Your training will incorporate biology, physics, computing, and engineering to enable investigation of human health and disease at the molecular, cellular, and systems levels. Your research could ultimately lead to the design of novel therapeutics for disease prevention and treatment.

Well Cornell Medicine
Physiology, Biophysics & Systems Biology

http://pbsb.med.cornell.edu

Structure and Function of Molecular Assemblies

Cellular and Biomolecular Imaging

Network Architecture and Functional Dynamics

Organogenesis and Development

Computational Modeling of Molecular and Signaling Processes

Bioinformatics and Complex Systems Analysis
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OVERVIEW:

The central mission of the Physiology, Biophysics, and Systems Biology (PBSB) graduate program is to educate and train doctoral students who use quantitative experimental, computational, and theoretical approaches to advance biomedical research. Through courses, research, and seminars, we aim to endow our students with the skills and knowledge to acquire data with fine resolution and large scale, to analyze these data using rigorous thinking and appropriate statistical and computational tools, and to use these analyses to develop and test quantitative models that elucidate hypotheses.

The quantitative approaches taught to our students stem from a broad set of disciplines represented by the background and expertise of the faculty, which include physics, mathematics, chemistry, statistics, and computer science. The biomedical subject matter with which we engage students is anchored in the research and experience of the faculty that ranges from genomics and proteomics, to molecular and cellular biophysics, to the physiology of systems and organs, and to quantitative aspects of integrative biology. Through educational and research opportunities across this multidisciplinary and multi-scale spectrum, our students learn and develop quantitative methods that generalize to every arena of biomedical research.

The PBSB program is a special place for doctoral studies. Our favorable faculty-to-student ratio and dedicated mentorship and administrative support ensures that every student receives the guidance and advice they need to find their own path. Our incorporation within Weill Cornell Medicine and the Sloan Kettering Institute provides a wealth of translational opportunities that greatly leverages our research efforts. Our location on the Upper East Side of Manhattan fosters immersion within the scientific and cultural critical mass formed by the New York City community. And our focus on quantitative experimental, computational, and theoretical approaches provides a powerful vehicle with which to drive forward the ongoing revolution in biomedical research.
<table>
<thead>
<tr>
<th>Administration</th>
<th>Location</th>
<th>Phone/Fax</th>
<th>E-mail address</th>
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</thead>
<tbody>
<tr>
<td>Harel Weinstein, D.Sc. Program Chairman</td>
<td>1300 York Avenue Room E-509</td>
<td>Ph# 212-746-6358</td>
<td><a href="mailto:haw2002@med.cornell.edu">haw2002@med.cornell.edu</a></td>
</tr>
<tr>
<td>Program Chairman Physiology, Biophysics and Systems Biology (PBSB)</td>
<td></td>
<td>Fax# 212-746-8690</td>
<td></td>
</tr>
<tr>
<td>Emre Aksay Ph.D. Program Director</td>
<td>1300 York Avenue Room W-820 B</td>
<td>Ph# 212-746-6207</td>
<td><a href="mailto:ema2004@med.cornell.edu">ema2004@med.cornell.edu</a></td>
</tr>
<tr>
<td>Physiology, Biophysics and Systems Biology (PBSB)</td>
<td></td>
<td>Fax# 212-746-8690</td>
<td></td>
</tr>
<tr>
<td>Barbara Hempstead, MD, PhD Dean of the Weill Cornell Graduate School of Medical Sciences (WCGS)</td>
<td>1300 York Avenue Room A-125</td>
<td>Ph# 212-746-1818</td>
<td><a href="mailto:blhempst@med.cornell.edu">blhempst@med.cornell.edu</a></td>
</tr>
<tr>
<td>Randi Silver, Ph.D. Associate Dean, Academic Affairs Weill Cornell Graduate School of Medical Sciences (WCGS)</td>
<td>1300 York Avenue Room A-128</td>
<td>Ph# 212-746-6340</td>
<td><a href="mailto:rbsilve@med.cornell.edu">rbsilve@med.cornell.edu</a></td>
</tr>
<tr>
<td>Anjali Rajadhyaksha, PhD Associate Dean, Program Development Weill Cornell Graduate School of Medical Sciences (WCGS)</td>
<td>1300 York Avenue Room LC-604</td>
<td>Ph# 212-746-5999</td>
<td><a href="mailto:amr2011@med.cornell.edu">amr2011@med.cornell.edu</a></td>
</tr>
<tr>
<td>Jaci Czarnecki Thompson, MA Departmental Administrator Weill Cornell Graduate School of Medical Sciences (WCGS)</td>
<td>1300 York Avenue Room A-128</td>
<td>Ph# 212-746-4809</td>
<td><a href="mailto:jac4009@med.cornell.edu">jac4009@med.cornell.edu</a></td>
</tr>
<tr>
<td>Audrey Rivera, M.S. Program Coordinator Weill Cornell Graduate School of Medical Sciences (WCGS)</td>
<td>1300 York Avenue Room E-509</td>
<td>Ph# 212-746-6361</td>
<td><a href="mailto:ajr2004@med.cornell.edu">ajr2004@med.cornell.edu</a></td>
</tr>
<tr>
<td>Physiology, Biophysics and Systems Biology (PBSB)</td>
<td></td>
<td>Fax# 212-746-8690</td>
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</table>
Students in the PBSB program learn, apply, and develop a range of quantitative experimental, computational, and theoretical tools in their work to advance biomedical research. Experimental approaches range from cryo-electron microscopy to single-molecule functional imaging, from single-cell sequencing to subcellular optical perturbations, and from susceptibility mapping to whole-retina information encoding. Computational and theoretical tools range from molecular dynamics to time-series analysis, from Bayesian inferencing to pattern-recognition networks, and from dynamical systems analysis to large-scale network simulations, with many of the applied tools refined and adapted to work across different biological scales. The quantitative approaches emphasized in the PBSB program enable our students and faculty to tackle biomedical challenges with a rigor that accelerates research, deepens understanding, and leads to testable predictions.

Our students begin research within days of arriving on campus and stay heavily involved in research throughout their graduate career. During their first year, students complete a minimum of three immersive research rotations, from which students select their thesis mentor (or mentors). We provide students with a wealth of resources and support during their graduate years and encourage them to take the lead in moving their project forward shortly after joining their thesis lab.

Faculty in the PBSB program are unified by their common conviction that quantitative approaches should be used and developed to advance biomedical research. To this effort they bring backgrounds and advanced research experience in mathematics, statistics, chemistry, physics, engineering, and computer science, combined with and knowledge and productive perspectives on specific biomedical research areas. Together, the areas covered by PBSB faculty span a very broad swath of biomedical and medical sciences ranging from cell fate and cell signaling at various scales, to the functions of specific tissues (e.g., electrogenic tissue) and organs, and the biology underlying diseases including cancer and brain disorders.

<table>
<thead>
<tr>
<th>Name</th>
<th>Research Interests</th>
<th>Methods</th>
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<tbody>
<tr>
<td>Alessio Accardi, Ph.D.</td>
<td>The Accardi lab seeks to elucidate the structural and mechanistic underpinnings of ion and lipid transport.</td>
<td>● Cryo-Electron Microscopy</td>
</tr>
<tr>
<td><a href="mailto:ala2022@med.cornell.edu">ala2022@med.cornell.edu</a></td>
<td></td>
<td>● Crystallography</td>
</tr>
<tr>
<td>212-746-8696</td>
<td></td>
<td>● Bioinformatics</td>
</tr>
<tr>
<td>Emre Aksay, Ph.D.</td>
<td>The Aksay laboratory is interested in understanding the molecular, cellular, and circuit mechanisms that give rise to dynamics in neural networks</td>
<td>● Multi-photon microscopy</td>
</tr>
<tr>
<td><a href="mailto:ema2004@med.cornell.edu">ema2004@med.cornell.edu</a></td>
<td></td>
<td>● Electrophysiology (Patch-clamp; whole cell)</td>
</tr>
<tr>
<td>212-746-6207</td>
<td></td>
<td>● Machine learning, AI</td>
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<td></td>
<td>● Mathematical modeling and simulations</td>
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<td></td>
<td>● Optogenetics</td>
</tr>
<tr>
<td>Olaf S. Andersen, M.D.</td>
<td>The Andersen lab’s research is focused on the molecular mechanisms governing the function of membrane-spanning ion permeable channels.</td>
<td>● Spectroscopy</td>
</tr>
<tr>
<td><a href="mailto:sparre@med.cornell.edu">sparre@med.cornell.edu</a></td>
<td></td>
<td>● Conformational energy calculations</td>
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<tr>
<td>212-746-6350</td>
<td></td>
<td>● Electrophysiological (single-channel)</td>
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<td>measurements</td>
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<td>Name</td>
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| Effie Apostolou, Ph.D. | The Apostolou lab focuses on the study of three-dimensional chromatin architecture and its dynamic rearrangements upon differentiation and reprogramming.                                                         | High-throughput sequencing  
Magnetic resonance imaging  
Computational analysis |
| Douglas J. Ballon, Ph.D.| The Ballon lab is focused on the development of imaging biomarkers for diagnosis, prognosis, staging, and therapeutic efficacy in cancer and neurologic diseases.                                                     | Next-generation DNA sequencing  
Computational cancer genomics |
| Michael F. Berger, Ph.D.| The Berger lab’s focus is to characterize the spectrum of genetic mutations in human tumors in order to identify biomarkers of cancer progression and drug response. znajdzie się tutaj:  
Next-generation DNA sequencing  
Computational cancer genomics |
| Doron Betel, Ph.D.      | The Betel lab is interested in the development of computational genomic tools and data integration approaches for the study of human diseases and cellular development.                                                   | Data integration, translational approaches  
Machine learning, Statistical Inference  
Genomic, epigenomic and transcriptome data analyses |
| Carl Blobel, M.D., Ph.D.| The Blobel lab studies how the cell surface metalloprotease ADAM17 and its regulators, the inactive Rhomboids (iRhoms), control TNFα and EGF-receptor signaling in development and autoimmune diseases such as RA and SLE.  
Molecular dynamics simulations  
High-throughput experiments  
High-performance computing, AI |
| Olga Boudker, Ph.D.     | The Boudker lab is interested in how molecular motions underlie function in ion-driven membrane transporters.                                                                                                   | Bioinformatics  
Cryo-Electron Microscopy  
Crystallography  
Nuclear Magnetic Resonance  
Single-Molecule fluorescence microscopy |
| John Chodera, Ph.D.     | The Chodera lab uses computation and experiments to develop quantitative, multiscale models of the effects of small molecules on biomolecular macromolecules and cellular pathways.                                           | Microarray technologies  
Next-generation sequencing |
| Ronald G. Crystal, M.D. | The Crystal lab’s current projects include gene transfer strategies for cancer, inherited CNS disorders, α1-antitrypsin deficiency, anti-bioterrorism applications and development of vaccines.                            | Chemical synthesis (probes, peptides)  
Protein biochemistry  
Protein engineering  
Biophysics (BLI, optical tweezers)  
Tissue culture, CRISPR |
| Yael David, Ph.D.       | The David lab applies core techniques in chemical biology, biochemistry, and cell biology to address fundamental questions in the epigenetic regulation of transcription.                                                      | Genetic model systems  
Quantitative imaging  
Membrane biophysics  
Protein Biochemistry |
| Jeremy Dittman, M.D., Ph.D.| The Dittman lab is interested in synaptic function at the molecular, cellular, and circuit levels                                                                                                    | Next-generation sequencing  
Cell culture models |
| Laura Donlin, Ph.D.     | The Donlin lab aims to deepen our understanding of autoimmune and musculoskeletal disorders by uncovering molecular patterns found within patient samples.                                                                                       | High performance computing  
Machine learning, AI, deep learning  
Mathematical modeling  
Genome and DNA sequencing |
| Olivier Elemento, Ph.D. | The Elemento lab combines Big Data analytics with experimentation to develop entirely new ways to help prevent, diagnose, understand, treat and ultimately cure cancer.                                                                | Pluripotent stem cell models  
Animal models  
Drug screens  
Omics |
| Todd Evans, Ph.D.       | The Evans lab’s goal is to understand the molecular regulation of normal organ development during embryogenesis, and thereby to reveal the underlying genetic programs that, when deregulated, cause developmental defects and organ-based disease throughout life. | Next-generation sequencing  
Cell culture models  
High performance computing  
Machine learning, AI, deep learning  
Mathematical modeling  
Genome and DNA sequencing |
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| Bishoy Morris Faltas, Ph.D. | The Faltas lab focuses on studying bladder cancer as a model disease for dissecting the fundamental biological mechanisms that drive the evolution of human cancers and resistance to therapy.                                                                                                                                                | ● Genomics  
● Animal models  
● Translational research                                                                                              |
| dmf9003@med.cornell.edu     |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| 646-962-2072                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| Daniel Gardner, Ph.D.       | The Gardner lab investigates how the cellular and network properties of individual neurons, and the information they convey, give rise to the complex behavior of the brain.                                                                                                                                                | ● Bioinformatics                                                                               |
| dgardner@med.cornell.edu    |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| 212-746-6373                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| Bernice Grafstein, Ph.D.    | The Grafstein lab is interested in nervous system development and regeneration.                                                                                                                                                                                                                                                                   | ● Integrative cell and systems physiology  
● Quantitative systems neuroscience                                                             |
| bgraf@med.cornell.edu       |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| 212-746-6364                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| Benjamin Greenbaum, Ph.D.   | The Greenbaum laboratory is interested in quantifying the interaction of tumors with the immune system and to predict immune driven evolution of tumors and viruses.                                                                                                                                         | ● Statistical physics  
● Computational analysis  
● Evolutionary biology                                                                              |
| greenbab@mskcc.org          |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| 646-608-7667                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| Iman Hajirasouliha, Ph.D.   | The Hajirasouliha lab is passionate about developing new algorithms, machine learning and deep learning methods, and their applications to genomics, metagenomics, cancer research, and In Vitro Fertilization (IVF).                                                                 | ● High performance computing  
● AI, Machine Learning, Deep Learning  
● Combinatorial and Graph Algorithms  
● Bioinformatics  
● Genome sequencing technologies                                                                 |
| imh2003@med.cornell.edu     |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| 646-962-7804                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| Katherine Hajjar, M.D.      | The Hajjar lab focuses on the receptor-mediated assembly of the fibrinolytic zymogen, plasminogen, and its endothelial cell-derived activator.                                                                                                                                                                                                                 | ● Animals models  
● Confocal microscopy                                                                                                                   |
| khajar@med.cornell.edu      |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| 212-746-2034                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| Daniel A. Heller, Ph.D.     | The Heller lab is inventing novel nanotechnologies to treat advanced cancers, detect disease at early stages, and investigate disease mechanisms.                                                                                                                                                                                                             | ● Nanotechnology  
● Machine learning, AI  
● Microscopy and optics  
● Drug delivery  
● Sensors                                                                                          |
| hellerd@mskcc.org           |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| 646-888-3438                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| Barbara L. Hempstead M.D.,  | The Hempstead lab is focused on defining the actions of neurotrophin growth factors in the vasculature and in neurons.                                                                                                                                                                                                                                       | ● Confocal microscopy                                                                                                                                |
| Ph.D. blhempst@med.cornell.edu |                                                                                                                                                                                                                                                                                                                                               |                                                                                               |
| 212-746-6215                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| Doris Herzlinger, Ph.D.     | The Herzlinger lab studies how the unique architecture of each organ’s vascular bed is established in the developing mouse embryo.                                                                                                                                                                                                                  | ● Animal models  
● Confocal microscopy  
● Immunofluorescence microscopy  
● In situ hybridization                                                                        |
| dahzli@med.cornell.edu      |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| 212-746-6377                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| Richard K. Hite, Ph.D.      | The Hite lab is focused upon determining the mechanisms of intracellular ion transport with a particular focus upon the lysosome and its role in the development of neurodegenerative disease.                                                                                                                                                                  | ● Cryo-electron microscopy  
● X-ray crystallography  
● Electrophysiology                                                                                      |
| hiter@mskcc.org             |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| 212-639-8694                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| Xin-Yun Huang, Ph.D.        | The Huang lab’s research focuses on the molecular mechanisms of cellular signaling pathways and their physiological functions, mainly signaling and regulatory mechanisms of G proteins and tyrosine kinases.                                                                                                           | ● Animal models  
● Single-cell sequencing and analyses  
● Confocal microscopy  
● Cryo-electron microscopy  
● Crystallography                                                                                 |
| xyhuang@med.cornell.edu     |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| 212-746-6362                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| Marcin Imieliński, M.D., Ph.| The Imieliński lab applies cancer genome assembly to study long range DNA structure in tumors.                                                                                                                                                                                                                                                 | ● Sequencing technology  
● Genomic data science                                                                                                           |
| Ph.D. mail9037@med.cornell.edu |                                                                                                                                                                                                                                                                                                                                            |                                                                                               |
| 646-862-6997                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| Steven Z. Josefowicz, Ph.D. | The Josefowicz lab’s long-term goal is to apply mechanistic knowledge of epigenetic regulation and functional histone genetic tools to understand epigenetic processes in immune cell development and function including immunologic memory, trained immunity, and immune cell exhaustion. | ● Single-cell sequencing  
● Epigenomics                                                                                       |
<table>
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<th>Name</th>
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<tr>
<td>Alex Kentsis, M.D., Ph.D.</td>
<td>The Kentsis lab seeks to understand the fundamental causes of cancers, especially in children and young adults, and develops definitive therapies for their control.</td>
<td>● Functional genomics&lt;br&gt;● Quantitative proteomics&lt;br&gt;● Protein engineering&lt;br&gt;● Animal models&lt;br&gt;● Computational modeling and drug design</td>
</tr>
<tr>
<td>Kayvan Keshari, Ph.D.</td>
<td>The Keshari lab’s goal is to improve our biochemical understanding of cancer metabolism and use metabolic changes to develop imaging agents for diagnosis and treatment.</td>
<td>● Hyperpolarized magnetic resonance (MR)</td>
</tr>
<tr>
<td>George Khelashvili, Ph.D.</td>
<td>The Khelashvili lab’s goal is to uncover dynamic mechanisms in fundamental biological processes of signal transduction by cell surface proteins in the categories of receptors such as G protein-coupled receptors, transporters in the family of neurotransmitter: sodium-symporters, and lipid scramblases.</td>
<td>● Mathematical modeling and simulations&lt;br&gt;● Molecular dynamics simulations&lt;br&gt;● Computational biophysics</td>
</tr>
<tr>
<td>Ekta Khurana, Ph.D.</td>
<td>The Khurana lab develops integrative computational models to understand the relationship between genomic sequence variation and disease.</td>
<td>● Bioinformatics&lt;br&gt;● High performance computing&lt;br&gt;● Machine learning, AI, deep learning</td>
</tr>
<tr>
<td>Jason A. Koutcher, M.D., Ph.D.</td>
<td>The Koutcher lab’s research program includes investigation of radiation sensitizers, antiangiogenesis agents, hypoxia, and molecular and cellular imaging.</td>
<td>● Magnetic resonance spectroscopy&lt;br&gt;● Magnetic resonance imaging</td>
</tr>
<tr>
<td>Jan Krumsieck, Ph.D.</td>
<td>The Krumsieck lab develops and applies novel methods for the analysis of metabolomics and multi-omics data.</td>
<td>● Bioinformatics&lt;br&gt;● Machine learning, AI, deep learning&lt;br&gt;● Mathematical modeling and simulations</td>
</tr>
<tr>
<td>Eric C. Lai, Ph.D.</td>
<td>The Lai lab’s guiding interest is to comprehend how complex biological patterns can be assembled with stereotyped precision.</td>
<td>● Genomics</td>
</tr>
<tr>
<td>Dan A. Landau, M.D., Ph.D.</td>
<td>The Landau lab is committed to discovering fundamental principles in evolutionary biology and biological regulation of mammalian cells.</td>
<td>● Bioinformatics&lt;br&gt;● High-performance computing&lt;br&gt;● Omics</td>
</tr>
<tr>
<td>Ashley Laughney, Ph.D.</td>
<td>The Laughney Lab seeks to discover context-dependent interactions supporting the adaptive abilities of disseminated tumor cells and their interplay with anti-tumor immunity.</td>
<td>● Bioinformatics&lt;br&gt;● Next-generation sequencing&lt;br&gt;● Animal models&lt;br&gt;● Fluorescence microscopy and FRAP&lt;br&gt;● High performance computing</td>
</tr>
<tr>
<td>Cristina Leslie, Ph.D.</td>
<td>The Leslie lab develops novel computational methods to study cellular biological systems from a global and data-driven perspective.</td>
<td>● Machine learning, AI&lt;br&gt;● High-performance computation</td>
</tr>
<tr>
<td>Joshua Levitz, Ph.D.</td>
<td>The Levitz Lab seeks to understand synaptic signaling molecules with a focus on neurotransmitter-gated G protein-coupled receptors.</td>
<td>● Chemical optogenetics&lt;br&gt;● Single molecule fluorescence-based assays</td>
</tr>
<tr>
<td>Massimo Loda, M.D.</td>
<td>The Loda laboratory is interested in investigating the mechanisms by which prostate cancer hijacks cell metabolism to allow tumors to flourish.</td>
<td>● Genomics&lt;br&gt;● Biochemical assays&lt;br&gt;● Electron microscopy&lt;br&gt;● Computational pathology</td>
</tr>
<tr>
<td>Stephen Long, Ph.D.</td>
<td>The Long lab focuses on the mechanisms of eukaryotic ion channels involved in calcium signaling and membrane-embedded enzymes.</td>
<td>● Cryo-electron microscopy&lt;br&gt;● X-ray crystallography</td>
</tr>
<tr>
<td>Christopher Mason, Ph.D.</td>
<td>The Mason lab develops and deploys computational and experimental methodologies to identify the functional genetic elements of the human genome and metagenome and engineer them into cells and clinical trials.</td>
<td>● Integrative functional genomics&lt;br&gt;● Space genetics and genome defense&lt;br&gt;● Epigenetics and genome technologies&lt;br&gt;● Machine learning, AI, bioinformatics&lt;br&gt;● Global metagenomics</td>
</tr>
<tr>
<td>Name</td>
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</table>
| Joel Meyerson, Ph.D. jrm2008@med.cornell.edu 212-746-5992 | The Meyerson lab’s research addresses questions about molecular structure and transmembrane signaling mechanisms. | ● Cryo-electron microscopy  
● High performance computing  
● Tomographic imaging |
| Jason G. Mezey, Ph.D. jam2054@med.cornell.edu 646-962-4546   | The Mezey lab is focused on understanding the genetics, development, and evolution of complex phenotypes and disease. | ● Computational statistics and analysis  
● Machine learning  
● Next-generation sequencing data |
| Crina Nimigean, Ph.D. cm2002@med.cornell.edu 212-746-5947   | The Nimigean lab’s research is geared toward understanding how ion channel protein structure and mechanism interrelate at the molecular level to allow channels to elaborate various biological properties. | ● Cryo-electron microscopy  
● Crystallography  
● Electrophysiology (patch-clamp; whole cell)  
● Isothermal Titration Calorimetry |
| Shelia Nirenberg, Ph.D. shn2010@med.cornell.edu 212-746-6372 | The Nirenberg lab’s research seeks to advance basic understanding of computational neuroscience, and, in parallel, use what we learn to address practical problems that improve quality of life. | ● Optogenetics  
● Electrophysiology (Multi-electrode arrays)  
● Brain-machine interfaces |
| Lawrence G. Palmer, Ph.D. lgpalm@med.cornell.edu 212-746-6355 | The Palmer lab is interested in the cellular and molecular events involved in the transport of Na+ and K+ between blood and urine, and in the hormonal mechanisms underlying the regulation of these transport processes. | ● Animal Models  
● Electrophysiology (Patch-clamp; whole cell) |
| Dana Pe'er, Ph.D. peerd@mskcc.org 646-888-3186  | The Pe’er lab aims to address fundamental questions in biomedical science addressing regulatory cell circuits, cellular development, tumor immune eco-system, genotype to phenotype relations and precision medicine. | ● Machine learning  
● Genomics  
● Single cell technologies |
| Shahin Rafii, M.D. srafi@med.cornell.edu 212-746-4538  | The Rafii lab focuses on the molecular and cellular mechanisms of angiogenesis, cancer, and stem cell biology. | ● Genetic, genomic, molecular and cell biological techniques  
● Animal models |
| Enrique Rodriguez-Boulan, M.D. boulan@med.cornell.edu 212-746-2272 | The Rodriguez-Boulan lab studies basic mechanisms involved in the generation of epithelial cell polarity using two model systems, the polarized epithelial cell line MDCK and the Retinal Pigment Epithelium. | ● Animals models  
● Quantitative microscopy |
| Simon Scheuring, Ph.D. sis2019@med.cornell.edu 646-962-2565 | The Scheuring lab performs atomic force microscopy-based research of biological samples, with a particular interest in membrane phenomena. | ● High-speed atomic force microscopy  
● Cryo-electron microscopy  
● Single-Molecule Spectroscopy |
| Robert E. Schwartz, M.D., Ph.D. res2025@med.cornell.edu 646-962-6197 | The Schwartz lab is focused on developing and building models of human liver disease in vitro, leveraging these models and interdisciplinary tools to study mechanisms underlying infectious and metabolic disease and liver cancer. | ● Stem cell biology  
● Hepatocyte biology  
● Engineering techniques  
● Animal Models  
● Genomic and cell biological techniques |
| Sohrab P. Shah, Ph.D. shahs3@mskcc.org 646-608-7558 | The Shah lab’s research focuses on developing and using computational methods to understand cancer evolution and treatment response. | ● Machine learning, AI  
● Bayesian statistics  
● High-resolution single-cell genomics  
● Transcriptomics |
| Randi B. Silver, Ph.D. rbsilve@med.cornell.edu 212-746-6354 | The Silver lab focuses on organ fibrosis and developing therapeutic interventions blocking collagen synthesis. | ● Animal Models  
● Primary cell culture  
● Histopathology  
● Organoids |
| Lucy (Luce) Skrabanek, Ph.D. las2017@med.cornell.edu 212-746-6363 | The Skrabanek lab is interested in expanding data analysis education and the routine use of software tools that support data lifecycle management activities that emphasize rigor and reproducibility in experimental design, data collection, analysis and interpretation. | ● Computational analysis  
● Bioinformatics |
<table>
<thead>
<tr>
<th>Name</th>
<th>Research Interests</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heidi Stuhlmann, Ph.D.</td>
<td>The Stuhlmann lab focuses on understanding the molecular and genetic pathways that regulate the three principal processes of vascular development: endothelial cell lineage determination, vasculogenesis, and angiogenesis.</td>
<td>● Mouse model</td>
</tr>
<tr>
<td><a href="mailto:hess2011@med.cornell.edu">hess2011@med.cornell.edu</a> 212-746-6156</td>
<td></td>
<td>● Embryonic stem cell in vitro differentiation system</td>
</tr>
<tr>
<td>Hagen Tilgner, Ph.D.</td>
<td>The Tilgner lab is interested in how the same, within an individual mostly invariant genome, can give rise to functionally extremely diverse cell types – such as the ones that are the building blocks of the human brain.</td>
<td>● Omics</td>
</tr>
<tr>
<td><a href="mailto:hut2006@med.cornell.edu">hut2006@med.cornell.edu</a> 646-962-7581</td>
<td></td>
<td>● Bioinformatics</td>
</tr>
<tr>
<td>Peter Torzilli, Ph.D.</td>
<td>The Torzilli lab’s research focuses on the study of cell and tissue biology of articular cartilage in health and disease; the enzyme mechanokinetics of collagen catalysis; and the design of novel approaches at the molecular level to enhance soft tissue repair and function.</td>
<td>● Tissue, cellular and molecular engineering</td>
</tr>
<tr>
<td><a href="mailto:torzillip@hss.edu">torzillip@hss.edu</a> 212-606-1087</td>
<td></td>
<td>● Gene therapy</td>
</tr>
<tr>
<td>Jessica Tyler, Ph.D.</td>
<td>The Tyler laboratory is interested in discovering and understanding the mechanistic basis of epigenetic regulation of aging, genomic integrity and gene expression.</td>
<td>● Epigenetics</td>
</tr>
<tr>
<td><a href="mailto:jet2021@med.cornell.edu">jet2021@med.cornell.edu</a> 212-746-4092</td>
<td></td>
<td>● Molecular genetics</td>
</tr>
<tr>
<td>Jonathan D. Victor, M.D., Ph.D.</td>
<td>The Victor lab is interested in the design principles of sensory processing, both in the sensory periphery and in the brain, and how these design principles are implemented in biological hardware.</td>
<td>● Mathematical and computational modeling</td>
</tr>
<tr>
<td><a href="mailto:jdvicto@med.cornell.edu">jdvicto@med.cornell.edu</a> 212-746-2343</td>
<td></td>
<td>● Visual psychophysics</td>
</tr>
<tr>
<td>Fei Wang, Ph.D.</td>
<td>The Wang laboratory focuses on data mining algorithms development and their applications in various health informatics problems.</td>
<td>● Machine learning</td>
</tr>
<tr>
<td><a href="mailto:few2001@med.cornell.edu">few2001@med.cornell.edu</a> 646-962-9405</td>
<td></td>
<td>● Data mining</td>
</tr>
<tr>
<td>Yi Wang, Ph.D.</td>
<td>The Wang lab’s research interest is to develop imaging methods using mathematics, physics, electronic engineering, and computer science tools.</td>
<td>● Computer modeling</td>
</tr>
<tr>
<td><a href="mailto:yiwang@med.cornell.edu">yiwang@med.cornell.edu</a> 212-746-2526</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alan Weinstein, M.D.</td>
<td>The Weinstein lab’s long-term interest is mathematical modeling of solute and water transport across epithelia, specifically the renal epithelia.</td>
<td>● Mathematical and computational modeling</td>
</tr>
<tr>
<td><a href="mailto:amweins@med.cornell.edu">amweins@med.cornell.edu</a> 212-746-4027</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harel Weinstein, D.Sc.</td>
<td>The Weinstein lab studies the interdependence of structure, dynamics, and function in macromolecular assemblies involved in physiological and disease processes, with a specific focus on receptors, transporters, scramblases.</td>
<td>● Quantitative allosteric models</td>
</tr>
<tr>
<td><a href="mailto:haw2002@med.cornell.edu">haw2002@med.cornell.edu</a> 212-746-6358</td>
<td></td>
<td>● Molecular Dynamics Simulations</td>
</tr>
<tr>
<td>Richard Mark White, M.D., Ph.D.</td>
<td>The White lab’s goal is to understand the mechanisms that allow tumors to successfully disseminate and take hold in new locations.</td>
<td>● Mathematical modeling and Bioinformatics</td>
</tr>
<tr>
<td><a href="mailto:whiter@mskcc.org">whiter@mskcc.org</a> 646-888-3415</td>
<td></td>
<td></td>
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<tr>
<td>Simone Angela Winkler, Ph.D.</td>
<td>The Winkler laboratory focuses on an interdisciplinary approach at the intersection of engineering and medicine to overcome key hardware and technological critical barriers that are holding back UHF MRI and its clinical applicability.</td>
<td>● Ultra high-field (UHF) magnetic resonance imaging (MRI)</td>
</tr>
<tr>
<td><a href="mailto:ssw4001@med.cornell.edu">ssw4001@med.cornell.edu</a> 212-746-2971</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joao Xavier, Ph.D.</td>
<td>The Xavier lab’s goal is to identify the underlying physical, biological, and evolutionary principles that are common among, and confer robustness to, multicellular systems.</td>
<td>● Computational models</td>
</tr>
<tr>
<td><a href="mailto:xavierj@mskcc.org">xavierj@mskcc.org</a> 646-888-3195</td>
<td></td>
<td>● Quantitative experiments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Molecular biology</td>
</tr>
</tbody>
</table>

**ADJUNCT AND AFFILIATE FACULTY**

<table>
<thead>
<tr>
<th>Name</th>
<th>Research Interests</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jason R. Banfelder, MCh.E.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="mailto:jbanfelder@rockefeller.edu">jbanfelder@rockefeller.edu</a> 212-327-8919</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Research Interests</td>
<td>Methods</td>
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</tbody>
</table>
| Scott Blanchard, Ph.D.      | The Blanchard lab’s mission is to develop novel approaches to examine conformational and compositional processes critical to the functions of biological systems.                                                      | Single-molecule imaging  
|                            |                                                                                                                                                                                                                  | Single-molecule Fluorescence Resonance Energy Transfer  
|                            |                                                                                                                                                                                                                  | Computational modeling and molecular dynamics simulations                                          |
| Shu-Hsia Chen, Ph.D.        | The Chen lab is focused on gene therapies and cancer immunotherapies, and, to a large extent, elucidating the mechanisms underlying the establishment of immune suppressive tumor microenvironments.                                        | Nanotechnology  
|                            |                                                                                                                                                                                                                  | T cell therapy                                                                                   |
| David J. Christini, Ph.D.   | The Christini lab studies cardiac electrophysiological dynamics from the cellular level to the organ level using computational and experimental approaches.                                                       | Electrophysiology (Patch-clamp and high-throughput, coupled with modeling via dynamic clamp)  
|                            |                                                                                                                                                                                                                  | Optogenetics                                                                                     |
| Colleen E. Clancy, Ph.D.    | The Clancy lab's research interests include computational approaches to reveal mechanisms of normal and pathological excitability in the heart and nervous system.                                             | High-performance computing  
|                            |                                                                                                                                                                                                                  | Multiscale modeling and simulation                                                                |
| John Cooke, M.D., Ph.D.     | The Cooke lab’s research program is focused on vascular regeneration, vascular cell identity and cell fate, and aims to understand the mechanisms underlying epigenetic plasticity that are required for functional adaptation to cellular challenges.        | Single cell trancriptomics  
|                            |                                                                                                                                                                                                                  | Heterokaryon technology  
|                            |                                                                                                                                                                                                                  | Animal models                                                                                     |
| Vittorio Cristini, Ph.D.    | The Cristini lab uses mechanistic mathematical and biophysical models to study the spatiotemporal evolution of diseases and drug transport for cancer, infectious diseases, Alzheimer’s disease, and cardiovascular diseases, in an effort to develop novel clinically translatable tools for personalized medicine. | Mathematical modeling  
|                            |                                                                                                                                                                                                                  | Pharmacokinetic and pharmacodynamic modeling                                                      |
| Thomas J. Fuchs, D.Sc.      | The Fuchs lab focuses on research in the novel field of computational pathology.                                                                                                                                   | Machine learning  
|                            |                                                                                                                                                                                                                  | Computer vision                                                                                   |
| Khaled Machaca, Ph.D.       | The Machaca lab is interested in the regulation of intracellular signaling pathways under both physiological and pathological conditions in the context of the regulation of oocyte maturation, meiotic arrest, cell cycle progression and secretion. | Cell signaling  
|                            |                                                                                                                                                                                                                  | Integrative cell and systems physiology                                                          |
| Glen Prusky, M.Sc., Ph.D.   | The Prusky lab focuses on understanding the nature of adaptive change in the nervous system.                                                                                                                     | Animal models                                                                                     |
|                            |                                                                                                                                                                                                                  | Cellular, electrophysiological, and theoretical methodologies                                    |
The graduate school experience is only as good as the guidance offered. The PBSB faculty take advising very seriously and dedicate a great deal of time to the mentoring effort. The guidance students receive happens in many settings, from informal discussions at the laboratory bench to formal evaluations during periodic reviews.

During the first year, students will meet with a Program Director a minimum of three times to discuss progress in courses, research rotations, and thesis decisions. The Director will serve as the primary mentor and is available at a snap of fingers.

During the first year, students also obtain guidance and direction from three rotation faculty.

At the end of the first year, students identify their thesis advisor, who then becomes the primary mentor.

Faculty critique and evaluation of research progress is offered when, at the beginning the 2nd year, students present at the Program retreat and du Vigneaud graduate school symposium.

During the second year, students form their Special Committee, which consists of the thesis advisor and at least two other Weill Cornell Graduate School of Medical Sciences (WCGS) faculty. This committee is the primary guidance body that monitors student progress until graduation.

In advance of the ACE and Thesis examination, additional faculty are added to your special committee to form an examination body that in many ways is there to help prepare you as they are to test you.
PBSB REQUIREMENTS AND CALENDAR

REQUIREMENTS:

Prior to the taking the ACE exam, a student must take 4 Core courses, 2 electives, and 3 seminar course series. Students will also complete at least 3 research rotations.

Students start their thesis research before completing their formal coursework, but they are not admitted to Ph.D. candidacy until passing their Admission to Candidacy Exam (ACE) at the end of the second year.

| Timeline                                                                 | Year 01 | Year 02 | Year 03 | Year 04 | Year 05...
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<tbody>
<tr>
<td>Core curriculum courses</td>
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<tr>
<td>Graduate research seminar</td>
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<td>Lab rotations</td>
<td>●</td>
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<tr>
<td>Select research focus and Special Committee (thesis mentor plus two other faculty members in relevant research field)</td>
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<tr>
<td>Admission to Doctoral Candidacy Examination (ACE) test (research proposal and oral examination)</td>
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<tr>
<td>Complete two electives</td>
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<tr>
<td>Submit PhD thesis description</td>
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<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Lab research</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Meetings with Special Committee</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Present at PBSB Program Retreat and du Vigneaud Symposium</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Develop PhD thesis</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>In-depth focus group participation</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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</tr>
<tr>
<td>Present at local and national meetings</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Continue research and defend PhD thesis</td>
<td></td>
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</tbody>
</table>
FIRST YEAR, SEPTEMBER – DECEMBER

• Contemporary PBSB: Cells, Systems, and Quantitative Methods – Modules 1, 2, and 3 (*core course 1*)
• Quantitative Understanding in Biology (*core course 2*)
• PBSB Seminar Series (*seminar course 1*)
• Faculty Research Presentations (*seminar course 2*)
• Tri-Institutional Responsible Conduct of Research (RCR) (*mandatory*)
• Begin Rotation #1 (*by mid-September*):
  o Register online at LEARN - https://learn.weill.cornell.edu/ics
  o Complete online Laboratory Rotation Agreement Form with Rotation Preceptor
• Meeting with Program Director (*October*)
• End Rotation #1 (*by late-December*):
  o Complete online Laboratory Rotation Evaluation Form with Rotation Preceptor

FIRST YEAR, JANUARY – MARCH

• Contemporary PBSB: Cells, Systems, and Quantitative Methods – Modules 4, 5, and 6 (*core course 3*)
• Quantitative Genetics and Genomics or Core Principles of Molecular Biophysics (*core course 4*)
• Critical Dissection of Scientific Data (CDSD) (*seminar course 3*)
• PBSB Seminar Series (*seminar course 1 - continued*)
• Begin Rotation #2 (*by early-January*):
  o Register online at LEARN - https://learn.weill.cornell.edu/ics
  o Complete online Laboratory Rotation Agreement Form with Rotation Preceptor
• Meeting with Program Director (*February*)
• End Rotation #2 (*by late-March*):
  o Complete online Laboratory Rotation Evaluation Form with Rotation Preceptor

FIRST YEAR, APRIL - JUNE

• Continue courses
• Begin Rotation #3 (*by early-April*):
  o Register online at LEARN - https://learn.weill.cornell.edu/ics
  o Complete online Laboratory Rotation Agreement Form with Rotation Preceptor
• Meeting with Program Director *(June)*

• End Rotation #3 *(by late-June)*:
  o Complete online Laboratory Rotation Evaluation Form with Rotation Preceptor

**FIRST YEAR, SUMMER**

• Students join their thesis laboratory and begin research
  -or -
• Complete a fourth rotation and decide on a thesis lab *(by early September)*

**SECOND YEAR**

• Continue research in thesis lab
• Present thesis ideas and early data at Program Retreat *(October)*
• Complete 2 electives *(can be chosen from any of the tri-institutional offerings, should be equivalent to a core course in workload. See Director for options or special cases)*
• PBSB Seminar Series
• ACE Tutorial *(November)*
• Form and meet with your special committee to discuss thesis and ACE goals *(by December: Submit committee meeting report to Program Coordinator)*
• Critical Dissection of Scientific Data (CDSD) *(February-June)*
• ACE exam *(begin preparation in January, complete by June 30th)*

**THIRD YEAR +**

• Continue research in thesis lab
• Present at Program Retreat
• Annual special committee meetings
• Present at du Vigneaud Symposium
• Present at national research meetings
• Publish!
FORMAL COURSES OFFERED BY PBSB:

The course of study in the PBSB Program is organized into modular courses and seminars offering education at the conceptual level, as well as in the experimental and computational tools of the component disciplines (Physiology, Biophysics, & Systems Biology), and offers immersion in specific research topics.

Course updates can be found on the PBSB website at http://pbsb.med.cornell.edu/courses/index.php

COURSES OFFERED ANNUALLY:

**Physiology, Biophysics and Systems Biology Research Seminar Series, Quarters I-IV (required):**
This required course exposes students to recent research developments in PBSB faculty focus areas including:
- Biophysical and Physiological Mechanisms of Membrane and Membrane Protein Function
- Quantitative and Integrative Biology
- Organogenesis and Physiological Genomics
- Biological and Biomedical Imaging

Course Director: Dr. Alessio Accardi

**Contemporary PBSB: Cells, Systems, and Quantitative Methods - Quarters I-IV (required):**
Course content and organization are designed to prepare students for twenty-first century research in the function, analysis, modeling, and understanding of living systems at each of several scales, from the molecular through the cellular to the organ system and organism. Multiscale and translational examples develop conceptual skills necessary to design meaningful experiments, derive insight from journal reports, work within the group structure now essential for contemporary research, and communicate new developments and related findings to today’s peers and future students. Structural and developmental concepts are covered as they illuminate function.

Each module consists of multiple weeks. Typical weeks for modules CPBSB1 through 5 include two in-depth lecture-conferences that combine careful presentation of core material with student participation, and conclude with either a computational analysis and/or model, or a relevant illuminating article from the literature. The final module, CPBSB6, introduces new instructional modalities and perspectives designed to instill skills essential for researchers.

The six modules are:
- CPBSB 1: Membranes and cells (MAC)
- CPBSB 2: Protein function signaling and synthesis (PFSAS)
CPBSB 3: Control and communication in bodies and brains (CCBB)
CPBSB 4: Action and mechanical work from biochemical energy (ΔG)
CPBSB 5: Introduction to Computational Systems Biology (CSB)
CPBSB 6: Physiology of Systems and Diseases

Each module consists of multiple weeks. Each week includes two in-depth lecture-conferences that combine careful presentation of core material with student participation, and concludes with either a computational analysis and/or model, or a relevant illuminating article from the literature.

Course Director: Dr. Daniel Gardner

**Faculty Research Presentations - Quarters I-II (required):**
This course is required for all 1st year PBSB graduate students, but is open to all WGSMS students. Program faculty will introduce the research in their laboratories and discuss potential rotation and thesis projects.

Course Director: Dr. Emre Aksay

**Quantitative Understanding in Biology I-II, Quarters I-II: (required)**
This course will prepare students to apply quantitative techniques to the analysis of experimental data. To emphasize both practical and theoretical skills, the course will involve several hands-on workshops, and the completion of several projects will be required. Students will be well positioned to meet the emerging requirements of funding agencies for formally planned experiments and fully reproducible and documented data analysis methods.

Specific topics in Quantitative Understanding in Biology (QBio) I include: practical aspects of data formatting and management; graphical, mathematical and verbal communication of quantitative concepts; a review of statistics, with emphasis on the selection of appropriate statistical tests, the use of modern software packages, the interpretation of results, and the design of experiments; the formulation, evaluation, and analysis of mathematical models of biological function, with an emphasis on linear and non-linear regression, determination of model parameters, and the critical comparison of alternative models with regard to over-parameterization.

Qbio II further prepares students to apply quantitative techniques to the analysis of experimental data and the modeling of dynamic biological systems. In the two modules of this class, we explore dynamic biological systems. Both continuous- and discrete-time systems are treated, as are both linear and non-linear systems. Examples are taken from a spectrum of biologically relevant domains including population biology, genetic evolution, auditory processing, enzyme kinetics, and the dynamics of ion channels. To emphasize both practical and theoretical skills, the course will involve hands-on workshops, and the completion of two projects by the students will be required.

Course Directors: Jason R. Banfielder, MCh.E., Dr. Luce Skrabanek, and Dr. Derek Shore
**Critical Dissection of Scientific Data, Quarters III-IV: (Required)**

This course is required for all 1st and 2nd year PBSB graduate students, but is open to all WGSMS students. It is designed to train students in scientific presentation and critique. The structure is a formalized, in depth "journal club". Each 1st year student will choose a paper from a list provided by the Course Directors. Each 2nd year student will select a paper in their thesis field, subject to approval of the Course Directors. Each session will consist of a student formally presenting their selected paper to the class, which is expected to serve as a critical audience. The presentation should consist of an introduction of the relevant background literature, an objective presentation of the study, a subjective analysis/critique of the work, and suggestions for future work. Presentations by 2nd year students will be scheduled first, giving the 1st year students the opportunity to learn from their more senior colleagues. Grading will be based on presentation quality and contribution to constructive feedback.

Course Directors: Dr. Carl Blobel, Dr. Christopher Mason, and Dr. Crina Nimigean

**Core Principles of Molecular Biophysics, Quarters III- IV:**

This elective course will offer an introduction to a set of fundamental biophysical principles applicable to studies of protein structure/function, spectroscopy, membranes, and cell signaling. The curriculum will combine lectures, group problem sets, and paper discussions to cover a range of topics including two-state models, concepts in thermal and chemical equilibria, diffusion, and kinetics. Students will participate in paper discussions and problem set solutions along with faculty preceptors. The problem sets will follow a problem-based learning model (PBL) where students work together on problem sets involving data analysis, applications of concepts derived from the lectures, and introductions to several biophysical methods commonly used in biomedical research.

Course Directors: Dr. Alessio Accardi, Dr. Jeremy Dittman, Dr. Josh Levitz, and Dr. Joel Meyerson

**Principles of Biomedical Imaging, Quarters III-IV:**

This survey course will cover the basic physical, biochemical, computational, and engineering principles underlying current medical imaging techniques, including magnetic resonance imaging, positron emission tomography, radionuclide production and radiochemistry, optical imaging, x-ray computed tomography, and ultrasound. The goal of the course will be to provide students with a broad knowledge of the concepts and implementation strategies of various imaging methods relevant in current research and clinical practice. Practical applications will be used to illustrate the main themes of the course. Tours of the Biomedical Imaging Core Facility and other imaging laboratories will augment the formal course material. At the end of the course students will be able to identify appropriate imaging strategies for clinical research and have a working knowledge of the major techniques available to the investigator.

Course Director: Dr. Douglas J. Ballon
Principles of Medical Imaging, Quarters I-II:
This survey course will cover the basic physical, biochemical, computational, and engineering principles underlying current medical imaging techniques including: magnetic resonance imaging, positron emission tomography, radionuclide production and radiochemistry, optical imaging, X-ray computed tomography, and ultrasound. The goal of the course will be to provide students with a broad knowledge of the concepts and implementation strategies of various imaging methods relevant in current research and clinical practice. Practical applications will be used to illustrate the main themes of the course. Tours of the Biomedical Imaging Core Facility and other imaging laboratories will augment the formal course material. At the end of the course students will be able to identify appropriate imaging strategies for clinical research and have a working knowledge of the major techniques available to the investigator.

Course Director: Dr. Yi Wang
Prerequisite: Calculus based physics is required.
NOTE: This course is video conferenced from Ithaca most of the time.

Quantitative Genomics and Genetics, Quarter III-IV:
A rigorous treatment of analysis techniques used to understand complex genetic systems. This course will cover both the fundamentals and advances in statistical methodology used to identify genetic loci responsible for disease, agriculturally relevant, and evolutionarily important phenotypes. Data focus will be genome-wide data collected for association, inbred, and pedigree experimental designs. Analysis techniques will focus on the central importance of generalized linear models in quantitative genomics with an emphasis on both frequentist and Bayesian computational approaches to inference.

Course Director: Dr. Jason G. Mezey
NOTE: Taught on both the Ithaca and Weill campus by video-conference

Clinical and Research Genomics, Quarter III-IV:
In this course, students will build a strong foundation of knowledge of high-throughput and NGS technologies (both existing and emerging), learn the applications of these technologies for basic and clinical research, and finally learn the essential tools for the analysis, integration, and application of these data relative to other public databases and phenotype repositories. Students will learn, first-hand, how to analyze and integrate data from: whole genome sequencing, RNA-sequencing, epigenome data (RRBS/ATAC-seq), proteomics data (LC-MS), microbiome, metagenomic, and cancer data, and then compare them to public repositories.

Course Director: Dr. Christopher Mason

Mathematical Structures in Neuroscience, Quarters III-IV:
The course will present a range of mathematical approaches that play a central role in systems neuroscience, both for model-driven and data-driven investigations. We will take an approach beginning with the mathematical fundamentals, and emphasize concepts rather than theorems.
Typical topics include time series analysis, linear and nonlinear systems theory, point processes, dimension reduction techniques, and information theory; these can be tuned to the needs of the group. For topics, notes, and homework problems from previous years, please see:

- http://www-users.med.cornell.edu/~jdvicto/mathcourse1011.html
- http://www-users.med.cornell.edu/~jdvicto/mathcourse0809.html

Course Director: Dr. Jonathan Victor
Prerequisite: Familiarity with matrices and basic linear algebra, complex numbers, and calculus, preferably multivariate.

NOTE: Offered alternating years.

ELECTIVES OF INTEREST IN RELATED PROGRAMS:

- Analysis of Next-Generation Sequencing Data
- Applied Machine Learning
- Data Mining and Statistical Learning
- Data Structures and Algorithms for Computational Biology
- Dynamical Models in Biology
- Functional Interpretation of High-Throughput Data
LABORATORY ROTATIONS

Laboratory rotations are an important part of the graduate program at Cornell, giving students the opportunity to experience different research projects and allowing the faculty to assess the interests and aptitude of the students. Each student is required to rotate through 3 laboratories, each rotation lasts approximately 9-12 weeks.

At minimum, two laboratory rotations will be undertaken with PBSB program faculty.

To facilitate and optimize the rotation experience for both the student and faculty, it is important that they meet prior to the start of the rotations to discuss expectations, goals, requirements and laboratory guidelines.


**PBSB ADMISSION TO CANDIDACY EXAM (ACE) REQUIREMENTS AND PROCEDURES**

(Document version: 2014-12-16)

**Document relevance**

This document details the Admissions-to-Candidacy Examination Guidelines of the Physiology, Biophysics, and Systems Biology (PBSB) graduate program. The guidelines in this document summarize and expand upon those detailed in Section X.C of the Weill Graduate School Code of Legislation and the form entitled *Regulations for the Admission-to-Candidacy Examination*. Clarification should be sought from the PBSB Program Coordinator about any perceived conflict between these three documents. Tri-I students under the umbrella of the PBSB program should also follow these guidelines, except where noted by their respective Tri-I program.

**Prerequisites**

Prior to taking the ACE, the student must have satisfied all course requirements established by the PBSB Program. Any exceptions must be approved by the Program.

**Timing**

There are three key dates for progressing through the ACE:

- By January 31st of the student’s second year in graduate school, the student must have
  a) formed their ACE committee
  b) received approval from their committee on the ACE topic and the Specific Aims page of their ACE.
- By April 30th of the same year, the student must have received approval from the ACE committee on the Written portion of the ACE.
- By June 30th of the same year, the student must have taken the Oral component of the ACE examination.

Failure to meet any of these deadlines results in the student being placed on probation for a period of three months, except in extenuating circumstances as approved by the Dean. Probation is lifted, and "good-standing" is restored, by proceeding to the next stage of the ACE process. If the student does not meet requirements at the end of the three-month period, the student will be dismissed from the graduate school unless the Dean chooses to extend the probationary period.

**Structure**

The ACE consists of a tutorial study program resulting in a written research proposal and an oral component.

- The purpose of the ACE exam is to demonstrate that the student has attained a breadth of knowledge and depth of understanding commensurate with the high standards of the Doctor of Philosophy, and that the student is prepared to
undertake full time thesis research. Accordingly, this examination should be a rigorous and meaningful determination of the student’s ability to employ and interpret information in an area of specialization and in a more general context.

- The proposal to be defended can either be ‘on thesis’ or ‘thesis related’. On thesis proposals will cover the student’s progressing and planned thesis work. Thesis related proposals will present and defend a research plan that is on a subject related to the student’s thesis project. The determination of which ACE examination format will be completed is made by the student. Tri-I students should consult with their respective programs for specific guidance.
- For ‘on thesis’ examinations, recognize that although preliminary data is not required, proposals with technical novelty will need to defend feasibility.

Committee

The ACE committee will be comprised of one ACE Committee Chairperson, to be selected by the Program, and at least three examiners to be selected by the student. Additional examiners are permitted and may be requested by the student, the committee, the Program, or the graduate school. Typically, one of the examiners will be the student’s thesis advisor (note that the thesis advisor may not also serve as the Chairperson). Every member of the ACE committee must be a member of the Weill Graduate School faculty, unless otherwise allowed by the Dean’s office. Exceptions for Tri-I students are automatically approved as detailed in the Regulations for the Admission-to-Candidacy Examination.

During the written process, committee members are expected to provide some guidance; however, committee members may not write or be directly responsible for any part of the proposal. It is expected that the committee members be available for discussion and feedback on the proposal details. The committee members are encouraged to provide feedback and critique at the level that they would when writing summaries for R01 reviews.

During the oral process, committee members are free to pose any question commensurate with the aims of the ACE, but are not free to provide answers or direct guidance. The thesis advisor is also free to ask questions. The Chairperson is responsible for ensuring the fairness of the questioning.

Exam Introduction

As the first step of the examination, the student should discuss with their advisor the format of the ACE to be followed and the topic to be defended. The student should then formulate a one page, specific-aims summary of their proposal. The student should then use this aims page as an introduction to their project as they seek to identify committee members. Once the committee is defined, the student should ideally organize a pre-meeting with their committee to formally introduce the project and discuss any amendments to the plan. The purpose of this meeting is largely to determine if the scope of the ACE proposal is appropriate. Once the committee agrees that the aims and plan are well chosen, the student should commence with writing the ACE exam. If a
full committee meeting cannot be scheduled in a reasonable timeframe, the student should seek similar guidance through individual meetings with each committee member. As specified above, this first step must be completed by January 31st of the student’s second year in graduate school.

**Written exam**

The student should take ~2 months to complete the written portion of the examination. The proposal must follow the format of a NIH R01 research grant proposal. The written research proposal should be no more than 12 pages in length (excluding the title page, 12 pt. font, single spaced, 1” margins), including figures, but not counting references. The proposal will consist of:

1. Title page (Title, Advisor, Committee)
2. Specific Aims - State the problem to be addressed and the specific aims of the proposed research. The importance of the problem at the molecular, cellular and organismal levels should be discussed. If pertinent, it is important to address the possible clinical relevance. (required length: 1 page)
3. Research Strategy - Significance: General background, significance in terms of basic science and disease relevance.
4. Research Strategy – Innovation: Explain how your proposal differs from what others have tried.
5. Research Strategy – Approach: More specific background information. Describe in detail the experimental design and research methods to be used. Technical hurdles to be overcome should be mentioned. Alternative approaches should be given for experiments that may not be feasible. Discussion of expected or possible results and their interpretation. Best format for each specific aim: a) rationale, b) methods, c) expected results, d) alternatives. Theory aims should follow a similar structure where possible.
6. References should be comprehensive and cited in full at the end of the entire proposal. Avoid leaning too much on review articles; expect to get questions on the primary literature.


The student should consult with the members of the ACE Committee while preparing drafts of the proposal. Once the committee receives the proposal, members are obligated to read and evaluate the proposal within two weeks. Committee members can approve the proposal as written or request revisions and resubmission. Before the oral component can be scheduled, all committee members must approve the written proposal through communication with the Program Coordinator. Each member of the committee is encouraged to provide the student with a short written critique of the proposal.

Note that if the student is seeking a terminal Master’s degree, they should alert the committee of this intention by the time they have submitted their written proposal.
such cases, once the committee gives the written a “Pass for Master’s” designation, the Oral examination may be scheduled.

**Oral exam**

After the written proposal has been approved by the committee, the oral examination should be formally scheduled with the Graduate School office. The formal scheduling must occur at least two weeks in advance of the oral examination date.

At the start of the Oral exam, after all members are convened, the student will be excused from the room. During this time, the committee will discuss the student’s academic process, the written ACE exam, and any other pertinent issues.

The oral examination will then continue with a presentation by the student describing the salient features of the written proposal. The prepared presentation should be 45 to 60 minutes, but it may last longer if the committee chooses to ask extensive questions during the presentation. During, and/or after the presentation, the committee will question the student. The committee’s questions will likely focus primarily on the significance of the problem addressed, the basic biological principles governing the problem, and the logic of the experimental approach used. Furthermore, the committee will probe the student’s knowledge of the relevant scientific areas (thus, any question is “fair game”), thereby ensuring that the student is an appropriate doctoral candidate in the PBSB program.

When the discussion has concluded, the student will again be excused from the room. The committee will discuss and vote on the exam according to the rules of the Graduate School. The committee will make a written evaluation of the student, which will be forwarded to the Graduate School by the committee chairperson. The committee will convey the assessment to the student before the committee disperses. At a later date, the student will receive a comment of the committee’s written comments (but not the voting).

**Grading**

*Passed exam:* Handshakes, hugs, kisses … now get to work!

*Tabled exam:* If, according to the voting rules of the Graduate School, the ACE committee tables the student’s ACE exam, the student must attempt to correct deficiencies as specified by the committee within one year, or according to a time frame established by the Committee.

*Pass for Master of Science:* The PBSB ACE rules for Master’s degrees are as defined by the Graduate School. If the student has already indicated during the written stage that they are seeking a terminal Master’s degree, the committee’s evaluation of a successful Oral examination will be that of “Pass for Master of Science.” Alternatively, if the committee, before or during the examination, comes to the conclusion that the
student is not a suitable candidate for the PhD, the Master’s degree may also be granted.

*Failed exam:* If, according to the voting rules of the Graduate School, the ACE committee determines that a student has failed her/his ACE exam, then the student will be dismissed from the graduate school. Appeals may be filed with the Dean’s office.

**Formal Feedback**

After the examination, the Chairperson will provide written feedback to the student and the Program summarizing the Committee’s evaluation of the strengths and weaknesses of the student’s proposal, presentation, and overall preparedness for proceeding with full-time thesis research. Where possible, the Chairperson should summarize specific suggestions and resources available for improvement.
When you are listed as an author on a publication or abstract, please be sure to acknowledge your WCGS Program.

For example: "<student name> is a member of the Physiology, Biophysics and Systems Biology (PBSB) Graduate Program, Weill Cornell Graduate School, New York, NY."

Of course, acknowledging membership in your mentor’s department/center/institute is also appropriate. Also, if you have received T32, F31, NSF, or other individual funding that should also be acknowledged.
PHYSIOLOGY, BIOPHYSICS AND SYSTEMS BIOLOGY
A Program in the Quantitative Biomedical Sciences

PROGRAM OVERVIEW
The central mission of the Physiology, Biophysics, and System Biology (PBSB) program is to educate and train doctoral students who use quantitative experimental, computational, and theoretical approaches to advance biomedical research.

COMPONENTS:

1 Physiology
The study of structure-based function and dynamics in cells, tissues, and organs.

2 Biophysics
The development of experimental and computational methods enabling the application of principles of physics to the study of biological structures and processes.

3 Systems Biology
The collection and organization of massive experimental data for a quantitative understanding of interactions between the genomic, molecular, cellular, and tissue components of organisms.

Required Courses
- Contemporary PBSB: Cells, Systems, and Quantitative Methods
- Critical Dissection of Scientific Data
- Faculty Research Presentations
- Quantitative Biomedical Sciences Seminars
- Quantitative Understanding in Biology
- Responsible Conduct of Research

Elective Courses
- Analysis of Next-Generation Sequencing Data
- Biomedical Machine Learning
- Clinical and Research Genomics
- Core Principals of Molecular Biophysics
- Data Structures and Algorithms for Computational Biology
- Dynamical Models in Biology
- Functional Interpretation of High-Throughput Data
- Mathematical Structures in Neuroscience
- Molecular Mechanisms of Membrane Transport
- Principles of Biomedical Imaging
- Quantitative Genomics and Genetics

Application
All applications and materials can be submitted online at http://bit.ly/WCGS-Apply

gradschool.well.cornell.edu

WCGS Overview
- Collaboration of two leading research institutions – Weill Cornell Medical College (WCMC) and Sloan-Kettering Institute (SKI)
- Over 285 research faculty members, selected for their research excellence and academic mentorship

Why WCGS?
- Research: Join researchers in leading laboratories making fundamental discoveries in biology, and translating them into new ways to understand and treat diseases.
- Stipend: $41,000 per academic year, full tuition scholarship and subsidized housing
- Location: New York City’s Scientific Corridor on the Upper East Side
PHYSIOLOGY, BIOPHYSICS AND SYSTEMS BIOLOGY

The course of study in the PBBS program is organized into modular courses and seminars offering education at the conceptual level, as well as in the experimental and computational tools of the component disciplines (physiology, biophysics and systems biology). Advanced methods of imaging and structure determination, quantitative modeling of physiological processes and the application of computational biology and genomics to medicine are emphasized.

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<th>Timeline</th>
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<td>Lab rotations</td>
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<td>Select research focus and Special Committee (thesis mentor plus two other faculty member experts in relevant research field)</td>
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<td>Complete two electives</td>
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<td>Submit PhD thesis description</td>
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<td>Develop PhD thesis</td>
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Links
To Apply: http://bit.ly/WCGS-Apply
Questions? WCGS-Admissions@med.cornell.edu

Faculty
More than 50 PBBS faculty members, who are members of Weill Cornell Medicine and the Sloan-Kettering Institute, representing our multidisciplinary research teams with appointments in various departments, centers and institutes, including the Meyer Cancer Center, the Institute for Precision Medicine, the Institute for Computational Biomedicine, and the Brain and Mind Research Institute.

Careers
WCGS is greatly focused on student outcomes and postgraduate career opportunities. We regularly host visits and talks by alumni, recruiters and career advisors, to discuss career opportunities and to help you develop the skills you need to succeed when looking towards your next steps. In addition, WCGS sponsors a Career Pathways Seminar series and is a sponsor of the Tri-Institutional Career Symposium and What Can you Be with a PhD? Career Symposium. Graduates typically go on to postdoctoral and research associate positions at top-tier laboratories before embarking on careers in fields such as academia, pharma, biotechnology, consulting, government work, and patent law.