IEEE Life Sciences Grand Challenges Conference

Session 3: Education and Training

Richard A. Baird, PhD
Director, NIBIB Division of Interdisciplinary Training
National Institutes of Health

Melur Ramasubramanian, PhD
W.H. Reynolds Professor and Chair, Mechanical Engineering
Clemson University

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NIH Standard Training Model

Mentored support for *graduate students* working toward their doctoral degrees and *postdoctoral fellows* obtaining additional research experience in a mentor’s laboratory.

**Institutional Training Grants:**
- T32 – Full-time Institutional Training
- T35 – Short-term Institutional Training

**Individual Fellowships:**
- F31 – Predoctoral Fellowships
- F32 – Postdoctoral Fellowships
Mentored support for basic and clinical investigators who are transitioning to independence, changing their research focus, or need protected research time.

- **K99/R00** – Pathway to Independence Award
- **K01** – Research Scientist Development Award
- **K25** – Quantitative Scientist Development Award
- **K08** – Clinical Scientist Development Award
- **K23** – Patient-Oriented Development Award

**K Kiosk:** [http://grants1.nih.gov/training/careerdevelopmentawards.htm](http://grants1.nih.gov/training/careerdevelopmentawards.htm)
Ongoing Training Grand Challenges

- Undergraduate STEM preparation.

- Increasing STEM participation by underrepresented groups.

- Multidisciplinary / interdisciplinary training for engineers, biological, computational, and physical scientists.

- Clinical and translational training for engineers and physical scientists.
Team-based Design in Biomedical Engineering Education (R25)

- Supports open-ended team-based design courses for undergraduate students in biomedical engineering.
- Uses clinical immersion to introduce biomedical engineers to clinical needs and clinical environment.
- Emphasizes translation of biomedical devices, including industrial design, regulation and commercialization.
Challenge open to bioengineering undergraduate students.

Team-based design projects in three categories:
- Diagnostic Devices/Methods
- Therapeutic Devices/Methods
- Technology to Aid Underserved Populations and Individuals with Disabilities

Winners in each category receive:
- $10,000 cash prize,
- $2,000 in travel costs to attend DEBUT Award Ceremony at BMES Annual Meeting
NIH Director’s Pathfinder Award

- Promote and improve diversity in the biomedical workforce.
- Support unique and novel research on the issue of diversity in the biomedical and behavior sciences.

Expanding Diversity in Engineering and the Physical Sciences

- Increase participation of underrepresented populations in engineering and the physical sciences.
- Test relative effectiveness of intensive recruitment; financial assistance; academic tutoring; student and faculty mentoring; professional development; and research experiences in increasing retention, academic achievement, graduation rates, and post-graduation career choices.
Institutional Research Training

Disciplinary

Multidisciplinary

Convergence

Interdisciplinary
HHMI-NIBIB Interfaces Initiative for Graduate Research Education

Supports interdisciplinary training programs that:
- Integrate the biological and physical sciences.
- Promote academic institutional change.
- Increase number of interdisciplinary researchers.

- Phase I – Howard Hughes Medical Institute (HHMI)
  November, 2005 - HHMI makes Phase I awards.

- Phase II – NIBIB program announcement
  April, 2009 – NIBIB makes Phase II Awards.
This interdisciplinary program, using Boot Camps in computation and molecular biology and Team Challenges in biomedical imaging, molecular biology, and systems biology, trains students to understand and engineer complex biological systems from the molecular to the organismal level.

Challenge 1 – *Design and build a fluorescent microscope from component parts, using it to analyze an unknown spectrum.*

Challenge 2 – *Given a set of yeast samples, deduce what molecular perturbation occurred prior to their demise,* using appropriate genomic microarrays and bioinformatic tools.

Challenge 3 - *Design a novel synthetic biological behavior,* using literature-derived genetic elements and specifying the system at the DNA level.
This interdisciplinary training program, by integrating graduate and medical coursework and mentoring students with basic and clinical preceptors, produces translational scientists who understand the medical basis of disease and have the technological know-how to develop new imaging methods for detection, diagnosis, and treatment.
New Training Grand Challenges

- Increased support for interdisciplinary science and early-stage interdisciplinary investigators.
- On-line interactive learning and web-based collaboration tools.
- Multi-institutional education and research training.
- Training externships and public-private partnerships between academia and private industry.
Biomedical Research Workforce

Structural Problem:

- The *upsurge in US-trained PhDs, increased influx of foreign-trained PhDs, and aging of academic workforce* make launching a traditional academic research career increasingly difficult.

- The *long training time and low early-career salaries* for many biological disciplines make a biomedical research career less attractive to the best and brightest.

- *Many NIH training programs do little to prepare people for anything besides an academic research career*, despite clear evidence that a declining percentage of graduates are finding such positions.
The NIH Common Fund invests millions of dollars to fund new high-risk research to explore ideas that have strong potential to improve health. Transformative R01 Awards (since 2009) support creative projects that have the potential to overturn conventional research paradigms.

Pioneer Awards (since 2004) support scientists of exceptional creativity who propose pioneering approaches to major research challenges.

New Innovator Awards (since 2007) support promising new investigators and stimulate highly innovative research.

Early Independence Awards (since 2010) help outstanding early-career investigators skip postdoc training and launch independent research careers.

Transformative R01 Awards (since 2009) support creative projects that have the potential to overturn conventional research paradigms.
In 2012, HHMI and NIBIB solicited supplement applications from NIBIB training programs to disseminate educational strategies and ‘best practices’ to advance interdisciplinary training.

**Interactive Web-based Training Biomedical Imaging Physics**

Georges El Fakhri, PhD
Mass General Hospital

Development of web-based video lectures and online reference manual on the physics of biomedical imaging.

**Teaching Systems Biology: A Regional Workshop**

Arthur Lander, PhD
UC, Irvine

Workshop to articulate and disseminate effective training strategies, including teaching materials and web-based videos, to advance Systems Biology.

**Disseminating Hands-On Training Experiences in Multi-Scale Biology**

Andrew McCulloch, PhD
UC, San Diego

Development and dissemination of web-based training materials for lab-based courses in biomedical imaging, numerical analysis, neuroengineering and tissue engineering.
Global Enterprise for Micro-Mechanics and Molecular Medicine (GEM⁴)

- Addresses problems at the intersection of engineering, life sciences, technology, and medicine.
- Global forum for development of novel educational tools and cross-fertilization of ideas among the above disciplines.
- 14 participating institutions, including Columbia, Georgia Tech, Harvard, Johns Hopkins, MIT, Texas A&M, UIllinois, UPenn, UPittsburgh, Princeton, Washington University, Yale, Institut Pasteur, Max-Planck Institute, and Natl University of Singapore.

Delegates from 2012 GEM⁴ Summer School, London