



Stimulating Science in a Unique Setting



RESEARCH UPDATE IN NEUROSCIENCE FOR NEUROSURGEONS (RUNN)

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SPONSORED BY

**The Society of
Neurological Surgeons**

CO-DIRECTORS

**Bruce Andersen
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COURSE DIRECTORS

**Allan H. Friedman, M.D.
Robert M. Friedlander, M.D.**

COURSE COORDINATOR

Karen Koenig

Mission Statement

The Mission of the course, Research Update in Neuroscience for Neurosurgeons (RUNN), is to provide an introduction to and update of the latest concepts, hypotheses and methods of neurobiology and neuroscience relevant to neurological surgery. These are presented by accomplished neuroscientists in an atmosphere emphasizing scientific rigor, highlighting models of career development for neurosurgeon-scientists, and illustrating potential future neurosurgical applications. A milieu of total immersion in scientific discourse is designed to foster creative discussions among neurosurgical trainees and faculty. Participants are instructed on selecting a research topic, identifying a mentor, designing hypothesis driven experiments and writing grants. The course is designed to stimulate neurosurgical trainees to participate in basic, translational, and clinical research relevant to the practice of neurological surgery.

Historical Background and Setting

The RUNN course was the brainchild of Henry Schmidek, formerly of Harvard University and the University of Vermont. The course was conceived in response to the anticipated expansion of neurosciences, which would be applicable to the practice of Neurosurgery. The course was initiated to combat illiteracy in basic neurobiology that he feared would weaken the specialty of Neurosurgery. Dr. Schmidek's RUNN Course has been instrumental in setting the course of many academic neurosurgeons.



As with so many neuroscientists from New England, Dr. Schmidek was very familiar with the Marine Biological Laboratory (MBL) at Woods Hole, Massachusetts. Established in 1888 as a non-profit institution devoted to research and education in basic biology, the MBL has been called “the uniquely national center for biology in this country” (Lewis Thomas, *The Lives of a Cell*).

Scientists and students throughout the world come to the MBL to conduct research, teach, study and collaborate. They often use the diverse and abundant organisms found in surrounding waters as model systems. Here research ships leave everyday to study the pristine waters around Martha's Vineyard sound and to collect and maintain more than 200 species of marine life. There are 230,000 square feet of research space at the MBL and a splendid library with an extraordinary repository of books and journals and incredible electronic connectivity to everything biological. It is here that the giant squid axon was (and continues to be) closely studied unfolding the splendid story of molecular mechanisms of neural function. There are incredible microscopy facilities, numerous amphitheaters and teaching facilities, a quintessential scientific community in true life and work, and a magnificent setting for creativity and scholarly productivity. And there is Swope

Hall, a simple dormitory sleepily straddling a quaint harbor, with a friendly staff that knows how to host students and scholars. It is all in Woods Hole, that lovely little spot and ideal gateway, along the magnificent coast of Cape Cod. With miles of bicycle and jogging trails and nearby ferries, the only competition to diligent scholarship at Woods Hole is the inspiring call of nature.



It is here that Henry Schmidek cast his RUNN course, and lobbied other residency program directors to send their trainees once a year. By the mid-1980's it was an established offering for two weeks each fall, immersing neurosurgery residents from New Orleans to Saint Louis, from Minnesota to Maryland, and from San Francisco to New York City. The faculty included scientists from the MBL, demonstrating microscopy and dissection and scientists from the New England

universities who would drive to the MBL for one or two days to participate in RUNN. There would also be neurosurgery's rising academic stars as role models, and wiser icons telling their tales of successes and challenges in the laboratory.



There was nothing like it in neurosurgical education, and there still is not. The founding mission of the RUNN course remains relevant today, and its culture and milieu remain as appealing. This crown jewel of American neurosurgical education was adopted in the late 1980's by the American Association of

Neurological Surgeons (AANS) and later by the Joint Committee on Education of the AANS and the Congress of Neurological Surgeons (CNS). This endorsement and administrative oversight by organized neurosurgery heralded an era of expansion and uninterrupted success under the Directorship of Charles Hodge, of Syracuse, New York, with his lovely wife Cathy shepherding the Course as its coordinator. In the mid 1990's Dr. Hodge became Co-Director, passing the helm of Directorship to Cordell Gross, of Burlington, Vermont. Linda Gross served as Course Coordinator.

During this period, Charlie and Cordell cultivated a core of devoted faculty from the MBL, Syracuse, Vermont, Harvard, Brown, the National Institutes of Health (NIH), and other institutions who would participate on a regular basis as faculty. A requirement for faculty participation remains-- that the individual be an active and accomplished scientist, speaking on topics he/she actively investigates, and that he/she be an effective speaker. Only those who are highly rated by the neurosurgical trainees would be invited again. Many would dazzle and inspire casting truly unforgettable lectures or discussions. The days would be filled with lectures, unhurried, with plenty



of time for discussion. There would be long blocks of time for reading in the library, or for creative and vivid discussions with beer, wine and snacks late into the night. Friendships would be forged among attendees, and research ideas and even an occasional scholarly career would be hatched. All attendees stay at the dorm at Swope Hall, where the legendary cafeteria is like no other, and the views from each simple bedroom (many shared by two residents) as memorable.

Because of untimely illness in 1998, Dr. Gross asked to step down from the Directorship of the RUNN Course which he had grown to love so much. The opportunity of change of leadership allowed a re-examination and re-commitment to the Mission and core values of the RUNN Course. The AANS and CNS asked the Society of Neurological Surgeons (SNS) to assume sponsorship and oversight of the course. Established in 1920 the SNS is known in neurosurgical lore as the “Senior Society” or organization of North American Chairmen and Residency Program Directors. The SNS would insure Program Directors’ continued commitment to this unique educational offering, and ensure residents’ continued participation.

In 1999, the leadership of the RUNN Course was entrusted to Issam A. Awad. Dr. Awad broadened the goals of the RUNN Course to educate neurosurgical residents in formulating hypothesis driven experiments, establishing laboratories and writing grants. To this end, several neurosurgeons who headed successful basic science laboratories were added to the faculty. The Society owes a debt of gratitude to Cathy Awad who administered the Course during Dr. Awad’s tenure. Cathy coordinated everything from “T” shirts to accommodations to finances.

RUNN Course Leadership

In 2004, Dr. Awad passed the baton of leadership to Allan H. Friedman (Duke University) and Robert M. Friedlander (University of Pittsburgh) as the new Directors of the Course. The Co-Directors of the Course are Issam A. Awad (University of Chicago), Bruce Andersen (Idaho Neurological Institute), Henry Brem (Johns Hopkins), E. Antonio Chiocca (Harvard) and Robert J. Dempsey (University of Wisconsin). Dr. Bruce Andersen works closely with Jim Galbraith (Oregon Health Sciences) to run a squid giant axon physiology hands-on laboratory experience. Course Coordinator, Karen Koenig, works throughout the year to insure RUNN is executed flawlessly, managing the organization, administration and accounting of the Course.

The 2015 RUNN Course Curriculum: Tradition and Innovation

The founding mission and core values of the RUNN Course remained unchanged. The SNS Executive Committee (representing North American Residency Program Directors) rearticulated its commitment to the course and its leadership.



In response to recent course evaluations and discussions with Program Directors and residents, the course was shortened in 1999 from two weeks to one week with travel days on adjacent weekends. The one and one-half hour length of individual lectures allows for stimulating interaction between the lecturer and the participants. Two such lectures are given each morning, two each afternoon, and one each evening. Curriculum content was reshaped to include lectures covering the spectrum of molecular, cellular and systems neuroscience. Lectures covered topics on molecular genetics, signaling and receptors, stem cells, cell death, regeneration, oncogenesis, glial barriers, vascular tone and phenotype, cognitive information science, circuit modeling, and higher cortical function. Although many of the lecturers return, their material is surprisingly fresh reflecting new discoveries made in their labs. Many of the lectures were given by practicing neurosurgeons with actively funded laboratories. There were tours of the MBL laboratories and the very popular squid giant axon dissection lab. There were discussions on academic career development, grantsmanship, history and philosophy of science and the scientific method, and history of the MBL. And there were the traditional opening get-acquainted reception and Course Orientation, and the farewell Lobster Bake and Diploma ceremony.



New Lectures Presented at the 2015 Course:

1. **Avniel Singh Ghuman, Ph.D.**, Assistant Professor of Neurological Surgery Director, Magnetoencephalography (MEG) Research, **Lecture Title: “Invasive and Non-invasive Electrophysiology for Understanding Human Cognition”**
2. **Nir Lipsman, M.D.**, Chief Neurosurgery Resident, Division of Neurosurgery, University of Toronto. **Lecture Title: “Brain Circuitry and Human Behavior: What Can Go Wrong and What Can We Do About It?”**
3. **Beth Stevens, Ph.D.**, Assistant Professor of Neurology, Department of Neurology, Children’s Hospital Boston, Intellectual and Developmental Disabilities Research Center, **Lecture Title: “Wiring and Unwiring the Brain: Role of Glia and Immune Molecules”**

The collegial atmosphere at Swope Hall remained unchanged, as were the memorable late night sessions with snacks, beer and wine and the very late night sessions at Captain Kidd's where residents discussed everything from research topics and career paths, to residency training, to NFL football. Each attendee received a hoodie sweatshirt embroidered with Research Update in Neuroscience for Neurosurgeons (RUNN) 2015.



Splendid Cast of Faculty

The faculty are world-class scientists who are able to present their work in a stimulating fashion. There were 29 faculty and 7 directors, representing an extraordinary student/faculty ratio of 3/1. Attendees were mesmerized by the dynamic speakers and post lecture discussions were lively and probing. The residents discussed personal choices in research commitments and career direction with the invited speakers. Many faculty members had participated in the RUNN Course for several years, and all promised to come again if invited. The Course evaluations filled out by the attendees are used to make modifications in the course's speakers and structure.

An Enthusiastic Cast of Attendees

A record number of 106 neurosurgery residents representing programs throughout the United States and Canada attended the course. The reshaped course is ideal for young attending neurosurgeons just embarking on their academic career. Our goal is to attract one neurosurgeon from each neurosurgical program in North America.

Our participants continue to be enthusiastic. It is exciting to see the participants swept up in the lectures and spontaneously confronting the lecturers with insightful questions. If this group is representative of neurosurgical residents, the future of neurosurgery looks very bright.



Course Report by Max Krucoff, M.D. Neurosurgical Resident, Duke University Hospital

Every year select neurosurgery residents from around the country gather to attend the RUNN course – a week long retreat in Woods Hole, Massachusetts, organized by Dr. Allan Friedman from Duke and Dr. Robert Friedlander from The University of Pittsburgh. Here, learners are exposed to the latest research in neuroscience and neurosurgery (hence the name) from those who are driving it. Attendees are privy to talks that span the breadth of neuroscience, both basic and clinical, from an esteemed list of lecturers that includes department chairs, McArthur genius grant winners, large NIH and private grant holders, and professionals in a variety of careers (e.g. engineers, scientists, neurosurgeons, etc.) who are all at the peak of their respective fields.

At face value, the agenda offers a crash course in modern neuroscience that updates the audience's knowledge of the state of the art. This in turn enables participants to focus their own research ideas and goals accordingly. More profoundly, however, the course offers its subjects the experience of being part of a special group of people who are all undergoing parallel and equally intense residency experiences of their own. The collective awareness and vibrancy of the group is something that is difficult to describe in prose, but is sensed by virtually all of its participants.



Personally, I encountered an engaging group of residents from across the country, several of whom I continue to keep in touch with and who will be lifelong friends and colleagues. After the daily lectures, many of us would gather at the local bar to discuss the most interesting topics from the day and relay tales of our personal residency experiences. It was these interactions that end up being the most unforgettable part of the week. My colleagues and I left the course with a sense of camaraderie and a renewed

energy with which to return to our residency programs and pursue what we all remembered to be our dreams. Ultimately, the course helped re-excite and remind me of my passion for the pursuit of creativity and knowledge, and inspired ideas for research projects that I am currently pursuing.

I am thankful for the time I was able to spend focused on pure learning, and for the relationships I formed during this time. It is no overstatement to say that it undoubtedly has been a career-shaping experience that I will never forget, and I would encourage all resident who are able to attend to do so without hesitation.

Course Report by Shervin Rahimipour, M.D. Neurosurgical Resident, Duke University Hospital

The RUNN course, held in historic Woods Hole Marine Biological Laboratory, was created in anticipation of the expansion of the neurosciences and an effort to ensure neurosurgeons remain up to date on advancements in research. A consequence of this has been the establishment of a stimulating and instrumental week-long dialog for future academic neurosurgeons. While the MBL is used as a world class research facility for marine biology research including research that has led to several Nobel prizes, it serves as an ideal facility for residents to gather and immerse themselves in a week long didactic on cutting edge neuroscience.

The course began with several lectures from leading neurosurgeon-scientists on grant writing and the beginnings to a successful academic career. The lectures quickly switched gears to discussions on spinal biomechanics, nanoparticle drug delivery, neural synaptivity, psychosurgery, restoration



of limb movements and other brain machine interface devices, to name a few. Each lecture captured the interests of different audience members, stimulating conversation between neurosurgery residents and leading experts of their respective fields. For me, I came into the RUNN Course with a research interest in functional neurosurgery, specifically movement disorders. While lectures on this topic were certainly captivating for me, I found that topics that may not have

specifically overlapped with my interests often offered novel techniques that may be applicable to old problems. As neurosurgery residents, it is not often that we have time to turn off the pagers and engage ourselves in a dedicated way towards tackling basic science questions and refining our own research ideas. The RUNN course is, however, just that!

While only a week, the course inspired me in a very meaningful way and left me energized as I pursue a career in academic neurosurgery. I feel strongly that every neurosurgery resident should have the opportunity to experience the RUNN course

We acknowledge generous grants from:

Education Grants 2015 RUNN Course	
Integra Foundation.....	\$5,000.00
Stryker Corporation (CMF & Neuro, Spine, ENT (NSE)	\$5,000.00
Surgicore.....	\$3,000.00
Zimmer/Biomet	\$3,000.00
Arbor Pharmaceutical, L.L.C.	\$2,500.00
Brainlab, Inc.	\$2,500.00
DePuy Synthes Codman Neuro	\$2,500.00
DePuy Synthes Power Tools/Anspach.	\$2,500.00
Leica Microsystems, Inc.....	\$2,500.00
Carl Zeiss Meditec, Inc.	\$2,500.00
Mizuho America	\$1,000.00
TOTAL	\$32,000.00

These grants subsidized faculty travel and honoraria costs.

Toward RUNN 2016 and Beyond!

We have finalized space contract with the MBL for 2016. RUNN 2016 will take place from October 29, 2016 – November 5, 2016. The SNS and the Course Co-Directors and Coordinator are committed to maintaining the best of the RUNN Course, while continuing to strive to enhance curriculum content and value to each registrant. We continue to call on Residency Program Directors to support this unique gem of North American Neurosurgical Education, by providing their residents the opportunity of exposure to, and update on the best of neurobiology. We hope that future courses will also attract fellows and young faculty at formative states of their academic careers, and to practicing neurosurgeons who want to get reacquainted with the future of neurosurgery!

RUNN Web Site

<http://www.societyns.org>



RUNN Course 2015 Attendees:

Adepoju, Adedamola	Albany Medical Center
Aliaga, Leonardo	University of California Los Angeles
Beckett, Joel	University of California Los Angeles
Behbahani, Mandana	University of Illinois Chicago
Boghani, Zain	Houston Methodist Hospital
Booher, Grant	University of Texas Health Sciences, San Antonio
Bullis, Carli	Oregon Health and Science University
Cajigas, Iahn	University of Miami
Chakraborty, Shamik	Hofstra North Shore-LIJ Neurosurgery Program
Chiluwal, Amrit	Hofstra North Shore-LIJ Neurosurgery Program
Cho, Newton	University of Toronto
Conner, Andrew	University of Oklahoma College of Medicine
Darrow, David	University of Minnesota
Davis, Matthew	University of Alabama at Birmingham
DiGiorgio, Anthony	LSUHSC New Orleans
Doan, Ninh	Medical College of Wisconsin
Du, Victor	Hofstra North Shore-LIJ Health System
Edem, IDARA	University of Ottawa
Ene, Chibawanye	University of Washington
Eseonu, Chikezie	Johns Hopkins Hospital
Esfahani, Darian	University of Illinois at Chicago
Faraji, Amir	University of Pittsburgh Medical Center
Foreman, Paul	University of Alabama at Birmingham
Foxx, Kenneth	University of Rochester
Gandhi, Shashank	Hofstra North Shore-LIJ Health System
Gill, Brian	Columbia University, New York Presbyterian
Goldschmid, Ezequiel	University of Pittsburgh
Grewal, Sanjeet	Mayo Clinic Florida
Guan, Jian	University of Utah

RUNN Course 2015 Attendees: continues

Hamilton, Kimberly	University of Wisconsin
Hazama, Ali	Upstate Medical University
Hefner, Matthew	LSU Health Sciences Center Shreveport
Heller, Robert	Tufts Medical Center
Herschman, Yehuda	Rutgers State University New Jersey
Himes, Benjamin	Mayo, Rochester MN
Hollon, Todd	University of Michigan
Hussain, Namath	Penn State Hershey
Jack, Megan	University of Kansas Medical Center
Kahn, Lora	Tulane-Ochsner University
Katzen, Stephen	University of Texas Medical School at Houston
Kerr, Keith	University of Texas Medical School at Houston
Koffie, Robert	Massachusetts General Hospital
Kole, Matthew	University of Maryland
Kovanda Timothy	Indiana University
Krucoff, Max	Duke University Hospital
Kunigelis, Katherine	University of Colorado School of Medicine
Kuzmik, Gregory	Yale University School of Medicine
Lamm, John	University of Kentucky
Li, Xun	UVM Medical Center
Li, Yiping	University of Wisconsin
Lipsman, Nir	University of Toronto
Lockney, Dennis	University of Florida
Lowe, Stephen	Medical University of South Carolina
Massie, Lara	Henry Ford
Mathes, Adam	Wake Forest
McDougall, Ian	University of Texas Health Sciences, San Antonio
Meleis, Ahmed	Rutgers State University New Jersey
Meng, Ying	University of Toronto
Moldovan, Krisztina	Brown University
Monaco, Gina	Indiana University School of Medicine
Monsivais, Daniel	University of Texas Medical School at Houston
Mukherjee, Debraj	Cedars-Sinai Medical Center
Mushlin, Harry	University of Maryland
Nakhla, Jonathan	Montefiore Medical Center
Nathan, Jay	University of Michigan
Omofoye, Seun	UNC Department of Neurosurgery
Paluzzi, Jason	University of South Florida
Patel, Vaibhav	University of Texas Health Sciences, San Antonio

RUNN Course 2015 Attendees: continues

Payne, Russell	Penn State Hershey
Pendharkar, Arjun	Stanford Hospital and Clinics
Penn, David	Brigham and Women’s Hospital
Pennicooke, Brenton	Weill Cornell Medical College
Polster, Sean	University of Chicago
Prickett, Joshua	Carilion Clinic
Prolo, Laura	Stanford Hospital and Clinics
Quinn, IV, Coridon	University of Minnesota
Radwan, Walid	West Virginia University
Rahimpour, Shervin	Duke University Hospital
Rodriguez, Abraham	University of Missouri
Romeo, Andrew	University of Alabama at Birmingham
Ronecker, Jennifer	New York Medical College
Root, Brandon	Dartmouth Hitchcock Medical Center
Salveti, David	University of Pittsburgh Medical Center
Sami, Mairaj	University of Kansas Medical Center
Say, Irene	Rutgers State University New Jersey
Schmalz, Philip	University of Alabama at Birmingham
Shah, Jugal	New York University
Sieg, Emily	Penn State Hershey
Simpson, Lauren	Oregon Health and Science University
Smith, Brandon	University of Michigan
Stark, Jessica	University of Texas Medical School at Houston
Steele, William	Houston Methodist Hospital
Suppiah, Suganth	University of Toronto
Sweiss, Fadi	GWU – George Washington University, DC
Todnem, Nathan	Medical College of Georgia, Georgia Regents University
Tomasiewicz, Hilarie	Weill Cornell Medical College
Uluc, Kutluay	University of Wisconsin
Valdes Quevedo, Pablo	Brigham and Women’s Hospital
Wicks, Robert	Wake Forest University
Woodard, Jos’lyn	University of California, Los Angeles
Wright, James	University Hospitals Case Medical Center, Cleveland
Yang, Alex	University of Colorado School of Medicine
Yap, Edward	UNC Department of Neurosurgery
Yeung, Jacky	Yale University School of Medicine
Zinn, Pascal	Baylor College of Medicine
Zussman, Benjamin	University of Pittsburgh Medical Center

Faculty and Topics

Bruce Andersen, M.D., Ph.D.

Saint Alphonsus Neuroscience Institute
“Squid Lab”

Issam A. Awad, M.D., MSc, FACS

University of Chicago
Lecture Title: “Philosophy of Science in Relevance to Neurosurgery” and “Deconstructing a Neurosurgical Disease: A Path to Therapy for Cerebral Cavernous Malformation”

Larry Benowitz, Ph.D.

Harvard University
Lecture Title: “Rewiring the Injured CNS”

Edward Benzel, M.D.

Cleveland Clinic
Lecture Title: “Spine, Biomechanics, Clinical Practice, and the Quest of Academic Excellence”

Kerry Bernstein, Ph.D.

Lecture Title: “A Matter of TRUST”

John Bookvar, M.D.

Cornell University
Lecture Title: “Intra-arterial Chemotherapy After Blood Brain Barrier Disruption to Target the Glioma Stem Cell Niche in Malignant Brain Tumors”

Henry Brem, M.D.

The Johns Hopkins Hospital
Lecture Title: “Brain Tumor Therapy”

Mark P. Burns, Ph.D.

Georgetown University
Lecture Title: “Acute CNS Injury and Chronic Neurodegenerative Disease: Common Pathways and Therapeutic Targets”

E. Antonio Chiocca, M.D., Ph.D.

Harvard University
Lecture Title: “Translational Therapeutics for Brain Tumors: From the Lab to the Clinic and Back”

Robert Dempsey, M.D.

University of Wisconsin
Lecture Title: “Inspiration and Neurosurgical Research – How to Start a Project, Grant or Paper”

V. Reggie Edgerton, Ph.D.

UCLA Medical Center
Lecture Title: “Activity Dependent Mechanisms that Enhance Sensorimotor Function Following Spinal Cord Injury”

Robert M. Friedlander, M.D.

University of Pittsburgh
Lecture Title: “Mechanisms of Cell Death in Neurologic Diseases”

James Galbraith, Ph.D.

Oregon Health Sciences
Laboratory Experience: “Squid Lab”

Zoher Ghogawala, M.D., FACS

Tufts University School of Medicine
Lecture Title: “What is Comparative Effectiveness Research, Why Should We Care About This Topic?”

Avniel Singh Ghuman, Ph.D.

University of Pittsburgh
Lecture Title: “Invasive and Non-invasive Electrophysiology for Understanding Human Cognition”

Murat Günel, MD

Yale University
Lecture Title: “Next Generation Genomics”

Faculty and Topics continues

Michael M. Haglund, M.D., Ph.D., FAANS, FCS (ECSA)

Duke University Medical Center

Lecture Title: "Academic Neurosurgery and Global Health"

Robert E. Harbaugh, MD, FACS, FAHA

Penn State University

Lecture Title: "Issues in Neurosurgical Clinical Research"

Nir Lipsman, M.D.

University of Toronto

Lecture Title: "Brain Circuitry and Human Behavior: What Can Go Wrong and What Can We Do About It?"

L. Dade Lunsford, M.D., F.A.C.S.

The University of Pittsburgh

Lecture: "The Expanding Role of Radiosurgery as a Part of Neurosurgery."

Joseph R. Madsen, M.D.

Harvard Medical School

Lecture Title: "Signals and Systems in the Human Brain: Water and Electricity"

James T. Rutka, MD, PhD, FRCSC, FACS, FAAP

University of Toronto

Lecture Title: "Glioblastoma Multiforme: Advances Beyond the Leading Edge"

Walter Schneider, Ph.D.

University of Pittsburgh

Lecture Title: "Clinically Actionable Fiber Tracking in Neurosurgery & Traumatic Brain Injury: MRI Tract Visualizations with Quality Exceeding Microdissection"

Andrew B. Schwartz, Ph.D.

University of Pittsburgh

Lecture Title: "Advances in High Performance Brain-Controlled Prosthetics"

Marc Simard, M.D., Ph.D.

University of Maryland

Lecture Title: "The SUR1-TRPM4 Channel – a Critical Player in CNS Ischemia and Trauma"

David Sinclair, Ph.D.

Harvard Medical School

Lecture Title: "Genes and Small Molecules that Extend Lifespan"

Beth Stevens, Ph.D.

Harvard University, Children's Hospital Boston

Lecture Title: "Wiring and Unwiring the Brain: Role of Glia and Immune Molecules"

Klaus van Leyen, Ph.D.

Massachusetts General Hospital Radiology

Lecture Title: "Targeting Mechanisms of Injury and Repair in Stroke"