Symposia Program

Biennial

Science of Learning Symposium

&

Symposium on

Excellence in Teaching & Learning in the Sciences

January 11th & 12th, 2016

Hodson Hall, Homewood Campus
Johns Hopkins University, Baltimore, MD

Science of Learning

Monday, January 11th: *Learning in Brains, Minds, and Machines*

8:00 - 9:00	**- Registration & Light Breakfast -**	2nd Floor
9:00 - 9:15	**WELCOME** **Robert Lieberman**, Provost and Senior Vice President for Academic Affairs, Johns Hopkins University **Barbara Landau**, Director of the Science of Learning Institute; Dick and Lydia Todd Professor of Cognitive Science, Johns Hopkins University	Room 110
9:15 - 10:00	**THE NEUROSCIENCE OF BRAIN CHANGES DURING LEARNING** *"Synaptic plasticity mechanisms underlying learning in the brain"* **Richard Huganir**, Professor and Director of the Solomon H. Snyder Department of Neuroscience; Director of the Kavli Neuroscience Discovery Institute; and Co-Director of the Johns Hopkins Medicine Brain Science Institute, Johns Hopkins University	Room 110
10:00 - 10:30	**- Break -**	1st Floor
10:30 – 11:45	**LEARNING IN THE VISUAL BRAIN** *"Towards understanding deep neural networks"* **Alan Yuille,** Bloomberg Distinguished Professor of Cognitive Science and Computer Science, Johns Hopkins University *"Neural changes underlying visual shape learning"* **Ed Connor**, Professor of the Solomon H. Snyder Department of Neuroscience; Director of the Zanvyl Krieger Mind/Brain Institute, Johns Hopkins University	Room 110
11:45 - 1:00	**- Lunch -**	2nd Floor
1:00 - 3:00	**LANGUAGE LEARNING** *"Developmental plasticity and language learning: Computational, maturational, and linguistic constraints"* **Elissa Newport**, Professor of Neurology; Director of the Center for Brain Plasticity and Recovery, Georgetown University *"Linguistic diversity marks social groups and facilitates interpersonal communication"* **Katherine Kinzler**, Associate Professor of Psychology; Associate Professor of Human Development, Cornell University *"Gradually learning to read a foreign language: Adaptive partial machine translation"* **Jason Eisner**, Professor of Computer Science, Johns Hopkins University	Room 110
3:00 - 3:30	**- Break-**	1st Floor
3:30 - 4:45	**LEARNING TO READ AND WRITE** *"Brain mechanisms of early reading skills"* **Bruce McCandliss**, Professor of the Graduate School of Education; Department of Psychology; and Stanford Neuroscience Institute, Stanford University *"Reading and spelling: Challenges and opportunities for evolutionarily recent brain networks"* **Brenda Rapp,** Chair and Professor of Cognitive Science, Johns Hopkins University	Room 110
4:45 - 5:30	**GIFTED LEARNING** "*Excellence Gaps: The role of translational research in implementing large-scale educational change*" **Jonathan Plucker**, Julian C. Stanley Endowed Professor of Talent Development, Johns Hopkins University	2nd Floor
5:30 - 6:30	**- Reception -** (Beer, Wine, Soda, and Hors d'oeuvres)	2nd Floor

Tuesday, January 12th: *Learning through Science, Theory and Practice*

8:00 - 9:00	**- Registration & Light Breakfast -**	2nd Floor
9:00 - 9:15	**WELCOME** **Robert Lieberman,** Provost and Senior Vice President for Academic Affairs, Johns Hopkins University	Room 110
9:15 - 10:00	**INCLUSIVE EDUCATION** *"A non-linear approach to inclusion"* **David J. Asai,** Senior Director of Science Education, Howard Hughes Medical Institute	Room 110
10:00 - 10:45	**LEARNING OBJECTIVES & COURSE DESIGN** *"Cooking up the modern undergraduate engineering education---learning objectives are a key ingredient"* **Sheri Sheppard,** Professor of Mechanical Engineering, Stanford University	Room 110
10:45 - 11:00	**- Break -**	1st Floor
11:00 - 11:45	**ACTIVE LEARNING CLASSROOMS & COURSES** *"The biomedical engineering design studio: form and function"* **Eileen Haase,** Senior Lecturer, Biomedical Engineering, Johns Hopkins University	Room 110
11:45 - 1:15	**- Lunch & GSI Poster Session (see p. 3 for details) –**	2nd Floor
1:15 - 2:00	**CURRICULUM REFORM & ASSESSMENT** *"Evidence-based approaches to curriculum reform and assessment"* **Melanie Cooper,** Lappan-Phillips Chair of Science Education, Michigan State University	Room 110
2:00- 2:45	**DISCOVERY-DRIVEN EXPERIENTIAL LEARNING** *"Chemical structure and bonding with laboratory"* **Tyrel McQueen**, Associate Professor of Chemistry, Johns Hopkins University	Room 110
2:45 - 3:00	**- Break -**	1st Floor
3:00 - 3:45	**ACTIVE LEARNING IN PHYSICS** *"The development of an active-learning-based course in introductory physics at JHU"* **Robert Leheny,** Professor of Physics, Johns Hopkins University	Room 110
3:45 - 4:30	**'FLIPPED' CLASSROOMS** *"An exploration of the methods, benefits, challenges and assessment recommendations for transforming a traditional large lecture course"* **Steven Luck,** Professor of Psychology, University of California Davis	Room 110
4:30 - 5:00	**CLOSING REMARKS** **Kelly Gebo,** Vice Provost of Education; Director Undergraduate Public Health Studies; Associate Professor of Epidemiology, Johns Hopkins University	Room 110
5:00 - 6:00	**- Reception -** **(Beer, Wine, Soda, and Hors d'oeuvres)**	2nd Floor

Gateway Science Initiative (GSI) – During Lunch on Tuesday

Poster Session:

Showcasing 2013 GSI Grant Recipients & Teaching-as Research Fellowship Projects

A. **Chemical Structure and Bonding with Laboratory: A New Course for Advanced Freshmen**
Tyrel McQueen, *Assistant Professor of Chemistry, Krieger School of Arts & Sciences*
Jane Greco, *Senior Lecturer of Chemistry, Krieger School of Arts & Sciences*

B. **Fundamentals of Energy: Student-Centered Learning for Active, Analytic, and Quantitative Energy Education**
Deborah Bleviss, *Professor and Acting Director, Energy Resources, & Environment, School of Advanced International Studies*
John Harrington, *Associate Dean, School of Advanced International Studies*
Vali Nasr, *Dean, School of Advanced International Studies*

C. **Harnessing the Undergraduate Teaching Laboratories to Enhance the Freshman, Sophomore Science Experience**
Bertrand Garcia-Moreno, *Professor and Chair of Biophysics, Krieger School of Arts & Sciences*

D. **Improving Clinical Reasoning in Diagnosis for Pediatric and Family Nurse Practitioner Students**
Shawna Mudd, *Assistant Professor of Acute and Chronic Care, School of Nursing*
Joanne Silbert-Flagg, *Assistant Professor of Acute and Chronic Care, School of Nursing*

E. **In-class Group Problem Sessions in Biochemistry**
Katie Tifft, *Lecturer of Biology, Krieger School of Arts & Sciences*
Emily Fisher, *Lecturer of Biology, Krieger School of Arts & Sciences*
Vince Hilser, *Professor of Biology, Krieger School of Arts & Sciences*
Young-Sam Lee, *Assistant Professor of Biology, Krieger School of Arts & Sciences*

F. **Institutionalizing Peer-Led Team (PILOT) Learning into the Culture of the Undergraduate Experience**
Laura L. Foster, *Assistant Director, Office of Academic Support, Krieger School of Arts & Sciences*
Richard J. Brown, *Director of Undergraduate Studies, Teaching Professor of Mathematics, Krieger School of Arts & Sciences*

G. **Introduction to Materials Chemistry**
Patricia McGuiggan, *Associate Research Professor of Materials Science & Engineering, Whiting School of Engineering*

H. **Introduction to the Biomedical Sciences: Collaborative Learning in the Onsite, Blended and Online Classroom**
Gundula Bosch, *Instructor of Molecular Microbiology & Immunology, Bloomberg School of Public Health*
Jelena Levitskaya, *Assistant Professor of Molecular Microbiology & Immunology, Bloomberg School of Public Health*
Noel Rose, *Professor of Pathology, School of Medicine*

I. **Transformation of the Chemical Sciences to Enhance the Freshman Experience**
Christopher Falzone, *Teaching Professor of Chemistry, Krieger School of Arts & Sciences*
Jane Greco, *Senior Lecturer of Chemistry, Krieger School of Arts & Sciences*
Gerald J. Meyer, *Professor of Chemistry, Krieger School of Arts & Sciences*

J. **Whiting School Biomedical Design Studio**
Robert Allen, *Lecturer of Biomedical Engineering, Whiting School of Engineering*
Eileen Haase, *Senior Lecturer of Biomedical Engineering, Whiting School of Engineering*
Elizabeth Logsdon, *Engineering for Professionals Lecturer, Whiting School of Engineering*
Leslie Tung, *Professor of Biomedical Engineering, School of Medicine*
Youseph Yazd, *Assistant Professor of Biomedical Engineering, School of Medicine*

Teaching-as-Research Fellowship Projects

K. **Comparing Student and Instructor Attitudes towards Course Learning Objectives and Teaching Strategies (HEART)**
Susan Liao, *PhD Candidate, Biochemistry, Cellular and Molecular Biology, School of Medicine*

L. **Patient Narratives as a Tool for Health Systems Performance Assessment**
Mariana Socal, *PhD Candidate, International Health, Bloomberg School of Public Health*

M. **The Impact of a "Check-in Routine" - A Group Activity which Aims to Prime Student Engagement - On Active Participation in College Teaching**
Erik T. Orberg, M.D., *PhD Candidate, Immunology Training Program, School of Medicine*

Keynote Speakers & Abstracts, January 11th

Richard Huganir
Professor and Director of the Solomon H. Snyder Department of Neuroscience; Director of the Kavli Neuroscience Discovery Institute; Co-Director of the Johns Hopkins Medicine Brain Science Institute
Johns Hopkins University

How does learning encode memories in our brain?

The human brain is a network of over 100 billion neurons that communicate with each other at trillions of contact points called synapses to form millions of unique electrical circuits. When we learn something new or form a new memory, new connections form, or the strength of connections or synapses change. These modified connections sculpt new neuronal circuits that actually physically encode the memory. This process is called synaptic plasticity. This talk will explore the molecular mechanisms involved in learning and memory. We try to understand what molecular changes occur in your brain when you learn something new and form a new memory.

Alan Yuille
Bloomberg Distinguished Professor of Cognitive Science and Computer Science
Johns Hopkins University

What can deep neural networks do?

Deep neural networks are very successful for computer vision applications such as detecting and recognizing objects. But there is limited understanding of how they work and whether they relate to neurons in the brain. This talk discusses strengths and weaknesses of deep neural networks with a range of examples. I will also present recent work, which gives some understanding of deep networks by showing that they can learn internal representations of objects. Finally, I will discuss the biological plausibility of neural networks, showing that they can account for some of the properties of neurons in the early visual cortex.

Ed Connor
Professor of the Solomon H. Snyder Department of Neuroscience and Director of the Zanvyl Krieger Mind/Brain Institute
Johns Hopkins University

What changes in the brain when we learn to recognize new shapes?

Learning to recognize new shapes, e.g., new letters, numbers, or other symbols, depends on changes in how the brain processes visual information. In this talk I will discuss how we measure these changes and understand how they produce visual recognition. We find that individual neurons in high-level visual cortex become responsive to logical combinations of shape fragments that distinguish between learned symbols.

Elissa Newport
Professor of Neurology; Director of the Center for Brain Plasticity and Recovery
Georgetown University

Why do children learn language better than adults?

In recent years a number of problems in the brain and cognitive sciences have been addressed through statistical approaches, hypothesizing that humans and animals learn or adapt to their perceptual environments by tuning themselves to the statistics of incoming stimulation. However, statistical learning is not merely learning the patterns that are presented in the input. Our research also shows that there are maturational changes in statistical learning, with children sharpening the statistics and producing a more systematic language than the one to which they are exposed. Our most recent work suggests that, when linguistic input is inconsistent, learners shift the languages they learn toward patterns that are common in natural languages, and children do this even more strongly than adults. These processes potentially explain why children acquire language (and other patterns) more effectively than adults, and also how systematic language structures emerge in communities where usages are varied and inconsistent. The central lessons for statistical learning approaches are that optimal statistical learning is not always veridical learning of the input statistics and that children do not learn identically to adults.

Katherine Kinzler
Associate Professor of Psychology and Human Development
Cornell University

How does language unite and divide us? How do children judge others based on their language, and how can being exposed to a bilingual context facilitate interpersonal understanding?

Beyond the literal content it provides, language conveys social meaning. This talk will explore the developmental origins of humans' thinking about language as a social category. People judge others based on their speech, and in some cases social attention to language and accent can surpass attention to race. Yet, while linguistic diversity may cause social divisions, it can also facilitate social understanding: children exposed to diverse linguistic environments exhibit more effective social communication skills than children in monolingual environments.

Jason Eisner
Professor of Computer Science
Johns Hopkins University

How can we use technology to gradually immerse a learner into a foreign language?

We propose that one should learn a foreign language by reading interesting prose. But how can one get started? We are building an intelligent user interface that partially translates text, leaning at first on the learner's native vocabulary but gradually introducing new foreign words and constructions in context. Faced with hybrid text of this sort, the learner can also use the mouse to translate or untranslate portions of a sentence; as a side benefit, this provides feedback about what the learner currently understands. This talk will give an overview of the project, including pedagogical motivation, modeling of the learner, data collection, user interface design, linguistic issues, and our use of machine translation and reinforcement learning inside the system.

Bruce McCandliss
Professor of the Graduate School of Education, Psychology and Stanford Neuroscience Institute
Stanford University

How does encouraging learners to focus their attention on the sound structure of language during learning impact brain activity associated with reading?

This talk will review recent research on brain processes that are important for learning to read. I will review recent insights into how encouraging learners to selectively attend to the sound structure of spoken words (i.e., phonology) changes activity in key brain areas that are crucial for reading. Furthermore, I will review how pedagogical approaches that encourage learners to attend to phonology drive changes in these regions during learning and explore the implications of these findings for the formation of brain circuitry that supports reading skill.

Brenda Rapp
Professor and Chair of Cognitive Science
Johns Hopkins University

What are some of the key challenges faced in establishing efficient brain networks for reading and spelling?

Reading and spelling are recent inventions compared to attention, spoken language and other skills whose brain bases have been shaped by long-time evolutionary pressures. As a consequence, there are specific challenges involved in establishing efficient brain networks for orthographic processing. In this talk, I will discuss neuroimaging findings that further our understanding of the nature of these challenges. In addition, I will discuss the considerable learning capacity and brain plasticity that support literacy learning throughout the lifespan.

Jonathan Plucker
Julian C. Stanley Endowed Professor of Talent Development
Johns Hopkins University

What are some pathways for implementing basic and applied research findings in K-12 schools?

Research on learning is a unique area within the social and life sciences, in that basic, applied, and translational research all play critical roles in improving practice and, critically, helping improve student learning. During this presentation, a case study will be described in how basic and applied research have been combined with a deliberate program of translational research to improve student outcomes, specifically in the area of promoting educational excellence and high-end learning. An emphasis will be placed on how various types of research need to interact with various levels of education and learning to produce positive student outcomes.

Keynote Speakers & Abstracts, January 12th

David J. Asai

Senior Director of Science Education
Howard Hughes Medical Institute

Rather than programs to "fix the student" and measure success by counting participants, how can we change the capacity of the institution to create an inclusive campus climate and leverage the strengths of diversity?

Inclusion is essential for scientific excellence. A diverse group of problem-solvers leads to better ways to find solutions to difficult and complex problems (see Scott Page, The Difference, 2007). In this talk I will explore why linear interventions (i.e., summer bridge activities, research experiences, remedial courses, and mentoring/advising programs), while at times effective, are not structured to effect the exponential change needed. More than improving science, inclusion is of existential importance: because of the rapidly changing demographics in our nation, the future of U.S. science depends on our ability to recruit scientists from the entire talent pool. *(Photo by Paul Fetters)*

Sheri Sheppard

Professor of Mechanical Engineering
Stanford University

How can learning objectives spawn creative course design? How can they help measure success?

Defining effective learning objectives is not easy. Yet, when well done, I will show how these objectives set the stage for a well-designed course, where students not only learn key knowledge, skills and attitudes (KSA), but are also challenged to integrate and connect their learning across courses. This talk will also demonstrate how well-done learning objectives support high quality course and program assessment, such that their achievement can actually be measured.

Eileen Haase

Senior Lecturer of Biomedical Engineering
Johns Hopkins University

How do we design learning spaces and courses that foster collaboration and innovation to address real-world challenges?

The Biomedical Engineering Design Studio offers the collaborative environment, lab space, equipment, and other resources necessary for undergraduate and graduate biomedical engineering students to brainstorm, design, prototype, build, and test solutions to real-world clinical and global health challenges. This talk will demonstrate how the studio is used to support a number of courses, workshops, and special events, such as the highly publicized Ebola Protective Gear Challenge. The Design Studio has become the nexus for the Biomedical Engineering program at Johns Hopkins, providing a facility where faculty, staff, and students can collaborate and apply their classroom knowledge to real world problems.

Melanie Cooper

Lappan-Phillips Chair of Science Education
Michigan State University

How do evidence-based approaches to curriculum reform and assessment support student learning?

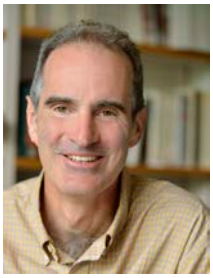
There is now fairly large body of work from the learning sciences that provides insights into how people learn; and from Discipline Based Education Research (DBER) we know what discipline-specific difficulties students face. While there is much discussion of evidence-based reform, most of these efforts are focused on incorporating pedagogical techniques, rather than redesigning the curriculum and the concomitant assessments of student learning in light of evidence from research. I will focus on the need for evidence-based curriculum reform, the research findings that can guide such reforms, and how we might assess the results of these reforms.

Tyrel McQueen

Associate Professor of Chemistry
Johns Hopkins University

Should foundational courses emphasize logical thought, scientific writing, and problem solving, or focus on knowledge transfer?

I will share experiences, frustrations, and triumphs from building the active learning freshman-level course "030.204 Chemical Structure and Bonding with Laboratory" from scratch. The introduction of concepts and initial 'routine' assessment are done in a set of thirty six 'pre-lectures', short online videos coupled to small quizzes, allowing the 'lecture' periods to focus on guided problem solving on boards. This model provides a scalable approach to a hands-on, discovery driven experience that fosters asking questions, problem solving, creativity, logical deduction, observation, and skepticism.



Robert Leheny

Professor of Physics
Johns Hopkins University

What have been the challenges and successes in developing of an active-learning-based course in introductory physics at JHU?

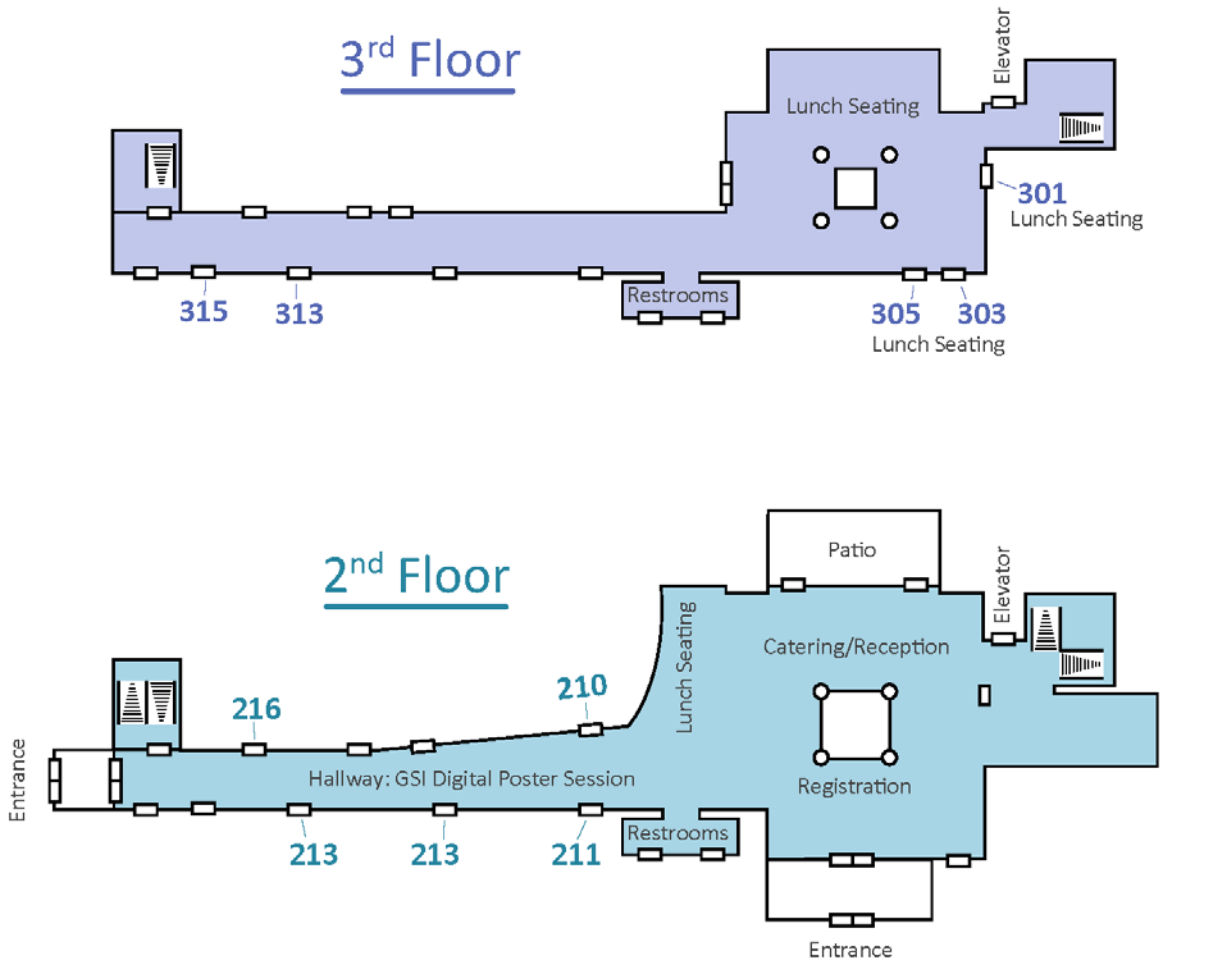
A major element of an effort to integrate more fully active-learning methods into the introductory physics curriculum has been the creation of a new track in first-year physics modeled on the "SCALE-UP" approach that integrates studio-style instruction into a large-class setting. I will recount the process through which the Department decided to create this course, describe the structure of a typical class and its cooperative group learning activities, and report some initial assessments. I will particularly focus on the design of simple experiments performed by the students in class that make concrete what are otherwise abstract ideas and that enable the students to test their conceptual understanding by comparing predictions against observations.

Steven Luck

Professor of Psychology
University of California Davis

What are the methods, benefits, challenges and assessment recommendations for transforming a traditional large lecture course into a hybrid format?

I will present how a "flipped" instructional format makes it possible to implement several useful pedagogical strategies into lectures and frees up instructor time to lead discussion sections where students learn key skills (i.e., understanding, evaluating, and explaining journal articles) that could not be taught in a traditional lecture course. A rigorous evaluation process demonstrates that this new format led to better learning of the all the original material, plus significant learning of additional skills.


3rd Floor
Lunch Seating
Elevator
301
Lunch Seating
315
313
Restrooms
305
303
Lunch Seating
2nd Floor
Patio
Elevator
Lunch Seating
Catering/Reception
216
210
Entrance
Hallway: GSI Digital Poster Session
Registration
213
213
211
Restrooms
Entrance
Ground Floor
Elevator
110
110
Entrance
Restrooms
Coat Racks

JOHNS HOPKINS
SCIENCE of LEARNING
INSTITUTE

The Science of Learning Institute seeks to understand and optimize the most essential part of our human capital: the ability to learn. The Institute supports interdisciplinary research that will generate scientific discoveries and build meaningful connections between research, practice, and policy. The Institute has three goals:

1. *Support Cutting-Edge Science of Learning Research.* Our grant programs support faculty who will generate new scientific discoveries about lifelong learning through interdisciplinary collaborations spanning basic and applied sciences.

2. *Train Future Leaders in the Science of Learning.* We train early career scientists to think broadly about learning, to generate innovative perspectives and research on how we learn, and to build meaningful connections between research, practice, and policy.

3. *Connect Science to Practice.* We collaborate with educators, practitioners and policymakers to advance the understanding of science of learning research and translate research into meaningful, evidence-based practices, programs, and policies.

Gateway Sciences Initiative

The Gateway Sciences Initiative is a multi-dimensional program to improve and enrich learning in undergraduate and graduate gateway sciences at Johns Hopkins University. Through a grant program, Symposia on Teaching Excellence, and a new Innovative Instructor blog, the University seeks to improve our understanding of how students learn and to promote pedagogical innovation in courses that form the foundation for, or provide a gateway to, more advanced work in sciences, engineering, and quantitative studies.

A special note of thanks is extended to the
Office of the Provost, Johns Hopkins University
and the private philanthropic donations
of symposia sponsors.