



HARVARD UNDERGRADUATE EDUCATION

IN THE

Life Sciences



Harvard College Undergraduate

HCURA

Research Association

The Second Annual
Life Sciences
Undergraduate
Research Fair

Abstracts
November 10th, 2011

www.lifescience.fas.harvard.edu

www.hcura.org

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Life Sciences
Education Office

Harvard College
Undergraduate
Research Association



Thursday, November 10th, 2011

Dear Harvard Undergraduates,

On behalf of the Life Sciences Education Office and the Harvard College Undergraduate Research Association (HCURA), we would like to welcome you to the inaugural Life Sciences Undergraduate Research Fair!

Harvard is committed to ensuring that every undergraduate who wants to engage in research in the Life Sciences has the opportunity to do so. The purpose of this fair is to provide you with a chance to learn about the wide range of ongoing research projects in the life sciences at Harvard and meet people from a variety of potential labs. In addition to the labs, representatives from several undergraduate research fellowship offices will be present to answer your questions.

We should note that while we have a broad range of research laboratories presenting their work today, there are several hundred other labs open to Harvard undergraduates that are not here; this is just a taste of the possibilities. Also, keep in mind that some of the labs presenting posters today may not have openings for undergraduates this year, but they are dedicated to undergraduate research for the future.

Finally, on behalf of the Life Sciences Education Office and HCURA, we wish to express our sincere thanks to all those who are presenting posters and fellowship information at this Fair today. Without their support for undergraduate research, we would not be able to offer Harvard students the crucial lab experiences that significantly enrich their academic careers.

Sincerely,

Ann Georgi, Tamara Brenner, and Rob Lue
Life Sciences Education Office

Tony Shen and Janet Song
Co-Presidents, HCURA

UNDERGRADUATE RESEARCH IN THE LIFE SCIENCES: FAQs

Is it easy to get involved in research?

Yes, many opportunities are available for undergraduates interested in the Life Sciences to get involved in research at Harvard. There are more than 500 research laboratories at FAS, Harvard Medical School, the Harvard School of Public Health, and the many hospitals affiliated with Harvard University, which provide an enormous range of projects for undergraduates. Students may do research during term time, over the summer, or both.

Is previous lab experience necessary?

No, the majority of labs do not expect students coming in to have had previous experience. They are prepared to train new students in the skills that will be needed to carry out independent research projects.

When should I start working in a lab?

It depends many individual factors; there is no single answer to this question. Generally students should not begin working in a laboratory until the second semester of freshman year so that they have some idea of the time commitments of their course load, have found their extra-curricular activities and have generally settled into life at Harvard. Some students want to get started freshman year, but many wait until spring of sophomore year or even later. However, students who are planning to do a thesis should be working in a lab by the beginning of fall semester of their junior year.

How do I find a position in a lab?

There are many ways to begin searching for a research laboratory. You can start by making an appointment to talk with Ann Georgi. If you already have some idea of what area of research interests you, then you can begin by browsing the faculty profiles and lab descriptions on the department websites. The Research tab on the Life Sciences web page provides links to all the major research departments at FAS, as well as departments at Harvard Medical School, the School of Public Health and the affiliated hospitals. Once you have found a few labs whose work seems interesting, you can meet with Ann Georgi to discuss how to approach the faculty about a lab position or proceed on your own. The Life Sciences website also provides information about how to write a science resume and email the Principle Investigator of the lab.

Can I receive academic credit for working in a lab during the term?

Yes, although the number of semesters of credit varies among the concentrations. Check with your concentration advisor or the Student Handbook for specific requirements for your concentration.

Is it possible to get paid for research during term time or the summer?

There are many funding opportunities available for summer research. See Ann Georgi in the Life Sciences Education Office for information. There is limited funding available for term time work through the Harvard College Research Program, HCRP, which is managed through the Student Employment Office. If you are eligible for Federal Work/Study, funding is available for both summer and term time work. The Faculty Aid Program is another possible source of support for work during the term. It is important to note that you may not get paid and receive academic credit for lab work during the same semester.

Where can I go for advice on getting started?

The undergraduate research advisor for Life Sciences is Ann Georgi. It is best to email her (ageorgi@fas.harvard.edu) to arrange an appointment. Her office hours are 11:00-5:00 on Monday, Tuesday and Thursday and 9:00-12:00 on Wednesday; her office is located in the BioLabs Room 1087. For more information on finding a research position, links to departmental web sites, and funding information, check out the Research section of the Life Sciences web page, <http://www.lifescience.fas.harvard.edu>.

A Note on Acronyms:

FAS = Faculty of Arts and Sciences (labs located in Cambridge)

LMA = Longwood Medical Area

HMS = Harvard Medical School

HSPH = Harvard School of Public Health

HSCI = Harvard Stem Cell Institute (labs in
Cambridge or at the Longwood Medical Area)

MGH = Massachusetts General Hospital

BIDMC = Beth Israel Deaconess Medical Center
(at the Longwood Medical Area)

SEAS = School of Engineering and Applied Sciences

MCB = Molecular and Cellular Biology

CPB = Chemical and Physical Biology

OEB = Organismic and Evolutionary Biology

HEB = Human Evolutionary Biology

CSB = Computational and Systems Biology

IDI = Infectious Disease and Immunology

ABSTRACTS

LSURF 2011

PSYCHOLOGY

Prof. Felix Warneken – Psychology – FAS

Poster #1, 2

Human social life involves complex interactions between individuals working together. For example, even a very simple interaction like holding a door open for another person requires understanding what that person wants, as well as a desire to help them. Other interactions, such as building a monument, requires that larger groups divide their labor and work together to achieve a joint goal. Although these types of helping and collaborative behaviors are common in humans, they are not in other species. How and why do humans cooperate in these various ways—and what cognitive skills allow them to do so? Our research group addresses this broad question in three ways:

- What are the earliest forms of cooperation? A major focus of our research concerned the cooperative abilities of very young children. Does human-like cooperation require language or extensive moral education? Research thus far indicates that infants in the second year of life already engage in various forms of altruistic behaviors such as helping others with their problems or sharing resources with them, suggesting that human infants may have a biologically based predisposition for altruism.
- What factors shape cooperation across development? Although young infants do cooperate in variety of contexts, their behavior also differs from that of adults in many ways. What allows children to cooperate in more adult-like fashion? This aspect of our research focuses on the impact of factors like moral instruction and understanding of norms on cooperation in childhood.
- What is the evolutionary basis of human cooperation? Developmental research by our group is complemented by collaborative projects examining our closest living primate relatives, the great apes. Such research is crucial to disentangle the aspects of human cognition that are unique, and to date few such studies have examined cooperative abilities in other apes. So far, our research suggests that some forms of human-like cooperation—such as helping out others in need—to appear to be shared with chimpanzees.

NEUROBIOLOGY

Prof. Corinne Augelli-Szafran – Neurobiology – HMS/ LEAD - Laboratory for Experimental Alzheimer Drugs

Poster #3

Alzheimer's disease (AD) is an irreversible and progressive brain disease that ultimately leads to a severe loss of mental function. It affects more than 5 million Americans. The current marketed drugs for AD only ease symptoms associated with AD. No drug prevents or slows the progression of this disease. The current focus for AD drug therapy is targeting the underlying AD pathology, particularly the overproduction and aggregation of beta-amyloid proteins, proteins that are proposed to be pivotal factors in the cause of AD. Such disease-modifying AD drugs are being vigorously pursued by the pharmaceutical industry and academic groups. The Laboratory for Experimental Alzheimer Drugs (LEAD) at Harvard Medical School and Brigham and Women's Hospital is one of the first medicinal chemistry drug discovery groups within the medical school and hospital environment. LEAD was founded and is directed by world-known scientists with decades of experience in deciphering Alzheimer's disease. Over the past few years, LEAD's research has been focused on the identification of small drug-like molecules that can selectively modulate a key enzyme (gamma-secretase) in the AD pathology. The LEAD group has made significant progress towards the discovery of novel disease-modifying agents that target this enzyme as a potential therapy for the treatment of Alzheimer's disease. Patent applications have been filed on novel drug molecules founded by LEAD scientists and proof-of-concept experiments in animal models were conducted. LEAD scientists continue to vigorously work on the optimization of the pharmacological and pharmaceutical properties of potential drug candidates using modern medicinal chemistry and pharmaceutical and biomedical approaches.

Prof. Elizabeth Engle – Neurobiology – HMS/LMA

Poster #4

The Engle lab uses a combination of genetic and neurobiological approaches to understand the etiology of congenital cranial dysinnervation disorders (CCDDs). CCDDs appear to arise from the improper growth or guidance of certain cranial nerves, or populations of motor neurons that originate the brainstem and send axonal branches to innervate muscle targets that control movement of the eyes, face, and tongue. This results in abnormal eye movement and facial weakness, occasionally concurrent with other symptoms. The lab has discovered multiple human CCDD disease genes whose normal function is essential for the proper development of specific groups of cranial nerves. Current projects involve both identifying new genes that are critical for cranial nerve development and using mice that harbor the identified genetic mutations to study the neurodevelopmental etiologies and cellular/molecular mechanisms underlying CCDDs.

Prof. Ole Isacson – Neurobiology – HMS/McLean

Poster #5

Our goal is to advance therapies for Parkinson's disease, Amyotrophic Lateral Sclerosis, Alzheimer's disease, Huntington's disease and related disorders. We develop innovative approaches to protective, restorative, regenerative and anti-inflammatory medicine for these neurodegenerative diseases by using cutting edge research in the fields of virus-mediated gene therapy, stem cell biology and drug screening. By testing these potential therapeutic interventions in a broad range of disease models, we provide a highly collaborative environment for talented undergraduate students to investigate new leads for discoveries.

Prof. Gabriel Kreiman – Neurobiology – HMS/LMA

Poster #6, 7

The Kreiman laboratory combines theory, psychophysics and neurophysiology to further our understanding of the neural mechanisms underlying vision, cognition and memory. Our interdisciplinary group includes people from Physics, Math, Engineering, Biology and Psychology. For publications and more information, see <http://kreiman.hms.harvard.edu>

Prof. Matthew LaVoie – Neurology – HMS/LMA

Poster #8

The overall goal of the LaVoie lab is to understand the mechanisms underlying the spontaneous neurodegeneration that occurs in Parkinson's disease (PD). In the LaVoie lab, we consider not only the inherited gene mutations that cause rare familial forms of PD, but also focus on the more common sporadic form of the disorder. Our study of familial PD is centered on pathogenic mutations in the Parkin and LRRK2 genes. Our examination of idiopathic PD focuses on novel models of mitochondrial dysfunction and oxidative stress. We employ a wide range of in vitro methodologies including protein biochemistry, cell biology, and molecular biology and this work is complemented by our current efforts to characterize multiple PD mouse models.

Prof. Diego Pizzagalli – Neuropsychology – HMS/McLean

Poster #9

The Center for Depression, Anxiety and Stress Research (CDASR) uses an interdisciplinary approach to investigate the psychological, environmental, and neurobiological factors implicated in affective disorders. Scientists in the Center use multi-modal imaging, computational modeling, and molecular genetics to study anxiety and depression, while also developing novel programs for the prevention and treatment of mental illness. The CDASR is located in the deMarneffe Building at McLean Hospital, which is the largest psychiatric facility of Harvard Medical School. Combining outstanding facilities with world class clinical care, McLean and the CDASR provide a unique mix of cutting-edge research opportunities focused on the neurobiology of mental illness.

Prof. Paul Rosenberg – Neurobiology – HMS/LMA

Poster #10, 11

In our first line of research, we seek to understand the cellular and molecular mechanisms underlying brain injury, with a special interest in injury to the developing human brain and in neurodegenerative diseases, particularly Huntington's disease. Glutamate transporters play an important role in protecting the brain against injury caused by excess activation of glutamate receptors. We are investigating how expression and function of the brain's major glutamate transporter, GLT1, is regulated at normal synapses and how GLT1 function, as well as the function of other transporters, is compromised in acute and chronic neurodegenerative diseases. In addition, we are working to characterize pathways of programmed cell death in neurons and oligodendrocytes.

In our second line of research, we are investigating the biochemical and molecular basis of behavioral state regulation, with a particular focus on the role of nitric oxide and adenosine in regulating behavioral states (sleeping and waking).

Prof. Jordan Smoller – Neurodevelopmental Genetics - HMS/MGH

Poster #12

The Psychiatric and Neurodevelopmental Genetics Unit (PNGU) was inaugurated in 2001 for the express purpose of enhancing the application of genomics to the study of psychiatric and neurodevelopmental diseases. The mission of PNGU is to identify the role of genetic factors in the etiology of psychiatric, neurodevelopmental, and behavioral disorders, examine the contributions of non-genetic or environmental factors, as well as risk and protective factors, and to develop approaches to gain a more complete understanding of the expression of these disorders.

PNGU is located in the Richard B Simches Research Center of the Massachusetts General Hospital in Boston and is affiliated with Harvard Medical School. Research studies are conducted in collaboration with clinicians at Massachusetts General Hospital, McLean Hospital, Harvard Medical School, the Broad Institute and many centers worldwide.

**Prof. Robert Stickgold – Neurobiology/
Physiology – HMS/LMA**

Poster #13

The Center for Sleep and Cognition (Bob Stickgold, PI) investigates sleep-dependent aspects of cognition, focusing on the roles of sleep and dreaming in off-line memory and emotional reprocessing. In examining the role of sleep in cognitive processes, our work has helped to define, delineate, and demonstrate sleep's role in perception, learning, memory, and emotions, focusing on sleep as a process that evolved to enhance the consolidation and integration of memories. We have extensive programs studying the relationship of dreaming to these processes, and the dysfunction of these systems in a variety of psychiatric and neurologic conditions. Undergraduates working in the lab have been coauthors on papers published in *Science*, *Biological Psychiatry*, *Nature*, *Nature Neuroscience*, *Neuron*, and *Learning and Memory*.

Prof. Jeffrey Macklis – Neurobiology/Stem Cell – HMS/FAS

Poster #37, 38

Jeffrey D. Macklis' laboratory is directed toward both 1) understanding molecular controls over neuron subtype specification and development in the cerebral cortex, and 2) applying developmental controls toward brain and spinal cord repair—specifically, the cellular repair of complex cerebral cortex and cortical output circuitry (in particular, corticospinal motor neuron (CSMN) circuitry that degenerates in ALS and other “upper motor neuron” degenerative diseases, and whose injury is centrally involved in loss of motor function in spinal cord injury). The Macklis lab focuses on neocortical projection neuron development and subtype specification; neural progenitor / “stem cell” biology; induction of adult neurogenesis (the birth of new neurons from within); and directed neuronal differentiation and development of connectivity via molecular manipulation of neural progenitors within murine neocortex (cerebral cortex).

MOLECULAR AND CELLULAR BIOLOGY

Prof. Mike Blower – MCB – HMS/MGH

Poster #14

The Blower lab studies the interplay between RNA localization and spindle assembly during mitosis in cell-free extracts derived from eggs of the frog *Xenopus laevis*. The lab has shown that RNA is required for proper spindle assembly and chromosome alignment within spindles. However, the requirement for RNA is not due solely to the need for protein production during metaphase. We are currently investigating non-coding functions for RNA—such as structural and catalytic roles-- in regulating proper spindle assembly. Secondly, we have found that many different mRNAs are localized to spindle microtubules during mitosis, especially mRNAs that code for proteins involved in mitotic functions. Other work in the lab focuses on elucidating the RNA signals that direct microtubule localization, and the protein factors responsible for transport and anchoring of selected RNAs on microtubules. RNA localization and functions of non-coding transcripts are also being studied during oocyte maturation and embryo development.

Prof. Thomas Michel – MCB – HMS/LMA

Poster #15

My laboratory studies the regulation of interesting signaling proteins in the cardiovascular system using biochemical and cell imaging approaches. We have focused on the nitric oxide synthases, a family of enzymes that synthesize the free radical nitric oxide. Important drugs such as nitroglycerin are metabolized in the body to form nitric oxide. Endogenously synthesized nitric oxide is a key messenger molecule involved in essential physiological processes. The nitric oxide synthase isoform in vascular endothelial cells undergoes a complex series of covalent modifications, including N-myristoylation, phosphorylation, S-nitrosylation, and thiopalmitoylation. These post-translational modifications modulate the subcellular targeting of the nitric oxide synthase enzyme to specialized signal-transducing domains in the plasma membrane termed caveolae. The lipid-lowering drugs called statins affect nitric oxide synthase signaling, and nitric oxide pathways are impaired in diseases such as diabetes. Greater understanding of the molecular regulation of nitric oxide signaling pathways may lead to the identification of new points for therapeutic intervention. Over the years, many undergraduates in MCB and CPB have pursued their thesis research projects in my lab, studying fundamental aspects of this fascinating and biochemically complex signaling system.

Prof. Winston Kuo – Translational Medicine – HMS/LMA

Poster #16, 17

An integral part of Harvard Catalyst, the HC-LITT accelerates the translation of laboratory research in therapeutics and diagnostics into the clinic. The HC-LITT model brings together innovative translational technologies (i.e., cell-based imaging, genomics, metabolomics, proteomics, sample preparation and sequencing) in one location and makes them available to investigators from diverse disciplines who share a common goal of addressing questions with human translational impact. HC-LITT has two broad operational functions: 1) Benchmarking of methodologies/technologies Benchmarking provides both the community with an introduction to leading-edge technology and methods creating the environment to test, improve and validate, laying the groundwork for the second function, clinical diagnostic assay/biomarker development. Broadly, benchmarking encompasses the planning phase (with investigators and industry), the acquisition of technologies and the launch of cross-platform evaluation studies. 2) Diagnostic assay/biomarker discovery to development. This comprises the process from 'proof of principle' to production. <http://catalyst.harvard.edu/services/litt/>

Prof. Rachelle Gaudet – MCB – FAS

Poster #18, 19

My lab is broadly interested in the mechanisms of signaling and transport across cellular membranes. Our research is centered on four protein families: TRP channels important to many sensory signaling events; non-classical cadherins involved in adhesion and signaling; ABC transporters that use the energy of ATP binding and hydrolysis to fuel the transport of substrates like short peptides across membrane; and Nramp transporters that use a proton gradient to facilitate the entry of divalent ions (iron and manganese in particular) into cells. Two overall biological themes are encompassed by these proteins: sensory perception (touch and hearing in particular) and immunology.

We use a combination of x-ray crystallography, biophysical and biochemical techniques, and functional assays to study these proteins. The overall goal is to determine the three-dimensional atomic structure of the proteins of interest and understand how their structure enables them to perform their cellular function. We have a particular interest in multidomain proteins and how the individual structure and properties of each domain is integrated to shape the function of the whole protein.

Prof. Philippe Cluzel – MCB – FAS

Poster #20

The Cluzel laboratory studies the impact of noise and heterogeneity on gene regulation in bacteria at the single cell level. We are developing novel imaging methods to reveal both protein and RNA dynamics in living cells and novel microfluidic methods to allow these measurements to be done in massive parallel.

CELL BIOLOGY

Prof. David VanVactor – Cell Biology – HMS/LMA

Poster #21

Neuronal growth cones face a complicated embryonic landscape with many types of extracellular guidance information. Although much progress has been made by many labs in identifying both secreted and cell surface guidance factors and their receptors, much less is known about the intracellular machinery that translates this information into specific and reproducible guidance behavior. Since this is fundamentally a problem of leading edge motility and cell movement, we have concentrated part of our effort on understanding the proteins that control cytoskeletal dynamics in the growth cone. Our ultimate goal is to understand the signaling pathways, from cell surface to actin polymer network to microtubule arrays, that growth cones use to accurately interpret guidance information and execute directional outgrowth. After a growth cone reaches the appropriate destination, it must construct a specialized cellular junction or synapse in order to communicate with its target cell in a functional circuit. Our studies of the LAR receptor phosphatase led us to the discovery that the LAR pathway regulates synaptic growth and the morphogenesis of the active zone – a structure that orchestrates neurotransmitter release at chemical synapses. We have defined factors upstream and downstream of LAR in this context, and the machinery appears to be highly conserved. In addition, we find that this pathway is under the regulation of genes linked to human mental retardation, suggesting a molecular model for disorders of cognitive dysfunction.

Tyrosine Kinase Coordination of Actin and Microtubule Cytoskeletal Dynamics

The accurate navigation of axons along stereotyped pathways *in vivo* requires coordination of the key effector systems that control growth cone motility. The Abl family of conserved intracellular tyrosine kinases act downstream of multiple classes of axon guidance factor receptors. Genetic screens for Abl effectors in *Drosophila* identified the both actin regulatory factors and the microtubule plus-tip interacting protein (MT+TIP) CLASP as a protein required for Abl function *in vivo*. Our subsequent biochemical and functional studies showed that CLASP associates with and is phosphorylated by CLASP in mammalian cells, suggesting conservation in the guidance machinery. We have used genetic and proteomic tools to define a network of functional partners for CLASP, and find not only additional MT+TIPs, but also MT-actin cross-linking factors suggesting that CLASP and Abl are involved in the coordination of the two major polymer systems.

MicroRNA Regulation of Synapse Development

Much has been learned about the signaling pathways and networks of proteins that function together to build and modulate synaptic connections. This rich molecular landscape is under the control of multiple classes of regulatory factors. MicroRNA are versatile posttranscriptional regulators capable of tuning levels of gene expression across a large number of target genes. Through genetic screens in *Drosophila*, we have discovered that synapse formation and growth are controlled by the conserved microRNA miR-8, a factor that orchestrates different stages of synapse development through distinct sets of direct and indirect targets. Having recently created a means of selectively inhibiting the function of any microRNA with spatio-temporal precision *in vivo*, we are now equipped to survey the functions of all.

COMPUTATIONAL AND SYSTEMS BIOLOGY

**Prof. John Quackenbush – Computational Biology
and Functional Genomics – HSPH**

Poster #22, 23

Genomics has revolutionized biology, but not in the ways that many scientists initially envisioned. While reference genome sequences and catalogues of genes are useful starting points for understanding development and disease, the tools and technology spawned by the genome project have had a far greater impact. The Computational Biology and Functional Genomics Laboratory at Dana-Farber focuses on the application of functional genomics techniques—including gene expression and chromosomal microarrays, ultrahigh-throughput sequencing (UHTS), proteomics, and metabolomics—and the development of computational approaches to support studies seeking to gain a comprehensive view of human diseases including cancer. Our goal is to develop software, databases, and bioinformatics techniques that will allow us to develop new diagnostics and a more complete understanding of the cellular networks that are responsible for human phenotypes and which are disrupted in a wide range of diseases.

To enable this work, and to facilitate the development of new methods, our group has developed a large number of analytical software tools and public databases. For example, MeV is a java-based desktop software package that provides sophisticated analytical tools for genomic data in an intuitive, user-friendly form. GeneSigDB, is the world's most comprehensive database of published gene signatures, allowing us and other scientists to tap into the wealth of published analyses of genomic data. And the Predictive Networks web application enables interactions between genes to be identified based on reports in the biomedical literature and in network and pathway databases. All of this work closely coupled with an active laboratory program focused on the use of genomic profiling methods to study human disease. The combination of strong computational methods and tools development and laboratory science give us a unique ability to both develop models and make predictions—and then to validate them in the laboratory.

Dr. Quackenbush is heavily involved in the Women's Cancer Program at Dana-Farber and, as a Member of both Ovarian and the Breast Cancer SPORE (Specialized Programs Of Research Excellence) programs, collaborates closely in the analysis of data from translational research projects. Many of these projects provide integrated sources of data on ovarian and breast cancer, including gene expression, miRNA expression, DNA/RNA sequencing, ChIP-seq, and copy number variation data.

Today, Dana-Farber is ranked the Best Cancer Hospital in New England and 4th Best in the US, according to U.S. News & World Report's Best Hospitals Guide. The Institute employs roughly 3,000 people who support almost 200,000 patient visits a year, and it engages in some 200 clinical trials. The Institute's internationally renowned blend of research and clinical excellence uniquely positions it to bring novel, beneficial, and safe therapies from the laboratory to the clinic. Institute researchers continue to pursue new approaches and currently lead investigations of targeted therapies that are less invasive and toxic than surgery, chemotherapy, or radiation, and that deter cancer growth by targeting specific genes or cell processes.

Prof. Angela DePace – Systems Biology – HMS/LMA

Poster #24

It is a well known paradox that some small changes in DNA sequence have dramatic effects on expression patterns, while other large changes in sequence have no effect. We want to understand the phenotypic consequences of changes in regulatory sequence. The DePace lab applies quantitative measurement and mathematical modeling to understand how regulatory DNA computes and how this computation evolves. We use early embryogenesis in multiple fully-sequenced *Drosophila* species as a model to understand gene regulation.

Prof. Jack Szostak – Synthetic Biology – HMS/MGH

Poster #25

The complexity of modern biological life has long made it difficult to understand how life could emerge spontaneously from the chemistry of the early earth. In order to understand the transition from chemical evolution to Darwinian evolution, we are attempting to synthesize extremely simple artificial cells. We will present recent experimental progress towards the development of the two key components of such a protocell, mainly a self-replicating nucleic acid genome, and a self-replicating cell membrane.

CHEMICAL AND PHYSICAL BIOLOGY

Prof. Erin O'Shea – CPB – FAS

Poster #26

Erin O'Shea studies how cells monitor the environment and regulate gene expression, work that has implications for understanding cancer and other diseases. She is also interested in deciphering the logic of signaling and transcriptional control, and in understanding the function and mechanism of oscillation of a three-protein circadian clock.

BIOPHYSICS

Prof. Aravi Samuel – Biophysics - FAS

Poster #27, 28

Small animals like *C. elegans* and the *Drosophila* larva (shown above, with GFP labeling the two Bolwig's organs in the larva's head that sense light) navigate their natural environments through the display of purposeful motile behaviors. Because worms and fruit-fly larvae have small nervous systems, navigational behaviors are encoded in simple algorithms that systematically transform sensory inputs into motor outputs. Because both animals are optically transparent, we can monitor or manipulate the nervous systems of intact individuals as they employ navigational strategies. We take a biophysical approach to the study of behavioral neuroscience in worms and larvae, using quantitative approaches to define the algorithms that underlie navigational behaviors, and developing methods to probe the encoding of these algorithms in small neural circuits.

ENGINEERING AND APPLIED SCIENCES

Prof. Joanna Aizenberg – Biomineralization and Biomimetics – SEAS

Poster #29, 30

In the course of evolution, Nature has developed strategies that endow biological processes and materials with exquisite selectivity, specificity, and adaptability. This is wonderfully exemplified in the realm of inorganic materials formation by organisms, so-called “biomineralization”, and in the self-assembled dynamic structures that enable organisms to respond to a constantly changing environment.

Learning from and mastering Nature’s concepts not only satisfies humankind’s insatiable curiosity for understanding the world around us, but also promises to drive a paradigm shift in modern materials science and technology.

The Aizenberg lab’s research is aimed at understanding some of the basic principles of biological architectures and the economy with which biology solves complex problems in the design of multifunctional, responsive materials. The goal is to use biological principles as guidance in developing new, bio-inspired synthetic routes and nanofabrication strategies that would lead to advanced materials and devices.

Dr. Aizenberg is one of the pioneers of this rapidly developing field of biomimetic inorganic materials synthesis. The lab pursues a broad range of research interests that include biomimetics, self-assembly, adaptive materials, crystal engineering, surface wettability, nanofabrication, biooptics, biomaterials, and biomechanics.

Please visit our website at: aizenberglab.seas.harvard.edu/ <aizenberglab.seas.harvard.edu/>

Prof. David Weitz – Engineering and Applied Sciences – SEAS

Poster #75, 76

We study a variety of biological systems from a soft matter perspective, especially focusing on the mechanical properties of cells and establishing new methods to probe how they sense and response to the outside world. we also develop new ways to create, control, and manipulate microfluidic droplets, and use them as drug carrier and picoliter-sized biological reactors for single-template digital PCR, high throughput library screening, and cell culture.

CHEMISTRY

Prof. Theodore Betley – Chemistry – FAS

Poster #31, 32

The research initiated in the Betley group falls generally into the area of synthetic inorganic chemistry with an emphasis placed on problems of energy, environmental, and biological relevance. Our research applies advanced synthetic techniques to prepare transition metal complexes tailored for specific reactivity patterns. Detailed reactivity studies, coupled with spectroscopic and computational analyses, will provide a wealth of information on small-molecule reactivity and provide further insight into the design on new transition metal architectures. Our research has two significant efforts: (1) the design of polynuclear complexes for cooperative small molecule activation chemistry and (2) iron-mediated, catalytic C–H bond functionalization using weak-field dipyrromethene platforms. Both research tracks use design elements present in the metallocofactors found in nature, but adapted for molecular catalyst development in abiological media.

Prof. Emily Balskus – Chemistry – FAS

Poster #33, 34

My research is inspired by the diversity of chemical transformations used by microorganisms in both primary and secondary metabolism. Microbes are Nature's synthetic chemists, continually evolving elegant chemical solutions for problems inherent to their growth and survival in diverse environments. Understanding microbial chemistry is important. In addition to playing a significant role in the ecology and survival of producing organisms, small molecules made and manipulated by microbes impact human health in many ways. My group seeks to discover and characterize new chemistry in living systems, with an emphasis on organisms from the human microbiota. Our work encompasses the study of biosynthetic pathways and enzymes as well as the development of synthetic transformations that are compatible with microbial chemistry. We utilize DNA sequencing and bioinformatics, an increasing understanding of the biosynthetic logic underlying secondary metabolic pathways, and modern synthetic chemistry to guide our approach.

Prof. Tobias Ritter – Chemistry – FAS

Poster #35

Research in the Ritter group focuses on the development of novel reaction chemistry. We seek to discover molecular structure and reactivity that can contribute to interdisciplinary solutions for challenges in science. The lab focuses on synthetic organic and organometallic chemistry, complex molecule synthesis, and mechanistic studies to develop practical access to molecules of interest in catalysis, medicine, and materials. Many of the most useful synthetic molecules, including numerous pharmaceuticals, contain fluorine due to the desirable unique properties of fluorinated molecules.

Carbon–fluorine bond formation is a challenging chemical transformation, especially in the context of general, functional group-tolerant late-stage fluorination of arenes. Our approach to carbon–fluorine bond formation is based on the use of high-valent transition metal fluorides via oxidation of aryl transition metal complexes with electrophilic fluorination reagents. A long-term goal of our research is the development of new methods for the synthesis of small-molecule tracers for positron emission tomography (PET), a powerful imaging technique to study biological processes in vivo. The conceptual advance of our approach is the implementation of new organometallic, organic, and inorganic chemical reactivity as solutions to challenges of interest to the biomedical community. Ultimately, we envision engaging in translational research through new and existing collaborations with physicians and imaging experts to affect the broadest possible impact of our science.

Prof. Hongkun Park – Chemistry – FAS

Poster #36

Chemical and Electrical Interrogation of Biological Networks Using Intracellular Vertical Nanowires

High throughput platforms based on nanomaterials and nanostructures have the potential to transform how intra- and inter-cellular processes are studied. In particular, vertical silicon nanowires (SiNWs), capable of penetrating the cellular membrane in a minimally invasive fashion, provide a multiplexed chemical and electrical interface to the cell's interior. Using SiNWs to deliver surface-bound molecules into the cell's cytosol, we study several cell signaling pathways including the immune response of mouse dendritic cells (DCs) and apoptosis in cancerous and normal human B cells. Furthermore, by making the SiNWs electrically active, we achieve a scalable method for performing parallel intracellular stimulation and measurement of neuronal activity; thus providing a path toward simultaneous intracellular interfaces to hundreds of individual cells in vivo.

STEM CELL AND REGENERATIVE BIOLOGY

Prof. Jeffrey Macklis – Neurobiology/Stem Cell – HMS/FAS
Poster #37, 38

Jeffrey D. Macklis' laboratory is directed toward both 1) understanding molecular controls over neuron subtype specification and development in the cerebral cortex, and 2) applying developmental controls toward brain and spinal cord repair—specifically, the cellular repair of complex cerebral cortex and cortical output circuitry (in particular, corticospinal motor neuron (CSMN) circuitry that degenerates in ALS and other “upper motor neuron” degenerative diseases, and whose injury is centrally involved in loss of motor function in spinal cord injury). The Macklis lab focuses on neocortical projection neuron development and subtype specification; neural progenitor / “stem cell” biology; induction of adult neurogenesis (the birth of new neurons from within); and directed neuronal differentiation and development of connectivity via molecular manipulation of neural progenitors within murine neocortex (cerebral cortex).

Prof. Khalid Shah – Stem Cell – HMS/MGH
Poster #39, 40

Our research is based on simultaneously targeting cell death and proliferation pathways in tumor cells in an effort to eradicate brain tumors using therapeutically engineered stem cells, microRNA inhibitors and shRNAs. We have engineered different stem cells types (i) to secrete therapeutic protein, S-TRAIL (secreted Tumor necrosis factor receptor-apoptosis inducing ligand) to specifically induce apoptosis in tumor cells and anti-proliferative anti-epidermal growth factor (EGFR) nanobodies to inhibit tumor cell proliferation. These stem cells are then used to populate primary tumors and their secondary micro-invasive deposits in the brain. Inherently linked to the brain tumor therapy paradigm, we employ fluorescent/bioluminescent imaging markers and optical imaging techniques to track stem cells, image apoptosis and changes in tumor volumes in real time in vivo. We also explore the use of microRNAs inhibitors to target brain tumor specific microRNAs and shRNAs to target proteins specifically over-expressed in brain tumors in combination with therapeutic stem cells.

MEDICINE AND HEALTH

Prof. Joyce Bischoff – Vascular Disease – HMS/LMA

Poster #41

The Bischoff lab studies endothelial cell differentiation, function and plasticity in angiogenic diseases and in the normal repair of the vasculature. Currently we have three areas of focus.

Building Vessels

We use human endothelial and mesenchymal progenitor cells to build new vascular networks. These two cell types assemble into vascular networks that are able to connect with the host (murine) circulation. We are using this technology to build vascular networks in ischemic tissue to restore blood flow and prompt endogenous repair mechanisms.

Fighting Blood Vessels in Vascular Tumor of Infancy

Infantile hemangioma (IH) is a common vascular tumor that appears soon after birth and can grow dramatically during infancy. A hallmark is that IH involutes – spontaneously – during childhood. We identified a vascular stem/progenitor cell in growing IH tumors and showed that the cell can recapitulate key features of IH. We are focused on finding new drugs that will prevent growth of IH and/or accelerate the involution process.

Plasticity in Cardiac Valve Endothelium

We showed that endothelial cells from adult valves can recapitulate processes that occur during valve development. We propose that mitral valves contain valvular progenitor cells along the endothelium that undergo an endothelial to mesenchymal transition (EMT) to replenish the valve interstitial cells on an as-needed basis throughout adult life and possibly during valve disease.

Prof. Jing Zhou - Polycystic Kidney Disease – HMS/LMA

Poster #42

Autosomal dominant polycystic kidney disease (ADPKD) is the most common monogenetic disorder in humans with an estimated prevalence of 1:1000 affecting ~12.5 million people worldwide. The main characteristic of ADPKD is the progressive development of epithelial lined cysts in the kidney, which ultimately leads to renal failure. The mechanisms of cyst development remain unclear. The disease causing genes (PKD1 and PKD2) encode polycystin-1 and -2, respectively. We have shown, by gene targeting experiments, a critical role of polycystin-1 in kidney and pancreas development. We demonstrated that polycystin-1 and -2 are calcium-permeable cation channels, and that polycystin-1 acts as an atypical G-protein coupled receptor whose functionality is coupled with polycystin-2.

During development, tubules can arise from cells in many different starting conditions and configurations, and their lumen size is strictly controlled. Our premise is that these diverse pathways converge on a smaller number of common downstream mechanisms that directly control the organization of epithelial cells into tubules. These mechanisms are poorly understood and sit at the crossroads of cell and developmental biology. Cyst formation in PKD, by definition, is characterized by the dilation of tubules -the loss of normal size control of tubular lumen. Cell biological studies of polycystic kidney have shown that the loss of tube lumen size control is accompanied by increased cell proliferation, decreased cell differentiation and survival. Using cells cultured from mouse models defective in polycystin-1, we have recently demonstrated, for the first time, that polycystin-1 and -2 mediate mechanosensation in the primary cilium of kidney epithelium. Primary cilium of kidney epithelium has been previously proposed to be a mechanosensor with unknown molecular composition. Our data suggest polycystin-1 and -2 functions as a mechanosensitive receptor-channel complex that controls normal tubular morphogenesis. Our recent discovery shows that the orientation of cell division in postnatal tubules of Pkd1 knockout mice is randomized, in striking contrast to the cells in normal kidneys which divide in an orientation that is in parallel to the tubular axis.

One of our discoveries is that the ADPKD protein polycystin-2 is in the same protein complex as FPC, the protein encoded by the gene PKHD1 whose mutation causes a recessive form of PKD in infants and children. Our current focus is to understand the downstream signaling events of both ADPKD and ARPKD proteins, particularly how these proteins are involved in cell differentiation and survival, in spindle bipolarity, in cell cycle progression, cell division, cilia and centrosome biology, and the signaling pathways downstream from shear stress induced Ca²⁺ signal. We are also interested in collaborations with other groups to study the role of polycystins in other organs and cell types as polycystins are expressed in multiple tissues with diverse functions. Polycystin-2 controls the left-right body axis and fertility. We are also using multidisciplinary approaches to identify the functions of four polycystin-like molecules identified in our lab.

**Prof. Elliot L. Chaikof – Surgery, Wyss
and HSCI – HMS/LMA**

Poster #43

Research positions available for HST PhD candidates in the laboratory of Dr. Elliot L. Chaikof, MD, PhD, Johnson and Johnson Professor and Chair, Department of Surgery, Beth Israel Deaconess Medical Center, Harvard Medical School, the Wyss Institute of Biologically Inspired Engineering at Harvard University (wyss.harvard.edu/viewpage/224), and the Harvard Stem Cell Institute (Lab location: Center for Life Sciences 11th floor).

Project areas include:

Organ fabrication

This project will involve the design, synthesis, assembly, and integration of artificial collagen and elastin fiber networks for the engineering of living tissues. Applications are focused on cardiovascular and musculoskeletal tissues. Studies will be directed at the development of strategies to promote tissue regeneration, delivery and differentiation of progenitor cells along appropriate lineage pathways, as well as designs to incorporate microvascular systems within engineered tissues. Available projects are appropriate for students with background or interests in synthetic chemistry, molecular and cell biology, biomedical, mechanical and/or chemical engineering, and the design of animal experiments (see *Biomaterials* 2011; 32: 5371-5379; *Biomaterials* 2010; 27: 7175-7182; *Advanced Materials* 2010; 22:2041-2044; *Biomaterials* 2010;31:779-91; *Advanced Drug Delivery Reviews* 2010; 62: 1468-1478).

Design of anti-thrombogenic surfaces

This project is directed at identifying and harnessing biologically inspired designs to limit blood clotting on artificial surfaces. The successful creation of implantable artificial organs, such as the artificial kidney, lung, or a totally synthetic artificial blood vessel will require engineering molecularly defined surfaces that prevent blood clotting in vitro and in vivo; and the development of computational models that describe surface induced coagulation events under flow as a design tool for this effort. Available projects are appropriate for students with background or interests in bio-orthogonal chemistry and recombinant gene technology, multiphysics modeling, bioengineering or chemical engineering, and the design of animal experiments (see *Biophys J* 2011; 101:276-286; *Current Opinion in Immunology* 2010; 22:634-642; Qu Z, Muthukrishnan S, Urlam MK, et al. In press *Advanced Functional Materials* 2011).

Cell transplantation

This project will involve the use of local and remote strategies to re-engineer living tissue surfaces, including pancreatic islets and donor sites for cell transplantation. The motivation for these studies is to develop new strategies to abrogate innate immune responses at the time of cell transplantation and, thereby, to both improve early outcomes and abrogate the development of a later adaptive immune response. Available projects are appropriate for students with background or interests in innate and adaptive immunity, chemistry, recombinant gene technology, drug delivery, and the design of animal experiments (see J Am Chem Soc 2011; 133:7054-64; J Am Chem Soc 2009; 131:18228-18229; Am J Transplantation 2009; 9:1308-1316; Nano Letters 2008; 8:1940-48; Bioconjugate Chemistry 2007; 18:1713-1715; Advanced Drug Delivery Reviews 2008; 60:124-145).

Chronic Vascular Inflammation

There is significant interest in resolving chronic inflammation by promoting the anti-inflammatory activity of endogenous regulators, such as alternatively activated macrophages. This project will involve the characterization of monocyte-derived subsets at sites of vascular lesion formation, specifically profiling inflammatory potential as it relates to proteoglycan expression. The motivation for these studies is to develop novel screening strategies as well as to better characterize the therapeutic potential of regulatory macrophages. Available projects are appropriate for students with background or interests in innate immunity, molecular and cell biology, biomedical engineering, and the design of animal experiments.

Prof. Len Zon – Physiology – HMS/LMA

Poster #44

The Zon laboratory focuses on the developmental biology of hematopoiesis and cancer. We have collected over 30 mutants affecting the hematopoietic system. Some of the mutants represent excellent animal models of human disease. We also have undertaken chemical genetic approach to blood development and have found that prostaglandins upregulates blood stem cells. This has led to a clinical trial to improve engraftment for patients receiving cord blood transplants. We recently developed suppressor screening genetics and found that transcriptional elongation regulates blood cell fate.

The laboratory has also developed zebrafish models of cancer. We have generated a melanoma model in the zebrafish system using transgenics. Transgenic fish get nevi, and in a combination with a p53 mutant fish develop melanomas. We recently found a histone methyltransferase that can accelerate melanoma, and discovered a small molecule that blocks transcription elongation and suppresses melanoma growth.

**Prof. Hernan Kopcow – Medicine, Health
and Disease – HMS/LMA**

Poster #45

Preeclampsia is a major cause of maternal and fetal disease and mortality worldwide. NK cells populating the maternal fetal interface are important for proper maternal endometrial spiral artery remodeling, a process affected in preeclampsia. Decidual NK cells differ from their peripheral blood counterparts in that they secrete angiogenic factors and are non-cytotoxic. We aim to understand the mechanisms of decidual NK cell differentiation. These studies may have potential applications in the development of novel therapeutic approaches for preeclampsia and related disorders.

Caterina Nardella, PhD – Cancer Genetics – HMS/LMA

Poster #46

The goal of the Preclinical Murine Pharmacogenetics Facility, which is funded by Beth Israel Deaconess Medical Center (BIDMC) and Dana Farber/Harvard Cancer Center (DF/HCC), is to provide expertise in the design and implementation of preclinical trials to test new drugs, drug combinations and novel therapeutic modalities in mouse models of human diseases. The need of this core facility originates from the realization that not only do mouse models represent an invaluable tool to study genetic alterations associated with human diseases, but they also represent an excellent platform for the pre-clinical assessment of new drugs and other therapeutic approaches aimed at eradication of the disease. Harnessing these models for therapeutic gain will have an important impact on human health, as results will be utilized to facilitate the identification of patient subtypes through key genetic determinants and biomarkers that predict response to specific treatments. Additionally, our approach will streamline the progression from bench to bedside for promising agents, or new combinations of approved drugs.

This core facility provides access to consultation on all aspects of using animal models for research, including study design, selection of an appropriate mouse model, drug dosing strategy, data collection and analysis. Furthermore, all technical procedures are performed through the implementation of standardized operating procedures performed by highly experienced staff that has been extensively trained to work with mice. Overall, these kind of services are very valuable for all the investigators that have in vitro evidence that a new compound has a potential therapeutic activity that warrants its testing in vivo in mice.

Prof. Pier Paolo Pandolfi – Cancer Genetics – BIDMC

Poster #47

Our team is dedicated to understanding the molecular genetics and basic mechanisms that lead to tumorigenesis. We have developed unique mouse models and tools that allow us not only to study in vivo the causal relationship between cancer associated genetic alterations and the pathogenesis of the disease, but also the co-clinical assessment of new therapeutic modalities aimed at the eradication of cancer. In turn, this has an important impact on human health, as results are utilized in real time to facilitate testing of new treatment modalities, as well as the identification of patient subtypes through key genetic determinants and biomarkers that predict response to specific treatments.

Selected Recent Publications:

H. K. Lin, Z. Chen, G. Wang, C. Nardella, K.I. Nakayama, C. Cordon-Cardo, J. Teruya-Feldstein, S.W. Lee, C. H. Chan, W.L. Yang, J. Wang, A. Egia and P.P. Pandolfi. Skp2 targeting suppresses tumorigenesis in vivo through induction of cellular senescence independently of p19Arf/p53. *Nature*, 2010 Mar 18;464(7287):374-9. PMID: PMC2928066.

L. Polisenio, L. Salmena, J. Zhang, B. Carver, W. J. Haveman, and P.P. Pandolfi. A coding-independent function of gene and pseudogene mRNAs regulates tumour biology. *Nature*, 2010 Jun 24;465(7301):1033-8. PMID: PMC 2928066..

C. Giorgi, K. Ito, H.-K. Lin, C. Santangelo, M.R. Wieckowski, M. Lebedzinska, A. Bononi, M. Bonora, J. Duszynski, R. Bernardi, R. Rizzuto, C. Tacchetti, P. Pinton, P.P. Pandolfi. PML Regulates Apoptosis at Endoplasmic Reticulum Modulating Calcium Release. *Science* 2010, Nov 26;330(6008):1247-51. Epub 2010 Oct 28. PMID: 21030605

M.S. Song, A. Carracedo, L. Salmena, S.J. Song, A. Egia, M. Malumbres and P.P. Pandolfi. Nuclear PTEN regulates the APC-CDH1 tumor suppressive complex in a phosphatase-independent manner. *Cell* 2011 Jan 21;144(2):187-99. PMID: 21241890

L. Salmena, L. Polisenio L, Y. Tay, L. Kats, P.P. Pandolfi. A ceRNA Hypothesis: The Rosetta Stone of a Hidden RNA Language? *Cell*, 2011 Aug 5;146(3):353-8. Epub 2011 Jul 28. PMID: 21802130.

A.H. Berger, A.G. Knudson and P.P. Pandolfi. A Continuum Model for Tumour Suppression. *Nature* 2011, Aug 10;476(7359):163-9. PMID: 21833082.

Y. Tay, L. Kats, L. Salmena, D. Weiss, S.M. Tan, U. Ala, F. Karreth, L. Polisenio, P. Provero, F. Di Cunto, J. Lieberman, I. Rigoutsos and P.P. Pandolfi.. Coding-independent regulation of the tumor suppressor PTEN by competing endogenous mRNAs. *Cell* 2011, Oct 14;147(2):344-57. PMID: 22000013

F.A. Karreth, Y. Tay, D. Perna, U. Ala, A.G. Rust, K.A. Webster, D. Weiss, P.A. Perez-Mancera, M. Krauthammer, R. Halaban, P. Provero, D.J. Adams, D.A. Tuveson and P.P. Pandolfi. In vivo identification of tumor suppressive PTEN ceRNAs in an oncogenic BRAF-induced mouse model of melanoma. *Cell*. 2011, Oct 14;147(2):382-95. PMID: 22000016

Prof. Gary Strichartz – Pain Research Center – HMS/LMA

Poster #48

Research in our lab is currently directed toward how the skin can interact with the peripheral nervous system in the generation of acute and chronic pain, with special focus on endothelin mediated pain mechanisms. Endothelin plays a complex role in pain sensation and is involved in both pain relieving and pain enhancing mechanisms in the skin. Endothelin has its effects on pain through activation of receptors on both nerve endings and skin cells, making it a prime target for the investigation of skin/nerve interactions. The general hypothesis of our lab is that an understanding of skin/nerve interactions will lead to the development of novel, peripherally acting pain relieving medications that lack CNS side effects and may be more effective in treating some chronic pain conditions.

Prof. Adam Hacking – Orthopedics – HMS/MGH

Poster #49

The Laboratory for Musculoskeletal Research and Innovation (LMRI) was established to develop new technology to improve orthopedic treatment and patient care. The lab is led by Dr. Adam Hacking (Ph.D.). The work in the lab presently includes expediting fracture and defect healing; implant fixation, imaging, implant infection, biomaterial development and tissue engineering of bone and cartilage.

Projects are multidisciplinary and provide students with basic training in many research aspects. These commonly include in vitro and in vivo work as well as mechanical testing and fabrication of biomedical instruments and devices. Students benefit from close interaction with research and clinical faculty while working in an academic healthcare environment. Student-initiated projects are encouraged or students may join projects currently underway. Students are encouraged to visit the lab and discuss their interests. Positions for summer, school year and thesis work are available.

Prof. Charles Day – Orthopedics – HMS/LMA

Poster #50, 51

Our laboratory researches clinical musculoskeletal medicine from both patient and provider perspectives to determine how to best to provide medical care. Our research spans diverse aspects of patient care and physician experience including clinical evaluation of treatment techniques in the hand and upper extremity, surgical practice management, and undergraduate medical education. Our ongoing research projects include developing a way to objectively evaluate pain, evaluating how web-links improve doctor-patient communication, developing a deeper understanding of diversity issues in orthopedic surgery, and analyzing the epidemiology of patient chief complaint in our hospital to quantify variation in caseload and the prevalence of musculoskeletal complaints to advocate for better education in medical school on musculoskeletal medicine. Our current clinical outcomes studies aim to evaluate outcomes of radial tunnel surgery, the effectiveness of acetic acid in hand scar management, and the prevalence of finger amputations in the ER. Additionally, our group is attempting to develop guidelines for transferring emergent hand cases while analyzing the demographics of transferred patients and characteristics of the referring facilities. Students are able to participate in any existing projects while also encouraged to propose unique projects based on their personal areas of interest.

Prior research: <http://www.ncbi.nlm.nih.gov/pubmed?term=charles%20day>

Facebook Group: <http://www.facebook.com/group.php?gid=22365010767>

Prof. Matthew Warman – Orthopedics – HMS/LMA

Poster #52, 53

My laboratory's research focuses on the skeletal system. We employ a "bedside to bench to bedside" approach in order to delineate biologic pathways that are essential for skeletal health. Our research questions originate from patients with heritable disorders that affect bones and joints. We address these questions using genetic, cell biologic, biochemical, and model organism approaches. Our long-term goal is to understand the patterning, growth, and maintenance of the skeleton, since this will lead to improved care for patients affected by skeletal disease.

Selected Recent Publications:

Jay, G.D., Torres, J.R., Rhee, D.K., Helminen, H.J., Hytinen, M.M., Cha, C-J., Elsaid, K., Kim, K-S., Cui, Y., and Warman, M.L. (2007) The association between friction and wear in diarthrodial joints lacking lubricin. *Arthritis & Rheumatism*.

Smits, P., Bolton, A.D., Funari, V., Hong, M., Boyden, E.D., Lu, L., Manning, D.K., Dwyer, N.D., Moran, J.L., Prysak, M., Merriman, B., Nelson, S.F., Bonafe, L., Superti-Furga, A., Ikegawa, S., Krakow, D., Cohn, D.H., Kirchhausen, T., *Warman, M.L., Beier, D.R. (2010) Lethal Skeletal Dysplasia in Mice and Humans Lacking the Golgin GMAP-210. *New England Journal of Medicine*. 362:206-216. (* corresponding author)

Bowen, M.E., Boyden, E.D., Holm, I.A., Campos-Xavier, B., Superti-Furga, A., Ikegawa, S., Cormier-Daire, V., Bovee, J.V., Pansuriya, T.C., de Sousa, S.B., Savarirayan, R., Andreucci, E., Vikkula, M., Garavelli, L., Pottinger, C., Ogino, T., Sakai, A., Regazoni, B.M., Wuyts, W., Sangiorgi, L., Pedrini, E., Zhu, M., Kozakewich, H.P., Kasser, J.R., Seidman, J.G., Kurek, K.C., Warman, M.L. (2011) Loss-of-function mutations in PTPN11 cause metachondromatosis, but not Ollier disease or Maffucci syndrome. *PLoS Genetics* 7:e1002050

Cui, Y., Niziolek, P.J., MacDonald, B.T., Zylstra, Alenina, N., Robinson, D.R., Zhong, Z., Matthes, S., Jacobsen, C.M., Conlon, R.A., Brommage, R., Liu, Q., Mseeh, F., Powell, D.R., Yang, Q.M., Zambrowicz, B., Gerrits, H., Gossen, J.A., He, X., Bader, M., Williams, B.O., *Warman, M.L., Robling, A.G. (2011) *Lrp5* functions in bone to regulate bone mass. *Nature Medicine*. 17:684-691. (* corresponding author)

INFECTIOUS DISEASES AND IMMUNOLOGY

Prof. Eleftherios Mylonakis – Infectious Disease - HMS/MGH Poster #54, 55

The outcome of the interaction between a pathogen and a host depends on the interplay between virulence factors of the microorganism and host responses to the infection. Investigators have increasingly turned to invertebrates as facile and inexpensive hosts to model a variety of human pathogens. We developed three invertebrate systems for the study of the fungal pathogens. These non-mammalian hosts are *Caenorhabditis elegans*, *Drosophila melanogaster* and *Galleria mellonella*. Each of these systems provides some unique advantages. Using the *C. elegans* system, we have ascertained a number of mutants of the fungal pathogen *Cryptococcus neoformans* that are hypovirulent. Also, we are exploring the host response of *C. elegans* to *C. neoformans* using an RNA interference library and random mutagenesis. This enables us to identify *C. elegans* genes that make the nematode more susceptible or more resistant to *C. neoformans* and identify similarities between nematode and mammalian responses to fungi. With the developed host-pathogen interaction, are able to apply the infection model to a high throughput, whole animal assay to screen libraries of chemical compounds and identify those with antifungal activity or that stimulate the host immune response. In vivo evaluation of libraries of chemical compounds could solve some of the main obstacles in current antifungal discovery, such as finding new classes of compounds and solving the bottleneck of toxicity/efficacy testing. *G. mellonella* is also a valuable model as it is the first non-mammalian host in the study of *C. neoformans* that can survive at mammalian temperatures and allows the administration of an exact inoculum. We are using this model in the study of antifungal agents and in the evaluation of “signature tag” libraries. These surrogate hosts fill an important niche in microbial pathogenesis research and, along with established mammalian models provide us with a unique opportunity to identify and study basic, evolutionarily conserved aspects of microbial virulence and host response.

Prof. Bruce Walker – Infectious Disease – HMS/MGH Poster #56

The Walker laboratory focuses on mechanisms of immune control in HIV infection, focusing in particular on persons who control HIV infection spontaneously without the need for medication. Through an international collaboration now funded by the Gates Foundation, more than 1500 persons who control HIV infection to less than 2000 RNA Copies/ml without the need for antiviral medications have been recruited, and immunologic, virologic and host genetic mechanisms accounting for this remarkable phenotype are being investigated. Our results, recently published in *Science*, <http://www.ragoninstitute.org/articles/110410_gwas.html> indicate that the major genetic determinants of HIV control affect the nature of the peptide-HLA binding. We are currently focusing our research efforts on this interaction and how it impacts the inductive and effector phases of the CD8 T cell response.

Other projects currently underway are building on a observation that the antiviral efficacy of CTL varies dramatically among different epitopes and different restricting HLA alleles, in an attempt to define the major antiviral effector functions and apply these to vaccine development. At the same time, efforts are underway to define the subset of CD8 T cell responses that exert the strongest antiviral effect, and to define those responses that are simply passengers and fail to contribute to immune control.

Prof. Marcia Goldberg – Infectious Disease – HMS/MGH

Poster #57

Our lab focuses on the molecular nature of interactions between microbial pathogens and the host. Pathogenic bacteria have evolved complex mechanisms to subvert host cell signaling pathways to enhance disease processes. Our work focuses on uncovering the molecular signaling events that occur during bacterial infection of host cells. The bacterial pathogen *Shigella*, a major cause of illness and mortality among children worldwide, infects cells of the intestinal epithelium and uses cellular actin cytoskeletal and other pathways to disseminate through host tissue. We are investigating the molecular mechanisms by which secreted bacterial proteins modulate host proteins to divert the host signaling pathways involved in these processes. Our approaches include both genome-wide screening and targeted investigations.

Prof. Edward T. Ryan – Infectious Disease – HMS/MGH

Poster #58

Globally, one in five people dies of an infection, and this reality is projected to continue for the next 50 years. Intestinal and respiratory infections are the two leading infectious causes of death, far exceeding malaria, TB and HIV. Our research focuses on understanding host-pathogen interactions during two intestinal infections that disproportionately affect the most impoverished and disenfranchised, typhoid and cholera. These two illnesses affect over 25 million people each year, killing 300,000. Our research focuses on studying these human-restricted infections, especially regarding the discovery and development of improved vaccines, improved immunization strategies, and improved diagnostics. We perform this work through an established collaborative effort with researchers at the International Centre for Diarrhoeal Disease Research in Dhaka, Bangladesh (ICDDR,B). Particular areas of focus include the application of high throughput genomic, proteomic, and immunoproteomic platform technologies to infections. Students would be welcome to join an active NIH-funded research program. Research would be bench-based in Boston, with potential in Bangladesh. Interested students can contact Dr. Ryan to discuss potential involvement and projects.

Prof. Cammie Lesser – Infectious Disease – HMS/LMA

Poster #59

Many bacterial pathogens and endosymbionts manipulate host cell processes to promote their own survival, which, in the case of pathogens, is often detrimental to the host. Many bacteria usurp eukaryotic host cellular processes by directly injecting proteins into the mammalian cells via specialized secretion systems. Our laboratory is interested in understanding how bacterial pathogens manipulate eukaryotic host cell processes to ultimately cause disease. Our work focuses on (1) determining the molecular mechanisms used by bacterial pathogens to identify and secrete virulence proteins directly into host cells by a specialized type III secretion system, (2) developing functional genomic approaches, cell biological and biochemical approaches using both yeast and mammalian cells to identify eukaryotic host cell processes targeted by the pathogens and (3) determining how pathogens act to modulate the host innate immune response. In addition, we are currently working towards reengineering pathogenic type III secretion machines to create nanomachines capable of delivering defined sets of proteins, rather than bacterial virulence proteins, into humans, which can be used for therapeutic applications such as generating induced pluripotent stem cells or delivering anti-inflammatory molecules to a host.

Prof. Suzanne Walker – Chemistry – FAS

Poster #60

Antibiotics are often our primary or only way of treating bacterial infections in humans and animals. Unfortunately bacteria continue to develop resistance to clinically used antibiotics at an increasing rate. This presents a worldwide problem. In the United States, one bacteria alone, *Staphylococcus aureus*, causes 18,000 deaths annually. There exists a pressing need to develop new antibiotics.¹ A major focus of the Walker laboratory is the study of metabolic pathways that are known or potential antibiotic targets. Peptidoglycan and wall teichoic acid pathways are of special interest in our lab.¹ Through our studies we hope to learn more about how to kill bacteria which can then lead to the discovery of new antibiotics or antibiotic targets.² Our lab also has a long-standing interest in the structure, function, and inhibition of glycosyltransferases. Glycosyltransferases are a class of enzymes that transfer sugars to acceptor substrates. We are currently researching the fascinating and essential human enzyme, O-GlcNAc transferase.^{3,4} The poster we are presenting is a summary of our lab's work on wall teichoic acid (WTA) biosynthesis.^{5,6} Our work shows by inhibiting WTA biosynthesis, *S. aureus* bacteria become sensitive to drugs for which the bacteria were previously resistant.⁷ This means we have discovered a new target for antibiotic development.

Selected Recent Publications:

Swoboda, J. G., Campbell, J., Meredith, T. C., and Walker, S. (2010) Wall teichoic acid function, biosynthesis, and inhibition, *ChemBioChem* 11, 35–45.

Swoboda, J.G., Meredith, T.C., Campbell, J., Brown, S., Suzuki, T., Bollenbach, T., Malhowski, A. J., Kishony, R., Gilmore, M. S., and Walker, S. (2009) Discovery of a small molecule that blocks wall teichoic acid biosynthesis in *Staphylococcus aureus*, *ACS Chem. Biol.* 4, 875–883.

Lazarus, M. B., Nam, Y., Jiang, J., Sliz, P., Walker, S. (2011) Structure of human O-GlcNAc transferase and its complex with a peptide substrate. *Nature* 469, 564-567.

Jiang, J., Lazarus, M. B., Pasquina, L., Sliz, P., Walker, S. (2011) A neutral diphosphate mimic cross-links the active site of human O-GlcNAc transferase. *Nat. Chem. Biol.* (In press).

Brown, S., Zhang, Y. H., and Walker, S. (2008) A revised pathway proposed for *Staphylococcus aureus* wall teichoic acid biosynthesis based on in vitro reconstitution of the intracellular steps, *Chem. Biol.* 15, 12–21.

Brown, S., Meredith, T., Swoboda, J., Walker, S. (2010) *Staphylococcus aureus* and *Bacillus subtilis* W23 make polyribitol wall teichoic acids using different enzymatic pathways. *Chem. Biol.* 17, 1101-1110.

Campbell, J. Singh, A.K., Santa Maria, J. P. Jr., Kim, Y., Brown, S., Swoboda, J. G., Mylonakis, E., Wilkinson B. J., Walker, S. (2011) *Chem Biol.* 6, 106-116.

Prof. Arlene Sharpe – Immunology - HMS/LMA

Poster #61

The Sharpe lab studies costimulatory pathways on T cells and their role in regulation of immune responses. Costimulatory pathways provide second signals that enhance or block the signal received by recognition of antigen through the T cell receptor, either stimulating or inhibiting the immune response. These pathways are critical to the balance between T cell activation and tolerance, and represent an intriguing new class of therapeutic targets: blockade of costimulatory pathways could promote anti-microbial or tumor immunity, while their activation could be used to control autoimmune diseases or achieve transplantation tolerance. Current projects include:

- Studying the CTLA-4 pathway using conditional gene targeting in mice. The CTLA-4 pathway plays a key role in regulating tolerance; mice lacking it die shortly after birth from autoimmune disease. We are using conditional gene targeting approaches, in which genes are “knocked out” in specific cell types or at specific time points, to define its function in adult mice and on specific T cell subsets.
- Studying the role of the PD-1 pathway in tolerance and immunity. PD-1 is an inhibitory costimulatory molecule expressed on activated T cells, as well as many other cell types. It plays an important role in inhibiting T cell responses and inducing regulatory T cells. We are using conditional gene targeting to dissect its function on different T cell subsets, including regulatory and effector T cells. We are also investigating its role on non-T cells, particularly endothelial cells, and the potential use of agonistic anti-PD-1 antibodies to induce tolerance.

- Studying the role of the PD-1 pathway in T cell exhaustion in chronic infection. In many chronic infections (including HIV and hepatitis C), T cells gradually lose responsiveness; this change is associated with upregulation of coinhibitory pathways, particularly the PD-1 pathway. We have determined that PD-1 and PD-L1 inhibit T cell function during chronic viral infection, and that blockade of this pathway can restore function of “exhausted” T cells. These findings have revealed a new therapeutic strategy for chronic viral infection.

- Studying the role of costimulation in aging and immunosenescence. Immune responses in the elderly are weaker than those in the young; at the cellular level, this is reflected in decreased T cell responsiveness in old mice (and humans), referred to as immunosenescence. These changes are accompanied by both upregulation of coinhibitory pathways (particularly the PD-1 pathway) and by metabolic changes in glucose and glutamine utilization by T cells. Current studies focus on the role played by costimulatory pathways in regulating these metabolic changes, and how aging-related changes in costimulation affect T cell function.

Prof. Vijay Kuchroo – Immunology – HMS/LMA

Poster #62

The major focus of research in the laboratory is the study of the autoimmune T cell response. Particular focus is given to elucidating the role of different CD4+ T helper subsets in disease, role of costimulatory molecules and their receptors in the induction and differentiation of T cells, role of the Tim molecules in regulating auto-reactive T cell responses, and identification of the mechanisms of protection associated with genetic intervals that confer resistance to autoimmunity.

HARVARD SCHOOL OF PUBLIC HEALTH

Prof. Sarah Fortune – Infectious Disease - HSPH

Poster #63

Mycobacterium tuberculosis remains an enormous global health problem. One of the challenges in controlling tuberculosis is the wide spectrum of disease that follows *M. tuberculosis* infection. It is estimated that over a third of the world's population is latently infected with *M. tuberculosis* yet only 10% of these individuals will ever develop clinical disease. When disease occurs, it may be localized or metastatic, rapidly progressive or indolent. There are similarly variable outcomes in response to treatment. It is currently unclear to what extent the variable clinical outcomes reflect differences in the infected individuals' ability to control the disease versus diversity in the bacterial responses during infection.

The Fortune lab seeks to define the mechanisms by which populations of *M. tuberculosis* generate functional diversity and determine how this diversification contributes to the variable course of clinical disease. We approach these questions using high throughput proteomic and genomic approaches. We study bacterial diversification both through model systems and through clinical isolates. We perform our work with patient isolates through the newly created HIV-TB coinfection research institute in Durban, South Africa funded by the Howard Hughes Medical Research Institute and through a program project grant studying the epidemiology and transmission of drug resistant tuberculosis in Lima, Peru.

As an example of the type of studies undertaken in our lab, we have used whole genome sequencing of TB isolates to estimate the rates of genetic mutation and thus acquisition of new drug resistances during active and latent disease. The results of these studies suggest that new recommendations for the treatment of latent TB could result in significant emergence of new drug resistant strains.

In addition, we are building on our expertise in mycobacterial surface diversity to address one of the major challenges facing the field of global TB control--the lack of a sensitive, rapid diagnostic for the disease. We are collaborating with biological engineers at the Massachusetts General Hospital whose expertise is in microfluidics and nanotechnology to develop a novel, point-of-care diagnostic for TB based on nanoscale-NMR. We are also collaborating with the Broad Institute to identify a serum or urine marker for TB by proteomically profiling patient samples.

**Prof. Marianne Wessling-Resnick –
Nutritional Biochemistry – HSPH**

Poster #64

Our laboratory is interested in the mechanisms and regulation of iron transport. We use medium throughput screens to discover small molecule inhibitors that block different iron transport pathways. One target is divalent metal transporter-1 (DMT1), the primary membrane protein responsible for iron absorption. We also focus on how regulation of this iron transporter may alter uptake of other metals, including the olfactory transport of manganese, a neurotoxin. The goals of this project are to determine the distribution of manganese in the brains of control and iron-deficient rats using MRI and to correlate these changes to behavioral effects elicited by the metal's neurotoxicity.

Prof. Tiffany Horng – Genetics and Complex Disease – HSPH

Poster #65

In the Horng Lab in the Department of Genetics and Complex Diseases at HSPH, our research is centered on the mechanisms regulating chronic inflammation, which contributes critically to the pathogenesis of many human diseases such as obesity and diabetes. One focus is in understanding how certain metabolic pathways influence the inflammatory response in macrophages, key mediators of inflammation. Another focus is on the crosstalk between macrophages and parenchymal cells, and how this interaction instigates and/or sustains inflammation in chronic diseases. Our ultimate goal in revealing mechanisms regulating inflammation is to develop new approaches to treat chronic inflammatory diseases.

HUMAN EVOLUTIONARY BIOLOGY

Prof. Tanya Smith – HEB – FAS

Poster #66

Research in the Dental Hard Tissue Laboratory centers around biological rhythms permanently recorded in tooth enamel and dentine. Counts and measurements of these mineralized daily clocks provide secretion rates and formation times in living and fossil ape and human dentitions. Moreover, the remarkable production of a line coincident with birth allows time to be registered with actual age (i.e., a birth certificate in your own mouth)! Various microscopic techniques allow us to resolve the evolution of human life history from a rapid ape-like pattern to the “live slow and die old” pattern found in recent humans. Additional ongoing research integrates studies of tooth development with isotopic chemistry to understand environmental variation during the origins of the genus Homo.

Prof. Richard Wrangham – HEB – FAS

Poster #67

The Kibale Chimpanzee Project was founded in 1987 by Professor Richard Wrangham in the department of Human Evolutionary Biology. It is a long-term field study of the behavior, ecology and physiology of wild chimpanzees. Our researchers and field staff conduct daily behavioral observations on a group of ~50 chimpanzees in Kibale National Park in southwestern Uganda. The 25 years of data we have collected allows us to conduct research that provides key contributions to understanding primate behavioral diversity, tracing the evolution of human biology and behavior, and conserving chimpanzees. Over the years, we have had several undergraduate students work with the project. They have extracted and coded data, done short projects and even gone to the field to collect data themselves. Working with our research project will provide you with valuable research experience in behavioral ecology, including learning data analysis techniques and how to work with large databases. This work will also give you an opportunity to work closely with faculty members in the department of Human Evolutionary Biology. If you have any questions, please contact Dr. Zarin Machanda (machanda@fas.harvard.edu).

ORGANISMIC AND EVOLUTIONARY BIOLOGY

Prof. Arkhat Abzhanov

Poster #68

My group is interested in a variety of topics related to the vertebrate craniofacial (head) development and craniofacial developmental evolution. We use molecular, cellular and developmental genetics approaches to study the precise mechanisms of cranial skeletal differentiation, especially in the context of the dermal intramembranous bone, which is unique to the skull and bones. We are also curious about issues of skull morphogenesis and integration of the cranial skeleton with cranial musculature. To perform functional experiments more effectively, we are designing and testing new viral-based vectors for introducing transgenes into developing embryos. The species we work with range from the laboratory “model” systems, such as chicken embryos and mouse mutants, to the “non-model” species used for evolutionary developmental studies, for example Darwin’s Finches and their close relatives (the classic textbook example of adaptive radiation), other species of birds and, more recently, reptiles, such as the anole lizards (great example of convergent/ parallel morphological evolution) and alligators (basal Archosaurian reptiles useful to study evolution of birds). Many of our projects are exciting collaborations with ecologists, evolutionary field biologists, applied mathematicians, specialists in biomechanics, virologists, etc.

Prof. Andrew Richardson – Ecology – FAS

Poster #69

We are physiological ecologists interested in interactions between plants (principally trees) and their abiotic environments. Specifically, we focus on the impacts of climate change on terrestrial ecosystems, and feedbacks of vegetation to the climate system. We use a combination of field measurements, remote sensing, laboratory analyses, as well as modeling and statistical analysis of large data sets, in our research. We are interested in both above- and below-ground processes, at spatial scales and levels of integration from individual stomata to entire ecosystems, and from leaves and roots to the biosphere.

Prof. Charles Nunn – OEB – FAS

Poster #70, 71

The Comparative Primatology Research Group focuses on the spread of infectious diseases in wildlife, mammalian behavior, and global health. We use phylogenetic methods and computational modeling to understand factors explaining variation across animal species, with a strong emphasis on primates (including humans). The lab has a variety of computational resources and databases to facilitate comparative research. For instance, the Global Mammal Parasite Database contains over 6000 lines of parasite data for 139 primate hosts (<http://www.mammalparasites.org/>). Post-doctoral researcher Hillary Young's fieldwork in East Africa examines the links between biodiversity, land-use change and rodent borne diseases. Post-doctoral researcher Natalie Cooper focuses on phylogenetic comparative methods; she is currently investigating the factors that influence the distribution of primate parasites. PhD student Collin McCabe investigates the links between social learning and disease risk, while Research Assistant Randi Griffin's research employs agent-based modeling and comparative methods to investigate the relationship between contact patterns in primate social networks and disease risk. The lab typically hosts two honors thesis projects per academic year, as well as several additional students working independently or in collaboration with others in the lab. We welcome undergraduates who are interested in learning more about these questions and computational approaches.

RESEARCH SUPPORT AND FELLOWSHIP ORGANIZATIONS

Life Sciences Concentrations and Advising:

Poster #72

Summer Research in Portugal:

Poster # 73

Harvard Medical School - Portugal <http://www.hmsportugal.org/> offers summer internships in health sciences <http://www.hmsportugal.org/AreaDetail.aspx?contentId=26&areaId=2> for Harvard undergraduates. Apply to participate in research in one of the Portuguese laboratories supported by a Collaborative Research Grant. We have exciting research opportunities in Portuguese labs working on projects such as developing novel drugs to eradicate malaria, improving perinatal decision-making by developing new computer methods to analyze a baby's heart rate, research on cancer, as well as other exciting projects. HMS-Portugal provides funding for travel as well as a generous stipend! Please contact Sandra Oliveira at Sandra_oliveira@hms.harvard.edu <mailto:Sandra_oliveira@hms.harvard.edu> for further details.

MCZ Undergraduate Research Grants-in-Aid (GUR):

Poster #74

The Museum of Comparative Zoology (MCZ) and the Harvard University Herbaria (HUH) award small grants (up to \$2500) in support of faculty-supervised research by Harvard undergraduates. Projects in any subject area are eligible for support, although priority may be given to projects that utilize MCZ or HUH research collections, laboratories and other facilities, and to related fieldwork. Funds from the HUH are primarily available to support projects in the field of plant biology. Projects that facilitate senior honors theses or associated preliminary studies are particularly encouraged. Priority is given to first-time applicants. http://www.mcz.harvard.edu/grants_and_funding/gur.html

PRISE and Office for Undergraduate Research Initiatives

Table #1

The Harvard College Program for Research in Science and Engineering (PRISE) is a 10-week program for students working with Harvard faculty in life, physical, engineering, and applied sciences departments and research centers in the Faculty of Arts and Sciences, as well as program directors and principal investigators in the Harvard Medical School, the School of Public Health, affiliated research institutes and hospitals, and other academic and administrative units throughout the University. Summer 2012 will be the seventh year for this innovative, high-profile program, which has been designed to stimulate community and creativity among a cohort of motivated Harvard undergraduates. Participation in the Program includes housing in one of the Harvard College residences, partial board, free shuttle service for those working in the Longwood Medical Area, and evening programming that includes distinguished scholars talking about their research and a variety of workshops on such topics as fundamentals in laboratory training and preparing for scientific presentations. In addition, PRISE fellows live among other undergraduate researchers in the Harvard Summer Research Village community, and contribute to the rich and vibrant environment through the creation of student-run science and social activities throughout the summer.

PRISE is administered by the Harvard College Office for Undergraduate Research Initiatives, located at 54 Dunster Street (OCS). For more information on PRISE and other research opportunities for undergraduates, please peruse the undergraduate research website: <http://undergrad-research.harvard.edu>.

Application instructions and materials for PRISE will be available in mid-December. The deadline to apply for PRISE is Tuesday, February 21, 2012.

HCURA

Table #2

As the premier undergraduate research association at Harvard, HCURA is dedicated to building an interdisciplinary research community. We have partnered with the newly established Harvard Office of Undergraduate Research Initiatives (OURI) to run our popular Peer Advising Program, which pairs freshmen interested in research with upperclassmen peer-advisers who guide each of the freshmen through the process of finding a lab, securing funding, and balancing lab work with other commitments. In addition, we collaborate with a number of Harvard departments to host seminars and socials in order to fortify the undergraduate research community here at Harvard.

We are also committed to providing a forum for student researchers to present their research and interact with their peers. We believe that these efforts deserve a greater campus presence and that all undergraduate researchers should be proud of their contributions to the collective scholarship of our student body. To this end, we have hosted the annual Harvard Undergraduate Research Symposium (HURS) since our founding in 2007 in order to furnish an arena for students to share their work. The Symposiums have also created opportunities for faculty to connect with students, offering a unique educational experience for all participants.

Recently, we have realized that it is important for undergraduates from other college campuses around the United States to come together and collectively present their research and interact with future colleagues. Thus, in January 2012, we are planning to launch the inaugural National Collegiate Research Conference (NCRC).

Student Employment Office:

Table #3

The Student Employment Office (SEO) works with faculty, the community, and all University departments to create term-time and summer research opportunities for students. Below are the three research programs run by the SEO:

Harvard College Research Program (HCRP) supports student-initiated scholarly research and creative endeavors undertaken with faculty guidance during the academic year and summer. HCRP grants advance academic experiences outside the classroom and expand opportunities for students to work closely with faculty members.

The Dean's Summer Research Award (DSR) is an award for rising seniors pursuing summer thesis research with an HCRP grant. Recipients are eligible to receive up to a \$1,000 credit on their term bill to cover the summer earnings expectation.

Faculty Aid Program (FAP) is a great program for students in the initial stages of their research careers. It provides opportunities for undergraduates to become closely involved in the ongoing research of a Harvard faculty member. The SEO subsidizes the hourly rate paid to the student by the faculty member. The program encourages professors to hire undergraduate research assistants and provides a platform to advertise the position through the online Jobs Database. Faculty members must apply for this award directly.

Office of Career Services:

Table #3

The Office of Career Services, for the Faculty of Arts and Sciences, is home to a number of divisions including the Office of International Education, the Undergraduate Fellowships Office, Premedical and Health Careers Advising Office, and the Office for Undergraduate Research Initiatives and PRISE. The office operates from three locations: 54 Dunster Street, 77 Dunster Street, and 1033 Massachusetts Avenue (On-Campus Interview Facility). The mission of the combined units is to educate, advise, and connect.

Mind/Brain/Behavior:

Table #4

As an interfaculty initiative, Mind/Brain/Behavior (MBB) does not have its own faculty and research programs as departments do. Instead, it serves as a clearinghouse for research opportunities for undergraduates. Faculty and researchers involved in MBB are encouraged to post positions on the MBB website at <http://mbb.harvard.edu/undergrad/opportunities.php>. This page is updated frequently and each year includes dozens of positions for a wide variety of projects. The page by no means encompasses all undergraduate opportunities dealing with topics in mind/brain/behavior, and listings are largely for positions in labs and research programs in psychology (FAS) and at the medical school. Listings also sometimes include positions in other FAS life science areas, at the Business School, and at the School of Education. Beyond the web listings, students are very welcome to contact Education Program Coordinator Shawn Harriman (shawn_harriman@harvard.edu) to discuss identifying additional research opportunities and integrating research experiences into their academic program or career planning.

Harvard School of Public Health Summer Internship Program

Table #4

This intensive 9 week laboratory-based biological research program is for undergraduate students during the summer following their sophomore or junior year. Interns apply state-of-the art technology in their own research projects, which focus on biological science questions that are important to the prevention of disease, under the direction of a Harvard faculty member.

Interns receive a generous stipend, travel allowance and free dormitory housing.

Deadline: February 1, 2012

Microbial Sciences Initiative:

Table #5

The Microbial Sciences Initiative (MSI) at Harvard is an interdisciplinary science program aimed at a comprehensive understanding of the richest biological reservoir of the planet, the microbial world. Microbes are ubiquitous and have an impact on every aspect of our existence. Yet, their intrinsic invisibility has meant that they have remained largely unknown, their effects and enormous potential often unrecognized. The recent realization of the vastness of microbial diversity and the genomics revolution have propelled the microbial sciences into an exciting new era of investigation. MSI is playing a leadership role in this emerging area by creating an organizational focal point for microbial studies with strong links to already existing science departments at Harvard. MSI connects work on microbial sciences to ongoing work in related areas including molecular biology, biogeochemistry, oceanography, and environmental engineering. MSI supports a variety of programs, including seminars, undergraduate fellowships for summer research, and an undergraduate secondary field in the microbial sciences.

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HARVARD UNDERGRADUATE EDUCATION
IN THE *Life Sciences*



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