and experience teaching from different perspectives in each of our core courses, they collectively serve a vital role in helping to deliver a contemporary, high quality and accessible education to HMS graduate students. The embedded teaching practicum provides practice-based training in facilitating a group discussion, professionalism in the classroom, curriculum design, course evaluation, assessment development and DBER, and preparation for teaching throughout and beyond time in graduate school. Teaching assistants are provided training and experience in the development of an early-career teaching philosophy.

*Note:* TAs should contact **Jason Heustis, [ronald\\_heustis@hms.harvard.edu](mailto:ronald_heustis@hms.harvard.edu)**

### **Fall 2016**

**Meeting Dates:** Wednesday August 31, 2016 through Wednesday December 14, 2016

**First Meeting Location:** TBD

**Course Heads:** Johanna Gutlerner, [johanna\\_gutlerner@hms.harvard.edu](mailto:johanna_gutlerner@hms.harvard.edu) and Jason Heustis, [ronald\\_heustis@hms.harvard.edu](mailto:ronald_heustis@hms.harvard.edu)

## **BBS 330. Critical Thinking and Research Proposal Writing**

**Monica P. Colaiácovo**

4 units

(Fall term). First Lecture – Th., 2:00 – 4:00, subsequent sessions will be defined later

A small group tutorial systematically guiding students in the writing of original, hypothesis-driven research proposals from initial topic selection through completion of a final draft.

*Note:* This course is required for second year BBS students, others need permission of the instructor. Dates, times, and locations for all sessions (except for Session 1, see below) will be determined by the faculty running the tutorial sessions. Students will be able to sign up for their specific groups on a first-come, first-served basis. The BBS office will coordinate this process. Group assignments will be posted on the course website.

Recommended Prep: Check course website for downloadable material

### **Fall 2016**

**First Meeting Date:** Thursday, September 8, 2016

**Meeting Dates:** Thursday, September 8, 2016 through Friday, December 16, 2016

**First Meeting Location:** NRB, Room 350

**Course Head:** Monica P. Colaiacovo, mcolaiacovo@genetics.med.harvard.edu

**Teaching Assistant:** Doris Lui

# Biological Chemistry and Molecular Pharmacology

## **BCMP 200. Principles of Molecular Biology**

**Joseph Loparo, Melissa Leger-Abraham, Timur Yusufzai, Johannes Walter, Stirling Churchman and Dipanjan Chowdhury**

4 units. Enrollment limited to 80

(Fall term). M., W., F., 10:45 – 12:15

Principles of Molecular Biology is a course organized around the Central Dogma of Biology with presentations covering fundamental aspects of DNA and RNA structure, their function and their interactions with proteins. The course opens with a discussion of the physical and chemical properties that drive the interactions of proteins with nucleic acids. This is used as a basis for understanding the material presented in the subsequent five modules, which cover DNA replication, DNA repair, gene regulation, transcription and translation. Throughout this course an emphasis will be placed on how the structure of small molecular machines (proteins) define their function in the processes and pathways that are introduced.

Note: Offered jointly with the Medical School as BP 723.0.

Recommended Prep: Intended primarily for graduate students familiar with basic molecular biology or with strong biology/chemistry background.

### **Fall 2016**

**Meeting Dates:** Wednesday, August 31, 2016 through Monday, December 5, 2016 (final assignment due December 16, 2016)

**First Meeting Location:** Cannon Room, Building C

**Course Head:** Joseph Loparo, joseph\_loparo@hms.harvard.edu

**Curriculum Fellow:** Jason Heustis, ronald\_heustis@hms.harvard.edu, (office) 617-432-5773

*A full schedule of class meetings, topics covered and the associated reading are presented in the following table.*

Module/Lecturer	Date & Day	Topic/Event	Associated Reading (Chapters)
<b>STUDENT ORIENTATION</b>	<b>08/23 Tu 10:00 am – 12:00 pm</b>	<b>BBS Core Course Meeting for Students (Cannon Room)</b>	
<b>Module 1</b> DNA-Protein Interactions LOPARO	08/31 W	Course Introduction Introduction to Protein Structure	
	09/02 F Due 10:45 am	<b>Each student in the class must READ AND ELECTRONICALLY SIGN the statement of academic integrity before the start of class.</b>  <b>PRE-COURSE Diagnostic Due Online</b>	
	09/02 F	Thermodynamics of Protein Folding (switch with lecture 3 possibly)	2 – 5
	<b>09/05 M</b>	<b>NO CLASS – Labor Day</b>	
	09/07 W	DNA Structure and Topology (switch with lecture 2 possibly)	6
	09/09 F	Protein-Protein and Protein-DNA Interactions	16
	09/12 M	Chromosome Structure	7
	<b>09/14 W</b>	<b>TUTORIAL: Using CANVAS Understanding SECTION</b>	

		<b>Understanding Experimental Design/Rubric</b>	
	09/14 W 2:30p – 4:00p	Workshop – Using PyMol (SGM 106 A+B) <i>OPTIONAL, but strongly encouraged; choose this workshop OR the 09/15 workshop</i>	
	09/15 Th 10:30a – 12:00p	Workshop – Using PyMol (TMEC 106) <i>OPTIONAL, but strongly encouraged; choose this workshop OR the 09/14 workshop</i>	
	09/16 F	<b>Research Seminar</b> - Single Molecule Approaches	
	09/19 M 10:45 am – 12:15 pm	<b>SECTION #1</b> (Various Rooms)	<b>VARIOUS ROOMS</b>
	Due 10:45am	<b>EXPERIMENTAL DESIGN WORKSHEET #1, based on the posted experimental design questions for Section #1, is due at the <u>START</u> of section.</b>	
<b>Module 2</b> DNA Replication WALTER	09/21 W	The Replication Fork	8
	09/23 F	Origins of Replication	
	09/25 Su Due 11:59 pm	<b>PROBLEM SET #1 DUE ONLINE</b>	
	09/26 M	<b>Research Seminar</b> – Replication Termination	
	09/28 W 10:45 am – 12:15 pm	<b>SECTION #2</b> (Various Rooms)	<b>VARIOUS ROOMS</b>
	Due 10:45 am	<b>EXPERIMENTAL DESIGN WORKSHEET #2, based on the posted experimental design questions for Section #2, is due at the <u>START</u> of section.</b>	
<b>Module 3</b> DNA Repair WALTER	09/30 F	Ribonucleotide Excision Repair (RER), Mismatch Repair (MMR)	9 and 10
	10/03 M	Base Excision Repair (BER) Nucleotide Excision Repair (NER)	
	10/04 Tu Due 11:59 pm	<b>PROBLEM SET #2 due online</b>	
	10/05 W	Homologous Recombination (HR) Non-Homologous End-Joining (NHEJ)	
	10/07 F	<b>Research Seminar</b> – DNA Cross-link Repair	
	10/10 M	<b>No CLASS – Columbus Day</b>	
	10/12 W	<b>YUSUFZAI LECTURE:</b> Histones and Histone Code  <i>This lecture will be videotaped to allow for attendance at the Cell Biology Retreat (October 11<sup>th</sup> and 12<sup>th</sup>). This lecture was moved to ensure that Section #3 does not conflict with the Cell Biology Retreat.</i>	7
	10/14 F	<b>SECTION #3</b> (Various Rooms)	<b>VARIOUS ROOMS</b>
	Due 10:45 am	<b>EXPERIMENTAL DESIGN WORKSHEET #3, based on the posted experimental design questions for Section #3, is due at the <u>START</u> of section.</b>	
<b>Module 4</b> Chromatin Structure and Gene Regulation YUSUFZAI	10/17 M	Chromatin Remodeling	21
	10/19 W	<b>No CLASS – BCMP Retreat</b>	
		<b>**Please note there will be no class meeting of BBS 230 on Thursday 10/20, so if you attend the retreat you will not be missing any classes.</b>	
	10/21 F	<b>No CLASS – BCMP Retreat</b>	



<i>**Please note that class notes from the GEN 201 session on 10/21 will be made available. Please e-mail Fred Winston to receive a copy of the notes.</i>			
	10/24 M	RNA Polymerase II	12, 16 and 17
	10/25 Tu Due 11:59 pm	<b>PROBLEM SET #3 due online</b>	
	10/26 W	Transcription Factors and Initiation	
	10/28 F	Gene Regulation	
	10/31 M	<b>Research Seminar – Chromatin Remodeling and Cancer</b>	
	11/02 W	<b>SECTION #4 (Various Rooms)</b>	<b>VARIOUS ROOMS</b>
	Due 10:45 am	<b>EXPERIMENTAL DESIGN WORKSHEET #4, based on the posted experimental design questions for Section #4, is due at the <u>START</u> of section.</b>	
<b>Module 5</b> Transcription CHURCHMAN	11/04 F	Transcription Elongation	
	11/07 M	Transcription Termination	
	11/08 Tu Due 11:59 pm	<b>PROBLEM SET #4 due online</b>	
	11/09 W	mRNA Processing	13
	11/11 F	mRNA Transport	
	11/14 M	<b>Research Seminar – Transcription at Single Nucleotide Resolution</b>	
	11/16 W	<b>SECTION #5 (Various Rooms)</b>	<b>VARIOUS ROOMS</b>
	Due 10:45 am	<b>EXPERIMENTAL DESIGN WORKSHEET #5, based on the posted experimental design questions for Section #5, is due at the <u>START</u> of section.</b>	
<b>Module 6</b>  Post-Transcriptional Regulation HEUSTIS, CHOWDHURY  &  Translation LEGER-ABRAHAM	11/18 F	RNA Interference: mRNA Repression and Degradation	
	11/21 M	<b>Research Seminar – MicroRNAs and DNA Double- Strand Break (DSB) Repair</b>	
	11/22 Tu Due 11:59 pm	<b>PROBLEM SET #5 due online</b>	
	11/23 W	<b>No CLASS – Thanksgiving Break</b>	
	11/25 F	<b>No CLASS – Thanksgiving Break</b>	
	11/28 M	Prokaryotic Translation	
	11/30 W	Eukaryotic Translation	14 and 15
	12/02 F	<b>Research Seminar – Divergent Translation Initiation</b>	18
	12/05 M	<b>SECTION #6 (Various Rooms)</b>	<b>VARIOUS ROOMS</b>
	Due 10:45 am	<b>EXPERIMENTAL DESIGN WORKSHEET #6, based on the posted experimental design questions for Section #6, is due at the <u>START</u> of section.</b>	
12/11 Su Due 11:59 pm	<b>PROBLEM SET #6 due online</b>		
12/16 F Due 11:59 pm	<b>POST-COURSE Diagnostic due online</b>		

**FINAL GRADES WILL BE POSTED NO LATER THAN THURSDAY DECEMBER 22, 2016.**

### **BCMP 218. Molecular Medicine**

**Irving M. London, George Q. Daley and Vijay Sankaran**

4 units. Enrollment limited to 25

(Fall term). Tu., 1:00 – 3:00

A seminar on various human diseases and their underlying genetic or biochemical bases. Primary scientific papers discussed. Lectures by faculty and seminars conducted by students, faculty supervision.

Note: Faculty mentors will guide student-led discussions of the papers. Jointly offered with the Medical School as HT 140.

Prerequisite: Molecular Biology and Biochemistry.

#### **Fall 2016**

**Meeting Dates:** Tuesday, September 13, 2016 through Tuesday, December 13, 2016

**First Meeting Location:** TMEC 128

**Course Head:** George Daley, george.daley@childrens.harvard.edu

### **BCMP 228. Macromolecular NMR**

**Gerhard Wagner, James Chou and Haribabu Arthanari**

4 units

(Fall term) M., F., 2:00 – 3:30

Theory and practice of modern methods of macromolecular structure determination using multi-dimensional NMR.

Note: Given in alternate years. Offered jointly with the Medical School as BP 722.0. Classroom lectures on Mondays and Fridays. The course will include classroom lectures, practical training and hands-on problem solving. The latter includes basic aspects of spectrometer operation, computer-based assignment of protein NMR spectra and structure calculation.

#### **Fall 2016**

**Meeting Dates:** Friday, September 9, 2016 through Friday, December 16, 2016

**First Meeting Location:** TMEC 227

**Course Head:** Wagner, Gerhard, gerhard\_wagner@hms.harvard.edu

**BCMP 230. Principles and Practice of Drug Development**  
**Stan Neil Finkelstein**

4 units

(Fall Term). W., 3:00 – 6:00

Critical assessment of the major issues and stages of developing a pharmaceutical or biopharmaceutical. Drug discovery, preclinical development, clinical investigation, manufacturing and regulatory issues considered for small and large molecules. Economic considerations of the drug development process.

Note: Classes are held at MIT.

**Fall 2016**

**Meeting Dates:** Wednesday, August 31, 2016 through Wednesday, December 14, 2016

**First Meeting Location:** MIT Bldg., Room 1-190

**Course Head:** Stan Finkelstein, [finkelst@hcp.med.harvard.edu](mailto:finkelst@hcp.med.harvard.edu)

# Cell Biology

## **Cell Biology 226. Concepts in Development, Self-Renewal, and Repair**

**Iain A. Drummond and Amar Sahay**

4 units. Enrollment limited to 12

(Fall term). F., 2:00 – 5:00

Explores developmental mechanisms through the life cycle, contrasting pluripotency and cell fate restriction in embryos and adult tissues. In depth analysis of in vivo approaches, with emphasis on adult stem cells, tissue repair and self-renewal.

Note: Offered jointly with the Medical School as CB 721.0. For more information visit:  
[http://www2.massgeneral.org/bbs/CB226/cb\\_226.htm](http://www2.massgeneral.org/bbs/CB226/cb_226.htm)

Prerequisite: Upper division cell biology or equivalent.

### **Fall 2016**

**Meeting Dates:** Friday, September 2, 2016 through Friday, December 9, 2016

**First Meeting Location:** TMEC L-007, HMS, 260 Longwood Ave.,

**Course Heads:** Iain A. Drummond, [idrummond@partners.org](mailto:idrummond@partners.org) OR [idrummond@mgh.harvard.edu](mailto:idrummond@mgh.harvard.edu) and  
Amar Sahay, [sahay.amar@mgh.harvard.edu](mailto:sahay.amar@mgh.harvard.edu).

# Genetics

## Genetics 201. Principles of Genetics

Fred Winston, Thomas Bernhardt, Maxwell Heiman, Mitzi Kuroda, Steven McCarroll, Jenna Galloway

4 units

(Fall term). M., W., F., 9:00 – 10:20, see schedule below

An in-depth survey of genetics, beginning with basic principles and extending to modern approaches and special topics. We will draw on examples from various systems, including yeast, *Drosophila*, *C. elegans*, zebrafish, mouse, human and bacteria.

Note: Intended for first-year graduate students. Offered jointly with the Medical School as GN 701.0.

### Fall 2016

**Meeting Dates:** Wednesday, August 31, 2016 through Thursday, December 8, 2016 (final exam due)

**First Meeting Location:** Cannon Room, Building C

**Course Heads:** Fred Winston (Winston@genetics.med.harvard.edu) and Max Heiman (heiman@genetics.med.harvard.edu)

**Curriculum Fellow:** Emily Gleason, Emily\_gleason@hms.harvard.edu, 617-432-7203

### GENETICS 201: 2016 SCHEDULE

<u>DATE</u>	<u>START</u>	<u>FINISH</u>	<u>LECTURE</u>
31-Aug W	9:00 AM	10:20 AM	Lecture 1: Lecture 1, Introduction to yeast genetics, complementation analysis – Winston
02-Sept F	9:00 AM	10:20 AM	Lecture 2: Introduction to yeast genetics, complementation analysis – Winston <i>Problem Set 1 Distributed</i>
05-Sept M			<i>Labor Day: No Classes</i>
07-Sept W	9:00 AM	10:20 AM	Lecture 3: Linkage and tetrad analysis in yeast – Winston
09-Sept F	9:00 AM	10:20 AM	Lecture 4: Molecular studies in yeast – Winston
12-Sept M	9:00 AM	10:20 AM	<a href="#">Discussion Section 1</a>
14-Sept W	9:00 AM	10:20 AM	Lecture 5: Genomic analysis in yeast – Winston
16-Sept F	9:00 AM	10:20 AM	Lecture 6: Suppressor analysis in yeast – Winston
19-Sept M	9:00 AM	10:20 AM	Lecture 7: Non-Mendelian and polygenic inheritance in yeast – Winston
21-Sept W	9:00 AM	10:20 AM	<a href="#">Discussion Session 2</a>
23-Sept F	9:00 AM	10:20 AM	Lecture 8: Introduction to bacterial genetics – Bernhardt <i>Problem Set 1 Due</i> <i>Problem Set 2 Distributed</i>
26-Sept M	9:00 AM	10:20 AM	Lecture 9: Genetic selections and screens for gene discovery – Bernhardt
28-Sept W	9:00 AM	10:20 AM	Lecture 10: Chemical genetics and antibiotics – Bernhardt
30-Sept F	9:00 AM	10:20 AM	Lecture 11: Genetics of bacterial pathogenesis – Bernhardt
03-Oct M	9:00 AM	10:20 AM	<a href="#">Discussion Section 3</a>

05-Oct	W	9:00 AM	10:20 AM	Computational Workshop 1: Using Galaxy for DNA sequence analysis <i>Problem Set 2 Due</i>
05-Oct	W	6:00 PM	7:00 PM	<a href="#">Optional Review Session</a>
06-Oct	Th	9:00 AM	10:20 AM	<b>Midterm handed out</b>
07-Oct	F	9:00 AM	10:20 AM	<b>Midterm handed in</b>
10-Oct	M			<b>NO CLASS Columbus Day</b>
12-Oct	W	9:00 AM	10:20	Lecture 12: How to do a <i>C. elegans</i> screen <i>Problem Set 3 Distributed</i>
14-Oct	F	9:00 AM	10:20 AM	Lecture 13: From mutant to gene in <i>C. elegans</i> – Heiman
17-Oct	M	9:00 AM	10:20 AM	Lecture 14: How to study animal development using <i>C. elegans</i> – Heiman
19-Oct	W	9:00 AM	10:20 AM	Lecture 15: How to study cell biology and the nervous system using <i>C. elegans</i> – Heiman
21-Oct	F	9:00 AM	10:20 AM	<a href="#">Discussion Section 4</a>
24-Oct	M	9:00 AM	10:20 AM	Lecture 16: Introduction to <i>Drosophila</i> : genotypes, recombination, and balancer chromosomes – Kuroda <i>Problem Set 3 Due</i> <i>Problem Set 4 Distributed</i>
26-Oct	W	9:00 AM	10:20 AM	Lecture 17: Forward genetic screens in <i>Drosophila</i> – Kuroda
28-Oct	F	9:00 AM	10:20 AM	Lecture 18: Modifier and mosaic screens in <i>Drosophila</i> – Kuroda
31-Oct	M	9:00 AM	10:20 AM	<a href="#">Discussion Section 5</a>
02-Nov	W	9:00 AM	10:20 AM	Lecture 19: Vertebrate genetics 1 – Galloway <i>Problem Set 4 Due</i> <i>Problem Set 5 Distributed</i>
04-Nov	F	9:00 AM	10:20 AM	Lecture 20: Vertebrate genetics 2 – Galloway
07-Nov	M	9:00 AM	10:20 AM	Lecture 21: Vertebrate genetics 3 – Galloway
09-Nov	W	9:00 AM	10:20 AM	<a href="#">Discussion Section 6</a>
11-Nov	F	9:00 AM	10:20 AM	<i>Veterans' Day: No Classes</i>
14-Nov	M	9:00 AM	10:20 AM	Lecture 22: Genome variation in humans – McCarroll
16-Nov	W	9:00 AM	10:20 AM	Lecture 23: Genetics in families and the analysis of Mendelian traits – McCarroll
18-Nov	F	9:00 AM	10:20 AM	Lecture 24: Complex traits, heritability, and the genetics of populations – McCarroll
21-Nov	M	9:00 AM	10:20 AM	Lecture 25: Mapping the genetic basis of complex phenotypes – McCarroll
21-Nov	M	3:00 PM	4:30 PM	Computational Workshop 2: Using R for statistical analysis
25-Nov	W			<b>Thanksgiving Break: No Class</b>
27-Nov	F			<b>Thanksgiving Break: No Class</b>
28-Nov	M	9:00 AM	10:20 AM	<a href="#">Discussion Section 7</a>
30-Nov	W	9:00 AM	10:20 AM	Lecture 26: Epigenetics 1 – Winston <i>Problem Set 5 due</i>
02-Dec	F	9:00 AM	10:20 AM	Lecture 27: Epigenetics 2 – Winston
05-Dec	M	9:00 AM	10:20 AM	<a href="#">Discussion Section 8</a>
05-Dec	M	6:00 PM	7:00 PM	Optional Review Session
07-Dec	W	9:00 AM		<b>Final exam handed out</b>
08-Dec	Th	9:00 AM		<b>Final exam due</b>

**Genetics 229 Computational Statistics for Biomedical Sciences**  
**Peter Park and Vincent Carey**

4 units. Enrollment limited to 60 students

(Fall term). Tu., Th., 10:00 – 11:30

Analysis of large datasets has become an integral part of biological and biomedical sciences. This course will provide a practical introduction to data analysis, with high-throughput sequencing data as the main source of examples. In the first half, it will cover basic statistical concepts and techniques, including hypothesis testing, nonparametric methods, principal component analysis, correlation analysis, and linear regression. In the second half, it will cover several advanced topics, focusing on issues that one encounters in the literature but are seldom covered in introductory statistics courses. To carry out statistical tests and visualize data, students will learn R, a powerful programming language for statistical computing and graphics. The class will be a combination of lectures and computer labs. We will use recent literature to motivate the statistical methods, and assignments will frequently include attempts to reproduce published findings.

Note: Offered jointly with Medical School as BMI713.0.

**Fall 2016**

**Meeting Dates:** Tuesday, September 6, 2016 through Thursday, December 8, 2016

**First Meeting Location:** TMEC 227

**Course Head:** Peter Park, peter\_park@hms.harvard.edu

# Human Biology and Translational Medicine

## **HBTM 235. Principles of Human Disease: Physiology and Pathology**

**Constance L. Cepko**

4 units

(Fall term). M., W., F., 9:00 – 10:30 lectures, M., W., 9:00 – 10:30 tutorial (select dates)

This course covers the normal physiology and pathophysiology of selected organs, through lectures, readings, tutorials based on clinical cases, and patient presentations. Human biology is emphasized, with some examples also drawn from model organisms. Recent therapeutic approaches, including RNAi, gene therapy, and genome editing will be covered

Note: Course enrollment is open to graduate students from any program as well as undergraduates.

Prerequisite: Knowledge of introductory biochemistry, molecular biology, and cell biology required (MCB52 and MCB54 or equivalent and one year of organic chemistry for undergraduates).

### **Fall 2016**

**Meeting Dates:** Wednesday, August 31, 2016 through Friday, December 2, 2016

**First Meeting Location:** NRB 350

**Course Head:** Connie Cepko, cepko@genetics.med.harvard.edu



# Immunology

## **Immunology 201. Principles of Immunology**

**Thorsten Mempel, Michael Carroll, Ulrich H. Von Andrian and members of the Program in Immunology**

4 units. Enrollment limited to 50

(Fall term). Tu., Th., 1:30 – 3:00pm (Discussion groups: 3.00-4:00pm)

Comprehensive core course in immunology. Topics include a broad but intensive examination of the cells and molecules of the immune system. Special attention given to the experimental approaches that led to general principles of immunology.

Note: Intended for students who have had prior exposure to immunology on the undergraduate level. In the absence of such exposure, students must obtain the permission of the Course Director. Offered jointly with the Medical School as IM 702.0.

Prerequisite: A background in genetics and biochemistry strongly recommended.

### **Fall 2016**

**Course Introduction:** Wednesday, August 31, 2016

**Meeting Dates:** Wednesday, August 31, 2016 through Thursday, December 1, 2016

**First Meeting Location:** Modell Immunology Center, Fred S. Rosen Lecture Hall, Room 100A

**Course Heads:** Thorsten Mempel, [tmempel@mgh.harvard.edu](mailto:tmempel@mgh.harvard.edu) and Ulrich H. Von Andrian, [uva@hms.harvard.edu](mailto:uva@hms.harvard.edu)

## **Immunology 301. Immunology Seminar**

**Michael C. Carroll, William Nicholas Haining and Galit Alter**

4 units. Enrollment limited to 20

(Fall term). W. 12:15 – 1:15 (lunch) and 3:30 – 5:00 (discussion)

Gives students exposure to research topics in Immunology. Students prepare for the weekly seminar through readings, discussions, and preparing brief write-ups. These discussions are facilitated by members of the Committee on Immunology.

Note: Required for, and limited to, first-year Immunology graduate students.

### **Fall 2016**

**Meeting Dates:** Wednesday, August 24, 2016 through Wednesday, December 14, 2016

**First Meeting Location:** Modell Immunology Center, Room 100A

**Course Head:** Michael Carroll, [michael.carroll@childrens.harvard.edu](mailto:michael.carroll@childrens.harvard.edu) and William Nicholas Haining, [nicholas\\_haining@dfci.harvard.edu](mailto:nicholas_haining@dfci.harvard.edu)

## Medical Sciences

### **Medical Sciences 250ab. Human Functional Anatomy**

**Lee Gehrke, Trudy Van Houten, Breda Zimkus, Mohini Lutchman and Sabine Hildebrandt**

8 units. Enrollment limited to 40

(Fall term). Lectures, M., W., F., 1:30 – 2:30, laboratory, M., W., F., 2:30 – 6:00

Lectures, detailed laboratory dissections, and prosections provide a thorough exploration of the gross structure and function of the human body. Fundamental principles of embryology and bioengineering promote analytical approaches to understanding the body's design.

Note: Open to qualified graduate students with permission of the course director. The course has a minimum enrollment of 30. This course requires rental of a locker for two hundred and ten dollars. There will also be an additional fee for microscope rental. Offered jointly with the Medical School as HT010.

### **Fall 2016**

**Meeting Dates:** Wednesday, September 7, 2016 through Friday, December 16, 2016 (final exam)

**First Meeting Location:** D Amphitheater

**Course Head:** Trudy Van Houten, [trudy\\_vanhouten@hms.harvard.edu](mailto:trudy_vanhouten@hms.harvard.edu) and Breda Zimkus, Zimkus, [bzimkus@oeb.harvard.edu](mailto:bzimkus@oeb.harvard.edu)

## Microbiology and Immunobiology

### **Microbiology 205. Mechanisms of Microbial Pathogenesis**

**Clyde S. Crumpacker II and members of the Department**

4 units. Enrollment limited to 40

(Fall term). Tu., Th., 8:30 – 12:30

The mechanisms of bacterial, mycoplasmal, fungal, and viral pathogenesis are covered. Topics are selected for intrinsic interest and cover the spectrum of pathophysiologic mechanisms of the infectious process. Emphasis on pathogenesis at the molecular level.

Note: Offered jointly with the Medical School as HT 040. Please note that there will be an additional fee for microscope rental.

Prerequisite: A background course in molecular biology is strongly encouraged.

#### **Fall 2016**

**Meeting Dates:** Tuesday, September 6, 2016 through Thursday, December 8, 2016

**First Meeting Location:** TMEC 250

**Course Head:** Clyde S. Crumpacker, ccrumpac@bidmc.harvard.edu

### **Microbiology 214. Mechanisms of Bacterial Pathogenesis and Host Immune Response**

**Marcia Goldberg, Jonathan Kagan, Michael Starnbach and Cammie Lesser**

4 units

(Fall term). Tu., Th., 10:00 – 12:00

This course focuses on molecular mechanisms of bacterial pathogenesis and the host response to infection. The class consists of lectures and group discussions emphasizing methods, results, and interpretations of classic and contemporary literature. The course is designed to complement Microbiology 201.

Note: Designed for graduate students in first year or beyond, however undergraduates with specific interest in the field may audit.

#### **Fall 2016**

**Meeting Dates:** Thursday, September 1, 2016 through Thursday, December 1, 2016

**First Meeting Location:** NRB 1031

**Course Head:** Marcia Goldberg, marcia.goldberg@mgh.harvard.edu

**Curriculum Fellow:** Bradley Coleman, bradley\_coleman@hms.harvard.edu

(617)432-1871

# Neurobiology

## **Neurobiology 200. Neurobiology**

**John A. Assad and Matthew P. Frosch**

4 units. Enrollment limited to 60

(Fall term). M., W., F., 8:30 – 12:00

This is a comprehensive course in Neuroscience. Basic principles of organization and function of the nervous system will be discussed with frequent reference to pathophysiology of neurological and psychiatric disorders. Combining pathophysiology with basic neuroscience should provide physician/scientists and Ph.D. candidates with a dynamic picture of the rapidly evolving field of neuroscience and the experimental process from which the picture is derived, and all students should emerge with a greater awareness both of the applications of their work in alleviating disease, and of the ways that disease can provide insight into basic scientific questions. The course will span modern neuroscience from molecular neurobiology to perception and cognition, and will include the following major topics: Anatomy and Development of the Brain, Cell Biology of Neurons and Glia, Ion Channels and Electrical Signaling, Synaptic Transmission, Integration, and Chemical Systems of the Brain, Sensory Systems, from Transduction to Perception, Motor Systems, and Higher Brain Function (Memory, Language, Affective Disorders).

Note: Offered jointly with Harvard Medical School as HST 130. Follows the HMS calendar. Nine hours of lecture or lab/conference weekly.

Prerequisite: Introductory cell and molecular biology course with permission of instructor.

### **Fall 2016**

**Meeting Dates:** Wednesday, September 7, 2016 through Friday, December 16, 2016 (final exam, Wednesday, December 21)

**First Meeting Location:** TMEC 227

**Course Heads:** John Assad, [jassad@hms.harvard.edu](mailto:jassad@hms.harvard.edu), (617) 432-2804 and Matthew Frosch, [mfrosch@partners.org](mailto:mfrosch@partners.org), (617) 726-5156

## **Neurobiology 220. Cellular Neurophysiology**

**Bruce P. Bean, Wade G. Regehr, Bernardo L. Sabatini, and Gary I. Yellen**

4 units

(Fall term). Tu., Th., 9:00 –12:00

Introduction to the physiology of neurons, focusing on using electrophysiology and imaging to study function of ion channels, generation of action potentials, and physiology of synaptic transmission. Includes problem sets and reading of original papers.

Note: Offered jointly with the Medical School as NB 714.0.

Prerequisite: Introductory neurobiology.

### **Fall 2016**

**Meeting Dates:** Tuesday, September 6, 2016 through Thursday, December 15, 2016

**First Meeting Location:** Goldenson 122

**Course Head:** Bruce P. Bean, [bruce\\_bean@hms.harvard.edu](mailto:bruce_bean@hms.harvard.edu)

## **Neurobiology 230. Visual Recognition: Computational and biophysical perspective**

**Gabriel Kreiman**

4 units

(Fall term). M., 3:30–5:30 (first meeting on Wednesday)

How does cerebral cortex store information, compute and learn? How can we build prosthetic devices to fix or augment brain function? How can we build biologically inspired artificial intelligence? This course will examine these questions in the context of visual cognition. Topics: architecture of visual cortex, neurophysiology, visual consciousness, computational neuroscience, models of pattern recognition and computer vision, artificial intelligence, brain-machine interfaces.

Note: Neuro 230 cannot be taken if Neuro 130 has been taken. Neuro 230 cannot be taken concurrently with Neuro 130.

Course Website: Neurobiology 230, Visual Recognition, brain-machine interfaces and artificial intelligence  
[http://klab.tch.harvard.edu/academia/classes/hms\\_neuro300\\_vision/hms\\_neuro300\\_vision.html](http://klab.tch.harvard.edu/academia/classes/hms_neuro300_vision/hms_neuro300_vision.html)

*Prerequisite:* Life Sciences 1a (or Life and Physical Sciences A) and Life Sciences 1b (or equivalent).

*Recommended:* Math (Maa/Mab, Math 1A, 1B, Math 19 a/or equivalent). Physical Sciences 1. MCB 80.

### **Fall 2016**

**First Meeting Date:** Wednesday, August 31, 2016

**Meeting Dates:** Wednesday, August 31, 2016 through Monday, December 5, 2016

**First Meeting Location:** Biolabs 1075, HU, Cambridge

**Course Head:** Gabriel Kreiman, [gabriel.kreiman@childrens.harvard.edu](mailto:gabriel.kreiman@childrens.harvard.edu), (617) 919-2530

# Speech and Hearing Bioscience and Technology

## **SHBT 200. Acoustics, Production, and Perception of Speech**

**Satrajit Ghosh and Hideko Heidi Nakajima**

4 units. Enrollment limited to 20

(Fall term). Lectures, Tu., Th., 1–2:30, recitations, W., 1:00 – 2:00

Reviews the physical processes involved in the production and propagation of sound, and acoustics related to hearing. Particular attention to how the acoustics and mechanics of the speech and auditory system define what sounds we are capable of producing and how we sense sound. Introduces acoustic theory of speech production, digital speech processing, and neural mechanisms of speech production and perception. Exposes students to applications around acoustics, recognition, and speech disorders. Also introduces analysis of various types of sounds. Includes take-home laboratory assignments and discussions of classic papers.

Note: This course is taught in consort with HSTU.714J at the Massachusetts Institute of Technology. Classes will be held at MIT. Must have a minimum of 5 students

Prerequisite: Mathematical methods in science (Applied Mathematics 21a or Mathematics 21a) or equivalent. Rigid body mechanics (Physics 11A), or electrical circuits (Engineering Science 154) or permission of the instructor

### **Fall 2016**

**First Meeting:** Wednesday, September 7, 2016

**Meeting Dates:** Wednesday, September 7, 2016 through Wednesday, December 14, 2016

**First Meeting Location:** MIT Building 46-4199

**Course Heads:** Satrajit Ghosh, [satra@mit.edu](mailto:satra@mit.edu) and Hideko Nakajima, [hkn@meei.harvard.edu](mailto:hkn@meei.harvard.edu)

**Course Website:** <http://web.mit.edu/6.551j/www/>

## **SHBT 201. Biology of the Inner Ear**

**M. Charles Liberman and Stephane Maison**

4 units. Enrollment limited to 12.

(Fall term). Tu., Th., 9–10:30

Normal biology, biophysics, physiology and morphology of the inner ear, its sensory innervation and efferent control systems, and the mechanisms underlying sensorineural hearing loss and balance disorders. Material is presented through lectures, laboratory exercises and discussions of the primary literature.

Prerequisite: Introductory neurobiology recommended.

### **Fall 2016**

**Meeting Dates:** Thursday, September 1, 2016 through Tuesday, December 6, 2016,

**First Meeting Location:** Massachusetts Eye and Ear Infirmary, 4<sup>th</sup> floor library

**Course Head:** Charles Liberman, [charles\\_liberman@meei.harvard.edu](mailto:charles_liberman@meei.harvard.edu)

# Virology

## **Virology 200. Introduction to Virology**

**Max L. Nibert, David M. Knipe and Priscilla L. Yang**

4 units. Enrollment limited to 20.

(Fall term). W., 9:00 – 10:30, F., 8:30 – 10:30

Introduction to virology. The lecture component reviews the basic principles of virology and introduces the major groups of human viruses. Weekly discussion groups critically analyze selected papers from the literature. Weekly written critiques of the selected papers are also required.

Note: There will be mid-term and final projects consisting of proposals based on laboratory rotations. Offered jointly with the [Medical School](http://www.courses.fas.harvard.edu/6075) as MG 705.0.

### **Fall 2016**

**Meeting Dates:** Wednesday, September 7, 2016 through Friday, December 9, 2016

**First Meeting Location:** TMEC 423

**Course Head:** Max Nibert, max\_nibert@hms.harvard.edu

## **Virology 202. Proposal Writing**

**Benjamin Gewurz, James DeCaprio, Daniel Lingwood, Sylvie LeGall and Molly Mclaughlin-Drubin**

4 units. Enrollment limited to 12

(Fall term). W., 1:45–5:00

Students will write, present, and evaluate research proposals in the areas of virus replication, viral pathogenesis and treatment and prevention of viral infections.

Note: Offered jointly with the Medical School as MG 724.0.

Prerequisite: General background in biochemistry and virology.

### **Fall 2016**

**Meeting Dates:** Wednesday, September 7, 2016 through Wednesday, November 9, 2016

**First Meeting Location:** TMEC 446

**Course Head:** Benjamin Gewurz, bgewurz@partners.org

## Other Courses of Interest

### **OEB 115. The Developmental Basis for Evolutionary Change**

**Mansi Srivastava**

4 units.

(Fall Term) Tu., Th., 10:00 - 11:30 F. 10:00 – 11:30 (discussion)

A lecture course in evolutionary developmental biology. This course will focus on the molecular and cellular bases of how embryos generate adult body plans in order to understand how form, physiology, and life history strategies are modulated over the course of evolution. We will discuss insights from both invertebrate and vertebrate animal model systems as well as plants. We will investigate the forces driving change at both micro- and macro-evolutionary time scales. Particular emphasis will be placed on how changes in development underlie major evolutionary transitions and the origin of innovation in organismal evolution. The course will also emphasize learning of experimental design, molecular tools, and phylogenetic methods currently used by researchers in the field of evolutionary developmental biology.

Recommended Prep: Life Sciences 1a (or LPS A) and 1b, or permission of instructor. OEB 10, MCB 52, and MCB 54 are recommended but not required. Open to students from any concentration.

#### **Fall 2016**

Meeting Dates: September 1, 2016 through December 20, 2016

Location: TBD

Course Head: Mansi Srivastava, [mansi@oeb.harvard.edu](mailto:mansi@oeb.harvard.edu)