First Meeting of Courses
Fall Term 2018-2019

Classes Start: Tuesday, September 4, 2018

Online Check-In (formerly known as registration: TBD
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 18-19 academic year

For information: Call 617-432-4134 or email dms_courses@hms.harvard.edu
Ph.D. Programs at Harvard Medical School
2018-2019 Fall Term Course Offerings

BBS 230. Qualitative and Quantitative Analysis of the Biological Literature
Jesse Gray and Roberto Chiarle

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

BCMP 200. Principles of Molecular Biology
Joseph Loparo, Johannes Walter, Karen Adelman, Stirling Churchman, Frank Slack and Alan Brown
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

BMIF 201 Concepts in Genome Analysis
Shamil Sunyaev, Cheng-Zhong Zhang and Michael Baym

Iain A. Drummond and Amar Sahay

Genetics 201. Principles of Genetics
Fred Winston, Matthew Pecot, Thomas Bernhardt, Maxwell Heiman, Steven McCarroll and Jenna Galloway Galloway
Curriculum Fellow: Rachel Wright

HBTM 235. Principles of Human Disease: Physiology and Pathology
Constance L. Cepko

Immunology 201. Principles of Immunology
Thorsten Mempel, Shiv Pillai 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 Curriculum Fellow: Katelyn Burkhardt
**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, Min Dong and Suzanne Walker
Curriculum Fellow: Deepali Ravel

**Neurobiology 215. The Discipline of Neuroscience**
Lisa Goodrich, John Assad, Gary Yellen, Bruce Bean, Wade Regehr, Sandeep Robert Datta, Tom Schwarz, Michael Do, Josh Kaplan, David Corey, Bernardo Sabatini and Rosalind Segal
Curriculum Fellow: Taralyn Tan

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

**SHBT 200. Acoustics of Speech and Hearing**
Satrajit Ghosh, Hideko Heidi Nakajima and John Rosowski

**SHBT 201. Biology of the Inner Ear**
M. Charles Liberman and Stéphane Maison

**Virology 200. Introduction to Virology**
Jonathan Abraham and Philip Kranzusch

**Virology 202. Proposal Writing**
Sean Whelan
BBS 230. Qualitative and Quantitative Analysis of the Biological Literature
Jesse Gray and Roberto Chiarle

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 and R programming skills using example data from papers. The midterm and final exams will focus on statistics and programming knowledge.

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 2018
Meeting Dates: September 6, 2018 through December 6, 2018
First Meeting Location: TMEC 209
Course Heads: Jesse Gray, gray@genetics.med.harvard.edu
BBS 301. Embedded Teaching Practicum (for Graduate Teaching Assistants) Jason Heustis and Madhvi Venkatesh

4 units. Instructor Consent Required

(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. Course for TAs working in BCMP 200

Note: TAs should contact Jason Heustis, ronald_heustis@hms.harvard.edu. Registration for this class is limited to students serving as Teaching Assistants for BBS core. Class meeting times will be in the daytime or evening. Evenings: 9/5, 9/10, 9/12, 12/12; Daytimes: 9/14, 9/24, 10/12, 10/29, 11/14, 12/05

Fall 2018
Meeting Dates: August September 5, 2018 through December 12, 2018
First Meeting Location: Students will be contacted directly with room
Course Head: Jason Heustis, 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/41914

Fall 2018
Meeting Dates: September 13, 2018 through December 18, 2018  
First Meeting Location: NRB, Room 350 – contact faculty  
Course Head: Rosalyn Adam, Rosalyn.Adam@childrens.harvard.edu and Matthew Harris,  
Matthew.Harris@childrens.harvard.edu
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 2018
Meeting Dates: September 5, 2018 through Monday, December 10, 2018
First Meeting Location: Cannon Room, Building C
Course Head: Joseph Loparo, joseph_loparo@hms.harvard.edu
Curriculum Fellow: Madhvi Venkatesh, Madhvi_Venkatesh@hms.harvard.edu
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 2018
Meeting Dates: Begins Tuesday, September 12
Meeting Location: TMEC 128 and MIT 66-168
Course Head: Vijay Sankaran, 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 2018
Meeting Dates: September 5 through December 12
First Meeting Location: MIT Bldg., Room 4-153
Course Head: Stan Finkelstein, finkelst@hcp.med.harvard.edu
Biomedical Informatics

BMIF 201. Concepts in genome analysis
Shamil Sunyaev, Cheng-Zhong Zhang and Michael Baym

4 units. M., W. 2:30PM – 4:00PM

This course focuses on quantitative aspects of genetics and genomics, including computational and statistical methods of genomic analysis. We will introduce basic concepts and discuss recent progress in population and evolutionary genetics and cover principles of statistical genetics of Mendelian and complex traits. We will then introduce current genomic technologies and key algorithms in computational biology and bioinformatics. We will discuss applications of these algorithms to genome annotation and analysis of epigenomics, cancer genomics and metagenomics data. Proficiency in programming and basic knowledge of genetics and statistics will be assumed.

Fall 2018
Meeting Dates: September 5, 2018 through December 3, 2018
First Meeting Location: TMEC 250
Course Head: Shamil Sunyaev, ssunyaev@rics.bwh.harvard.edu
Cell Biology

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: https://canvas.harvard.edu/courses/42283

Prerequisite: Upper division cell biology or equivalent.

Fall 2018
Meeting Dates: September 6, 2018 through December 7, 2018
First Meeting Location: TMEC L-007
Course Heads: Iain A. Drummond, idrummond@partners.org OR idrummond@mgh.harvard.edu and Amar Sahay, sahay.amar@mgh.harvard.edu.
Genetics

Genetics 201. Principles of Genetics
Fred Winston, Matthew Pecot, Thomas Bernhardt, Maxwell Heiman, 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 2018
Meeting Dates: September 5, 2018 through December 7, 2018
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
**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 2018**

**Meeting Dates:** September 5, 2018 through December 12, 2018

**First Meeting Location:** NRB 350

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

Immunology 201. Principles of Immunology
Thorsten Mempel, Shiv Pillai 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 2018
First Meeting Date: Wednesday September 4, 2018
Meeting Dates: September 4, 2018 through December 6, 2018
First Meeting Location: Modell Immunology Center, Fred S. Rosen Lecture Hall, Room 100A  Course Heads: Thorsten Mempel, 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. 12:00PM – 1:00PM (lunch) and 2:30 – 4:00PM (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 2018
Meeting Dates: September 5, 2018 through December 5, 2018
First Meeting Location: Modell Immunology Center, Room 100A  Course Head: Shiv Pillai, pillai@helix.mgh.harvard.edu and Galit Alter, galter@partners.org
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 52

(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 2018
Meeting Dates: September 5, 2018 through December 14, 2018
First Meeting Location: D Amphitheater
Course Head: Trudy Van Houten, Trudy_vanhouten@hms.harvard.edu and Breda Zimkus, 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 2018
Meeting Dates: Tuesday, September 4, 2018 through Thursday, December 18, 2018
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, Michael Starnbach, Jonathan Kagan, Darren Higgins and Min Dong

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 themes of pathogenesis, methods, results, and interpretations of classic and contemporary literature. Subjects including bacterial secretion systems, mechanisms of entry into host cells, biofilm formation, and motility are viewed primarily from the pathogen’s perspective, whereas topics including inflammasome activation, TLR signaling, and adaptive immune responses provide a host-centric view. Additional sessions are spent examining current methods of antibiotic discovery and vaccine development. The course also introduces students to the wide diversity of pathogenic bacteria. Organisms discussed include pathogenic E. coli, Shigella species, Vibrio cholerae, Listeria monocytogenes, Chlamydia trachomatis, Pseudomonas aeruginosa and Staphylococcus aureus, as well as a discussion of the challenges presented by currently unculturable species.

The course is designed to complement Microbiology 201; however students who have not taken Microbiology 201 previously are welcome.

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

Fall 2018
Meeting Dates: September 4, 2018 through November 29, 2018
First Meeting Location: NRB 1031
Course Head: Marcia Goldberg, marcia.goldberg@mgh.harvard.edu Curriculum
Fellow: Deepali Ravel, dravel@fas.harvard.edu
Neurobiology

Neurobiology 215A. The Discipline of Neuroscience
Lisa Goodrich, John Assad, Gary Yellen, Bruce Bean, Wade Regehr, Sandeep Robert Datta, Tom Schwarz, Michael Do, Josh Kaplan, David Corey, Bernardo Sabatini and Rosalind Segal

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 2018

Meeting Dates: September 5, 2018 through December 20, 2018
First Meeting Location: WAB 236
Course Head: Lisa Goodrich, lisa_goodrich@hms.harvard.edu and John Assad, john_assad@hms.harvard.edu
Curriculum Fellow: Taralyn Tan, Taralyn_Tan@hms.harvard.edu
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  

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 2018  
Meeting Dates: Monday, September 10, 2018 through Monday, December 10, 2018  
First Meeting Date: September 10, 2018  
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)
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 2018
First Meeting Date: September 6, 2018
First Meeting Location: MIT Building 46-5056 (43 Vassar St, Cambridge, MA 02139)
Course Heads: Satrajit Ghosh, satra@mitu.edu and Hideko Nakajima, Heidi_Nakajima@meei.harvard.edu
Course Website: https://goo.gl/rhNqY4
SHBT 201. Biology of the Inner Ear
M. Charles Liberman and Stéphane 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 2018
Meeting Dates: September 4, 2018 through December 13, 2018,
First Meeting Location: Massachusetts Eye and Ear Infirmary, 4th floor library, Room 432
Course Head: Charles Liberman, charles_liberman@meei.harvard.edu
Virology

**Virology 200. Introduction to Virology**  
Jonathan Abraham and Philip Kranzusch  

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](http://www.courses.fas.harvard.edu/6075) Medical School as MG 705.0.

**Fall 2018**  
**Meeting Dates:** September 5, 2018 through December 5, 2018  
**First Meeting Location:** TMEC 447  
**Course Heads:** Jonathan Abraham, abraham@crystal.harvard.edu and Philip Kranzusch, Philip_Kranzusch@DFCI.HARVARD.EDU

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**Virology 202. Proposal Writing**  
Sean Whelan  

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 2018**  
**Meeting Dates:** September 5, 2018 through November 7, 2018  
**First Meeting Location:** TMEC 426  
**Course Head:** Sean Whelan, sean_whelan@hms.harvard.edu