

Division of Medical Sciences

Ph.D. Programs at Harvard Medical School

# **First Meeting of Courses**

## **Fall Term 2017-2018**

**Classes Start: Wednesday, August 30, 2017**

**Online Check-In (formerly known as registration): August 14, 2017**

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 17-18 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  
2017-2018 Fall Term Course Offerings**

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

Jesse Gray, Dipanjan Chowdhury, Roberto Chiarle, Luk Vandenberghe, Mike Blower, Rani George, Frank Slack, Radhika Subramian, Steve Haggarty, Jeff Dvorin, Marjorie Oettinger, Kevin Haigis, Elaine Elion, Susan Shao, Julie Aurore-Losman, Joe Italiano, Steve Elledge, Hari Arthanari, Hidde Ploegh, Alex Soukas, Yi Zhang, Olivier Pourquie, Mo Motamedi, Hans R. Widlund, Luca Pinello, Soumya Raychaudhuri and Peter Kharchenko

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

Jason Heustis and Madhvi Venkatesh

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

Rosalyn Adam and Matthew Harris  
Teaching Assistant: Doris Lui

**BCMP 200. Principles of Molecular Biology**

Joseph Loparo, Johannes Walter, Karen Adelman, Stirling Churchman, Frank Slack and Melissa Leger-Abraham  
Curriculum Fellow: Madhvi Venkatesh

**BCMP 218. Molecular Medicine**

Vijay Sankaran, Irving M. London and Suneet Agarwal

**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

**Cell Biology 235. History and Philosophy of Experimentation in Biology**

David Glass

**Genetics 201. Principles of Genetics**

Fred Winston, Thomas Bernhardt, Maxwell Heiman, Mitzi Kuroda, Steven McCarroll and Jenna Galloway  
Curriculum Fellow: Rachel Wright

**Genetics 229 Computational Statistics for Biomedical Sciences**

Peter Park and Nils Gehlenborg

**HBTM 201. Tumor Pathophysiology and Transport Phenomena - A Systems Biology Approach**

Rakesh Jain  
Teaching Assistant: William Ho

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

Constance L. Cepko

**Immunology 201. Principles of Immunology**

Thorsten Mempel and Stephanie Dougan

**Immunology 301. Immunology Seminar**

Shiv Pillai 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 and Harvey Simon

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

Marcia Goldberg, Jonathan Kagan, Michael Starnbach, Darren Higgins and Suzanne Walker  
Curriculum Fellow: Deepali Ravel

**Neurobiology 215. The Discipline of Neuroscience**

Lisa Goodrich and John Assad  
Curriculum Fellow: Taralyn Tan

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

Gabriel Kreiman

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

Satrajit Ghosh, Hideko Heidi Nakajima and John Rosowski

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

M. Charles Liberman and Stephanie Maison

**Virology 200. Introduction to Virology**

Max L. Nibert, Ben Gewurz, David Knipe, Phil Kranzusch, Molly McLaughlin-Drubin and Priscilla L. Yang  
Lecturers: Jim Cunningham, Ed Harlow, Steve Harrison, Peter Howley, Elliott Kieff, Luk Vandenberghe

**Virology 202. Proposal Writing**

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

## Biological and Biomedical Sciences (BBS)

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

**Jesse Gray, Dipanjan Chowdhury, Roberto Chiarle, Luk Vandenberghe, Mike Blower, Rani George, Frank Slack, Radhika Subramian, Steve Haggarty, Marjorie Oettinger, Kevin Haigis, Elaine Elion, Susan Shao, Julie Aurore-Losman, Joe Italiano, Steve Elledge, Hari Arthanari, Hidde Ploegh, Alex Soukas, Yi Zhang, Olivier Pourquie, Mo Motamedi, Hans R. Widlund, Luca Pinello, Anne Mullally, Joseph Mancias, Evan Macosko, and Soumya Raychaudhuri**

4 units

(Fall term). Tu., Th., 3:00PM – 6:00PM

BBS 230 is an integrated literature analysis course comprised of two related components: (1) intensive paper discussion and (2) workshops that develop statistical intuition based on data from the papers that have been discussed. For the midterm and final exams, the students will evaluate recent papers from the literature.

On Thursdays, students participate in intensive small group discussions focused on critical analysis of basic research papers from a wide range of fields including biochemistry, cell and developmental biology, genetics, and microbiology. Pairs of faculty will lead these small group discussions of papers. Discussions will cover background, significance, hypothesis, experimental methods, data quality, and interpretation. Students will also be asked to propose future research directions, to generate new hypotheses and to design experiments aimed at testing them.

On Tuesdays, students will participate in intensive small group workshops led by TAs. The first ~30 minutes will consist of student presentation of background material helpful for understanding the papers to be discussed that week. The remainder of the Tuesday workshops will be devoted to the completion of R-based problem sets designed to develop the statistical intuition necessary to critique papers, as well as design and interpret experiments.

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

Fall 2017

Meeting Dates: August 31, 2017 through December 15, 2017

First Meeting Location: TMEC 209

Course Heads: Jesse Gray, [gray@genetics.med.harvard.edu](mailto:gray@genetics.med.harvard.edu)

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

**Jason Heustis and Madhvi Venkatesh**

4 units

(Fall term). M., W., F., on select dates T., regular nightly sessions 6:00PM – 8:00PM

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). Registration for this class is limited to students serving as Teaching Assistants for BBS core.

**Fall 2017**

**Meeting Dates:** August 30, 2017 through December 13, 2017

**First Meeting Location:** Students will be contacted directly with room

**Course Head:** Jason Heustis, [ronald\\_heustis@hms.harvard.edu](mailto:ronald_heustis@hms.harvard.edu)

**BBS 330. Critical Thinking and Research Proposal Writing**  
**Rosalyn Adam and Matthew Harris**

4 units

(Fall term). At discretion of faculty instructors and students

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  
<https://canvas.harvard.edu/courses/27345>

**Fall 2017**

**Meeting Dates:** September 7, 2017 through December 15, 2017

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

**Course Head:** Rosalyn Adam, Rosalyn.Adam@childrens.harvard.edu and Matthew Harris,  
Matthew.Harris@childrens.harvard.edu

**Teaching Assistant:** Doris Lui, doris\_lui@hms.harvard.edu

# Biological Chemistry and Molecular Pharmacology

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

**Joseph Loparo, Johannes Walter, Karen Adelman, Stirling Churchman, Frank Slack and Melissa Leger-Abraham**

4 units.

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

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 2017**

**Meeting Dates:** August 30, 2017 through Monday, December 4, 2017

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

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

**Curriculum Fellow:** Madhvi Venkatesh

## **BCMP 218. Molecular Medicine**

**Vijay Sankaran, Irving M. London and Suneet Agarwal**

4 units. Enrollment limited to 25

(Fall term). Tu., 1:00PM – 3:00PM

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. (Also meets at MIT 66-168)

Prerequisite: Molecular Biology and Biochemistry.

### **Fall 2017**

**Meeting Dates:** Begins Tuesday, September 12

**First Meeting Location:** TMEC 128 HMS

**Course Head:** Vijay Sankaran, [vsankaran@partners.org](mailto:vsankaran@partners.org)

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

**Stan Neil Finkelstein**

4 units

(Fall Term). W., 3:00PM – 6:00PM

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 2017**

**Meeting Dates:** September 6, 2017 through December 13, 2017

**First Meeting Location:** MIT Bldg., Room 4-149

**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., 2:00PM – 5:00PM

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 2017**

**Meeting Dates:** September 1, 2017 through December 8, 2017

**First Meeting Location:** TMEC L-007

**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).

## **Cell Biology 235. History and Philosophy of Experimentation in Biology**

David Glass

4 units. Enrollment limited to 30

Fall Term. T., 6:30PM – 8:30PM

We will trace the influence of particular philosophical arguments concerning science that have developed over the last 500 years, with the evolution of Scientific Method in biology, showing how changes in philosophy wrought changes in methodology. The course will impart on students familiar or new to the study of philosophy a framework for thinking about philosophical arguments, as well as a foundation for exploring how today's scientific method relates to scientific research, medicine, and society's popular understanding of science. This might be of particular importance given current controversies relating to the reproducibility of many published findings.

### **Fall 2017**

**Meeting Dates:** September 6, 2017 through December 19, 2017

**Meeting Location:** Boylston 110

**Course Head:** David Glass, Feldman, Glass, ([David\\_Glass@hms.harvard.edu](mailto:David_Glass@hms.harvard.edu))

**Curriculum Fellow:** Theodore Feldman, [theodore\\_feldman@hms.harvard.edu](mailto:theodore_feldman@hms.harvard.edu)

# Genetics

## Genetics 201. Principles of Genetics

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

4 units

(Fall term). M., W., F., 9:00AM – 10:20AM

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 bacteria, yeast, *Drosophila*, *C. elegans*, zebrafish, mouse, and human.

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

### Fall 2017

**Meeting Dates:** August 30, 2017 through December 7, 2017

**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:** Rachel Wright, Rachel\_Wright@hms.harvard.edu

### GENETICS 201: 2017 SCHEDULE

<u>DATE</u>	<u>START</u>	<u>FINISH</u>	<u>LECTURE</u>
30-Aug W	9:00 AM	10:20 AM	Lecture 1: Mendel – Winston
01-Sept F	9:00 AM	10:20 AM	Lecture 2: Introduction to bacterial genetics – Bernhardt <i>Problem Set 1 distributed</i>
04-Sept M			<i>Labor Day: No Classes</i>
06-Sept W	9:00 AM	10:20 AM	Lecture 3: Genetic selections and screens for gene discovery – Bernhardt
08- Sept F	9:00 AM	10:20 AM	Lecture 4: Chemical genetics and antibiotics – Bernhardt
11-Sept M	9:00 AM	10:20 AM	Lecture 5: Genetics of bacterial pathogenesis – Bernhardt
13-Sept W	9:00 AM	10:20 AM	Discussion Section 1
15-Sept F	9:00 AM	10:20 AM	Lecture 6: Computational Workshop, Next generation sequencing and data analysis - Heiman <i>Problem Set 1 due</i> <i>Problem Set 2 distributed</i>
18-Sept M	9:00 AM	10:20 AM	Lecture 7: Introduction to yeast genetics; complementation analysis - Winston
20-Sept W	9:00 AM	10:20 AM	Lecture 8: Linkage and tetrad analysis in yeast – Winston
22-Sept F	9:00 AM	10:20 AM	Lecture 9: Molecular studies in yeast – Winston
25-Sept M	9:00 AM	10:20 AM	Discussion Section 2
27-Sept W	9:00 AM	10:20 AM	Lecture 10: Genomic analysis in yeast – Winston
29-Sept F	9:00 AM	10:20 AM	Lecture 11: Suppressor analysis in yeast – Winston

02-Oct	M	9:00 AM	10:20 AM	Lecture 12: Non-Mendelian and polygenic inheritance in yeast – Winston <i>Problem Set 2 due</i>
04-Oct	W	9:00 AM	10:20 AM	Discussion Section 3
04-Oct	W	6:00 PM	7:00 PM	Optional Review Session
05-Oct	Th	9:15 AM		<b>Midterm exam posted</b>
06-Oct	F	10:00 AM		<b>Midterm due</b>
09-Oct	M			<b>NO CLASS Columbus Day</b>
11-Oct	W	9:00 AM	10:20	Lecture 13: Mutant screens in <i>C. elegans</i> - Heiman <i>Problem Set 3 distributed</i>
13-Oct	F	9:00 AM	10:20 AM	Lecture 14: From mutants to genes in <i>C. elegans</i> – Heiman
16-Oct	M	9:00 AM	10:20 AM	Lecture 15: From genes to mechanisms in <i>C. elegans</i> I: Cell signaling–Heiman
18-Oct	W	9:00 AM	10:20 AM	Lecture 16: From genes to mechanisms in <i>C. elegans</i> II: Cell death – Heiman
20-Oct	F	9:00 AM	10:20 AM	Discussion Section 4
23-Oct	M	9:00 AM	10:20 AM	Lecture 17: Introduction to Drosophila: genotypes, recombination, and balancer chromosomes – Kuroda <i>Problem Set 3 due</i> <i>Problem Set 4 distributed</i>
25-Oct	W	9:00 AM	10:20 AM	Lecture 18: Forward genetic screens in Drosophila – Kuroda
27-Oct	F	9:00 AM	10:20 AM	Lecture 19: Modifier and mosaic screens in Drosophila – Kuroda
30-Oct	M	9:00 AM	10:20 AM	Discussion Section 5
01-Nov	W	9:00 AM	10:20 AM	Lecture 20: Vertebrate genetics I – Galloway <i>Problem Set 4 due</i> <i>Problem Set 5 distributed</i>
03-Nov	F	9:00 AM	10:20 AM	Lecture 21: Vertebrate genetics II – Galloway
06-Nov	M	9:00 AM	10:20 AM	Lecture 22: Vertebrate genetics III – Galloway
08-Nov	F	9:00 AM	10:20 AM	Discussion Section 6
10-Nov	F	9:00 AM	10:20 AM	<b>NO CLASS Veterans Day</b>
13-Nov	M	9:00 AM	10:20 AM	Lecture 23: Genome variation in humans – McCarroll <i>Problem Set 5 due</i> <i>Problem Set 6 distributed</i>
15-Nov	W	9:00 AM	10:20 AM	Lecture 24: Genetics in families and the analysis of Mendelian traits – McCarroll
17-Nov	F	9:00 AM	10:20 AM	Lecture 25: Complex traits, heritability, and the genetics of populations – McCarroll
20-Nov	M	9:00 AM	10:20 AM	Lecture 26: Mapping the genetic basis of complex phenotypes – McCarroll
22-Nov	W			<b>NO CLASS Thanksgiving Break</b>
24-Nov	F			<b>NO CLASS Thanksgiving Break</b>
27-Nov	M	9:00 AM	10:20 AM	Discussion Section 7
29-Nov	W	9:00 AM	10:20 AM	Lecture 27: Epigenetics – Winston <i>Problem Set 6 due</i>
01-Dec	F	9:00 AM	10:20 AM	Lecture 28: Epigenetics – Winston
04-Dec	M	9:00 AM	10:20 AM	Discussion Section 8
04-Dec	M	6:00 PM	7:00 PM	Optional Review Session
06-Dec	W	9:15 AM		<b>Final exam posted</b>

07-Dec	Th	10:00 AM		<b>Final exam due</b>
--------	----	----------	--	-----------------------

**Genetics 229 Computational Statistics for Biomedical Sciences**  
**Peter Park and Nils Gehlenborg**

4 units. Enrollment limited to 60 students

(Fall term). Tu., Th., 10:00AM – 11:30AM

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:** October 17, 2017 through December 5, 2017

**First Meeting Location:** Modell 100A

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

# Human Biology and Translational Medicine

## **HBTM 201. Tumor Pathophysiology and Transport Phenomena - A Systems Biology Approach**

**Rakesh Jain**

4 units

(Fall term) M., 5:00PM – 6:59PM

Tumor pathophysiology plays a central role in the growth, metastasis, detection, and treatment of solid tumors. Principles of transport phenomena are applied to develop a quantitative understanding of tumor biology and treatment.

Note: Given in alternate years. Offered jointly with the Medical School as PA 712.0. Classes held at MIT.

### **Fall 2017**

**Meeting Dates:** September 11, 2017 through December 11, 2017

**First Meeting Location:** MIT E25 - 117

**Course Head:** Rakesh Jain, jain@steele.mgh.harvard.edu

**Teaching Assistant:** William Ho, who2@mit.edu

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

**Constance L. Cepko**

4 units

(Fall term). M., W., F., 9:00AM – 10:30AM lectures, M., W., 9:00AM – 10:30AM 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 2017**

**Meeting Dates:** August 30, 2017 – December 1, 2017

**First Meeting Location:** NRB 350

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

### **HBTM 235 : Schedule Fall 2017**

Date	Topic	Lecturer	Problem set	Evaluation
W- Aug. 30	Introduction to Pharmacology I	Carl Rosow	Problem set 1 (PS1)	No
F- Sept. 1	Introduction to Pharmacology II	Carl Rosow		Yes
M- Sept. 4	Labor Day			
W-Sept. 6	Normal Cardiac Physiology	Tony Rosenzweig		No
W- Sept. 6	Case 1 preparation lunch @ noon: Dilated Cardiomyopathy			
F-Sept. 8	Heart Failure Pathophysiology	Tony Rosenzweig	PS1 due	No
M-Sept. 11	Tutorial 1-1: Dilated Cardiomyopathy			
W-Sept. 13	Heart Failure Treatment	Tony Rosenzweig		Yes
F – Sept. 15	Introduction to Respiratory Physiology	Robert Padera		No
M – Sept. 18	Lung Transplantation Biology	Robert Padera		Yes
W- Sept. 20	Tutorial 1-2: Dilated Cardiomyopathy			
F- Sept. 22	Stem Cells	Konrad Hochedlinger	PS2 Imm	Yes

M- Sept. 25	Introduction to GI Physiology	Jay Thiagarajah		Yes
M- Sept. 25	Immunology lecture (optional)@ 10:45-12	Robert Anthony		Yes
W- Sept. 27	Tutorial 1-3: Dilated Cardiomyopathy			
F- Sept. 29	Liver Disease/Hepatitis	Raymond Chung	PS2 Due	Yes
Patient presentation				
F- Sept. 29	Case 2 preparation lunch @ noon: Inflammatory bowel syndrome			
M- Oct. 2	Renal Physiology	Dennis Brown		No
W- Oct. 4	Tutorial 2-1: Inflammatory bowel syndrome			
F- Oct. 6	Acidosis	Dennis Brown		Yes
M- Oct. 9	Columbus Day Holiday			
W- Oct. 11	Tutorial 2-2: Inflammatory bowel syndrome			
F- Oct. 13	Neuroanatomy/disease	David Cardozo		No
M- Oct. 16	Neuropathology I	David Cardozo		No
W – Oct. 18	Tutorial 2-3: Inflammatory bowel syndrome			
F- Oct. 20	Neuropathology II	David Cardozo		Yes
F – Oct. 20	Case 3 preparation lunch @ noon: Renal			
M- Oct. 23	Intro to endocrinology	Evan Rosen	PS3	No
W- Oct. 25	Tutorial 3-1: Renal			
F- Oct. 27	Reproductive Endocrinology	Hope Riccioti		Yes
M- Oct. 30	Pituitary	Evan Rosen	PS3 Due	Yes
W- Nov. 1	Tutorial 3-(2+3): Renal			
F- Nov. 3	Cancer Genetics	Scott Lovitch		Yes
F- Nov. 3	Case 4 preparation lunch @ noon: ALS			
M- Nov. 6	Tumor Immunology	Arlene Sharpe		Yes
W-Nov. 8	Tutorial 4-1: ALS			
F- Nov. 10	Veteran's Day	No class		
M- Nov. 13	RNA therapeutics	Rachel Meyers		Yes
W- Nov. 15	Tutorial 4-(2+3): ALS			
W-Nov. 15 noon	Case 5 preparation lunch @ noon: Breast cancer	David Frank		

F- Nov. 17 Tutorial 5-1: Breast Cancer

M- Nov. 20 Gene therapy Connie Cepko Yes

W-S Nov. 22 – 26: Thanksgiving Holiday

M- Nov. 27 Tutorial 5-2: Breast Cancer

W- Nov. 29 Genome editing Keith Joung Yes

F- Dec. 1 Tutorial 5-2: Breast Cancer

Due Dec X. Take home final exam

Location: NRB 350 seminar room from 9am to 10:30 AM;

In yellow: No class: holidays

In Green: tutorials

In Blue: Luncheons for tutors (optional) and day 1 presenters (required), on indicated day, 12-1 in NRB 354

Tutorial rooms: TMEC 235, 425, 443, 445



# Immunology

## **Immunology 201. Principles of Immunology** **Thorsten Mempel and Stephanie Dougan**

4 units. Enrollment limited to 50

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

Comprehensive core course in basic immunology, providing an intensive and in-depth examination of the cells and molecules of the immune system. Special attention is given to the experimental approaches that led to the discovery of the 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 2017**

**First Meeting Date: Wednesday August 30, 2017**

**Meeting Dates:** August 31, 2017 through November 30, 2017

**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 Stephanie Dougan

## **Immunology 301. Immunology Seminar**

**Shiv Pillai and Galit Alter**

4 units. Enrollment limited to 20

(Fall term). W. 12:15PM – 1:15PM (lunch) and 3:30 – 5:00PM (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 2017**

**Meeting Dates:** August 23, 2017 through December 6, 2017

**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., 1:30PM – 2:30PM, laboratory, M., W., F., 2:30PM – 6:00PM

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 2017**

**Meeting Dates:** September 6, 2017 through December 15, 2017

**First Meeting Location:** Amphitheater D

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

# Microbiology and Immunobiology

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

**Clyde S. Crumpacker and Harvey Simon**

4 units. Enrollment limited to 40

(Fall term). Tu., Th., 8:30AM – 12:30PM

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 2017**

**Meeting Dates:** Tuesday, September 6, 2017 through Thursday, December 19, 2017

**First Meeting Location:** TMEC 250

**Course Head:** Clyde S. Crumpacker, [ccrumpac@bidmc.harvard.edu](mailto:ccrumpac@bidmc.harvard.edu)

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

**Marcia Goldberg, Michael Starnbach, Jonathan Kagan, Darren Higgins and Suzanne Walker**

4 units

(Fall term). Tu., Th., 10:00AM – 12:00PM

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 2017**

**Meeting Dates:** August 31, 2017 through November 30, 2017

**First Meeting Location:** NRB 1031

**Course Head:** Marcia Goldberg, [marcia.goldberg@mgh.harvard.edu](mailto:marcia.goldberg@mgh.harvard.edu)

**Curriculum Fellow:** Deepali Ravel, [dravel@fas.harvard.edu](mailto:dravel@fas.harvard.edu)

		Topic
Thursday	8/31/17	Overview of host pathogen interactions

Tuesday	9/5/17	Mechanisms of entry using type 3 secretion
Thursday	9/7/17	Type 3 secretion disruption of host signaling pathways
Tuesday	9/12/17	Mechanisms of antibiotics and approaches to antibiotic discovery
Thursday	9/14/17	Antibiotics II
Tuesday	9/19/17	TBA
Thursday	9/21/17	no class
Tuesday	9/26/17	Cellular trafficking and type 3 secretion
Thursday	9/28/17	NFKB signaling
Tuesday	10/3/17	Alteration of host ubiquitination
Thursday	10/5/17	Autophagy
Tuesday	10/10/17	Overview of immune response to pathogens (innate and adaptive)
Thursday	10/12/17	Regulation of chronic infection
Tuesday	10/17/17	Bacterial manipulation of adaptive immunity
Thursday	10/19/17	Mechanisms of living within a vacuole
Tuesday	10/24/17	Toll-like receptors
Thursday	10/26/17	Inflammasome activation
Tuesday	10/31/17	Disease tolerance
Thursday	11/2/17	Manipulation of MAP kinase pathways
Tuesday	11/7/17	Bacterial killing via type 6 secretion systems
Thursday	11/9/17	Other bacterial toxins
Tuesday	11/14/17	Mechanisms of entry into cells (non-type 3 secretion mediated)
Thursday	11/16/17	Actin-based motility
Tuesday	11/21/17	Bacteria and apoptosis
Thursday	11/23/17	no class
Tuesday	11/28/17	Biofilms
Thursday	11/30/17	Vaccine development and adjuvants

# Neurobiology

## Neurobiology 215. The Discipline of Neuroscience

**Lisa Goodrich, John Assad, Gary Yellen, Bruce Bean, Thomas Schwarz, Sandeep Robert Datta, Rosalind Segal, Pascal Kaeser, Wade Regehr, Michael Do, David Corey, Joshua Kaplan, Bernardo Sabatini, Rachel Wilson, Richard Born, Jan Drugowitsch, Christopher Harvey and Mark Andermann**

4 units

(Fall term). T., Th., 9:00AM – 11:50AM

This course will endow students with the broad conceptual fluency in the discipline of neuroscience required to relate genes to circuit function, metabolism to neurological disease, and cell biology to neural computations. Through a combination of lectures and in-class activities, students will learn to design, quantitatively analyze, and interpret experiments that address a variety of questions spanning molecular to systems neuroscience. During the first semester, students will think critically about the fundamental units of the nervous system within the context of cellular function, electrical conduction, and chemical signaling. The second half of the course builds upon this foundation to focus on broadly defined “networks of neural function” as related to coordinated neural activity, the concerted execution of genetic programs, and anatomically defined structural networks. The course culminates with students writing a grant proposal in the style of the NIH NRSA.

### Fall 2017

**Meeting Dates:** September 5, 2017 through December 20, 2017

**First Meeting Location:** WAB 236

**Course Head:** Lisa Goodrich, [lisa\\_goodrich@hms.harvard.edu](mailto:lisa_goodrich@hms.harvard.edu) and John Assad, [john\\_assad@hms.harvard.edu](mailto:john_assad@hms.harvard.edu)

**Curriculum Fellow:** Taralyn Tan, [Taralyn\\_Tan@hms.harvard.edu](mailto:Taralyn_Tan@hms.harvard.edu)

### **Course Schedule (pg. 1 of 2)**

Week (Fall)	Day	9:00-10:20 a.m.	10:30-11:50
1 (Sept. 5, 7)	Tues	(0) Overview of the nervous system and its formation  <b>LG + JA</b>	(1) Cell biology of neurons & glia <b>LG</b>
	Thurs	(2) Neuronal Morphogenesis / Regulation of Cytoskeleton <b>LG</b>	(3) Central dogma for neuroscientists (intro to DNA --> RNA --> protein) <b>SRD</b>
	Tues	(4) <i>Paper Discussion: RNA trafficking</i>	(5) Cellular energetics: Neurons, astrocytes, BBB <b>TS</b>

2 (Sept. 12, 14)	<b>Thurs</b>	(6) Regulation of gene expression (lecture + <i>Paper Discussion</i> ) <b>SRD</b>	
3 (Sept. 19, 21)	<b>Tues</b>	(7a) Manipulating genes in the mouse brain <b>PK</b>	
	<b>Thurs</b>	(7b) <i>Problem Set Discussion: Genetics &amp; Molecular Biology</i> <b>LG</b>	(8a) Intro to electrophysiology; Passive electrical properties <b>GY</b>
4 (Sept. 26, 28)	<b>Tues</b>	(8b) <i>Problem Set Discussion: Passive membrane properties</i> <b>GY</b>	(9a) Resting potentials and ionic conductances <b>GY</b>
	<b>Thurs</b>	(9b) <i>Problem Set Discussion: Resting potential</i> <b>GY</b>	(10a) Action potentials, intro to voltage clamp <b>BB</b>
5 (Oct. 3, 5)	<b>Tues</b>	(10b) <i>Problem Set Discussion: Action potentials &amp; voltage clamp</i> <b>BB</b>	(11a) Voltage clamp strategies for characterizing conductances <b>GY</b>
	<b>Thurs</b>	(11b) <i>Problem Set Discussion: Voltage clamp strategies</i> <b>GY</b>	(12a) Principles of permeation & gating; intro to channel structure <b>GY</b>
6 (Oct. 10, 12)	<b>Tues</b>	(12b) Channel structure lecture 2 <b>GY</b>	(13a) Principles of channel pharmacology <b>GY</b>
	<b>Thurs</b>	(13b) <i>Problem Set Discussion: Channel pharmacology</i> <b>GY</b>	(14a) V-dependent Na <sup>+</sup> channels: structure & function; <i>epilepsy &amp; pain-associated mutations</i> <b>BB</b>
7 (Oct. 17, 19)	<b>Tues</b>	(14b) <i>Paper Discussion: Nav1.1 channels &amp; mechanical pain</i> <b>BB</b>	(15a) Cable properties of axons & dendrites; propagation of action potentials in axons & dendrites <b>BB</b>
	<b>Thurs</b>	(15b) <i>Problem Set Discussion: Cable properties &amp; axon potential propagation</i> <b>BB</b>	(16a) Diversity of channels controlling neuronal function; families of K <sup>+</sup> and Ca <sup>2+</sup> channels; pharmacology <b>BB</b>
8 (Oct. 24, 26)	<b>Tues</b>	(16b) <i>Paper Discussion: Hyperexcitability in ALS</i> <b>BB</b>	(17) Diversity of neuronal structure & firing properties; interneuron vs. pyramidal neuron firing; pacemaking <b>BB</b>
	<b>Thurs</b>	EXAM I	

**Course Schedule (pg. 2 of 2):**

	<b>Tues</b>	(18) Optical control of neurons/circuits <b>BS</b>	(19a) Ca <sup>2+</sup> as a signaling molecule <b>WR</b>
--	-------------	--	--

9 (Oct. 31, Nov. 2)	<b>Thurs</b>	<i>(19b) Paper Discussion: Diverse intracellular effects of Ca<sup>2+</sup> (e.g. gene expression + synaptic transmission) WR</i>	(20a) AMPA, NMDA, GABAA, & nicotinic receptor channels <b>BB</b>
10 (Nov. 7, 9)	<b>Tues</b>	<i>(20b) Paper Discussion: Ketamine treatment of depression: NMDARs &amp; AMPARs BB</i>	(21) G-protein coupled receptors & signaling pathways <b>BB</b>
	<b>Thurs</b>	(22) Sensory transduction: vision <b>MD</b>	(23) Sensory transduction: mechanosensation <b>DC</b>
11 (Nov. 14, 16)	<b>Tues</b>	<i>Paper Discussion: Mechanosensation in the auditory system DC</i>	(24) Overview of synaptic transmission: concepts & methods <b>WR</b>
	<b>Thurs</b>	(25) Exocytic pathways in neurons <b>PK</b>	(26) Presynaptic mechanisms & plasticity <b>WR</b>
12 (Nov. 21, 23)	<b>Tues</b>	<i>Student paper presentations</i>	(27) Regulatory protein networks for synaptic vesicle exocytosis <b>PK</b>
	<b>Thurs</b>	<i>No Class (Thanksgiving)</i>	
13 (Nov. 28, 30)	<b>Tues</b>	<i>Student paper presentations</i>	(28) Synaptic plasticity: NMDA-dependent LTP; extracellular recording <b>WR</b>
	<b>Thurs</b>	<i>Student paper presentations</i>	(29) Postsynaptic molecular machinery and receptor trafficking (w/relation to LTP) <b>JK</b>
14 (Dec. 5, 7)	<b>Tues</b>	<i>Student paper presentations</i>	(30) Synaptic plasticity: LTD <b>BS</b>
	<b>Thurs</b>	<i>Student paper presentations</i>	(31) Dendritic properties <b>BS</b>
15 (Dec. 12, 14)	<b>Tues</b>	<i>Student paper presentations</i>	(32) Introduction to grant proposal <b>LG</b>
	<b>Thurs</b>	EXAM II	

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

**Gabriel Kreiman**

4 units

(Fall term). M., 3:30PM –5:30PM

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 2017**

**Meeting Dates:** Monday, September 11, 2017 through Monday, December 4, 2017

**First Meeting Date:** September 11, 2017

**First Meeting Location:** Biolabs 2062, HU, Cambridge

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

**Teaching Assistant:** Yuchen Xiao (yxiao@g.harvard.edu)



# Speech and Hearing Bioscience and Technology

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

**Satrajit Ghosh. Hideko Heidi Nakajima and John Rosowski**

4 units.

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

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 2017**

**First Meeting Date:** September 6, 2017

**First Meeting Location:** MIT Building 46-5056 (43 Vassar St, Cambridge, MA 02139)

**Course Heads:** Satrajit Ghosh, [satra@mit.edu](mailto:satra@mit.edu) and Hideko Nakajima, [Heidi\\_Nakajima@meei.harvard.edu](mailto:Heidi_Nakajima@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., 9:00AM –10:30AM

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.

Course Notes: Lecture notes will be available online.

Prerequisite: Introductory neurobiology recommended.

**Fall 2017**

**Meeting Dates:** August 31, 2017 through December 13, 2017,

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

**Course Head:** Charles Liberman, charles\_liberman@meei.harvard.edu

# Virology

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

**Max L. Nibert, Ben Gewurz, David Knipe, Phil Kranzusch, Molly McLaughlin-Drubin and Priscilla L. Yang**

4 units. Enrollment limited to 20.

(Fall term). M., 1:45PM – 3:15PM, W., 1:45PM – 3:45PM

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 <http://www.courses.fas.harvard.edu/6075> Medical School as MG 705.0.

### **Fall 2017**

**Meeting Dates:** August 30, 2017 through December 7, 2017

**First Meeting Location:** TMEC 447

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

**Lecturers:** Jim Cunningham, Ed Harlow, Steve Harrison, Peter Howley, Elliott Kieff, Luk Vandenberghe

## **Virology 202. Proposal Writing**

**Molly McLaughlin-Drubin, Benjamin Gewurz, James DeCaprio, Daniel Lingwood, Sean Whelan and Sylvie LeGall**

4 units. Enrollment limited to 12

(Fall term). W., 1:45PM–5:00PM

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 2017**

**Meeting Dates:** September 6, 2017 through November 8, 2017

**First Meeting Location:** TMEC 340

**Course Head:** Molly McLaughlin-Drubin, mdrubin@rics.bwh.harvard.edu