Institute for Quantitative Biomedicine at Rutgers
July 1st 2015-June 30th 2016 Annual Report

Title of Initiative:

Institute for Quantitative Biomedicine at Rutgers (IQB@R)

Institute Website:

IQB.Rutgers.edu

People:

Stephen K. Burley, M.D., D.Phil.

IQB@R Roles:
Founding Director
Co-Chair, Research Working Group in Cancer Genomics and Proteomics
Co-Chair, Research Working Group in Antimicrobial Resistance

Rutgers Affiliations:
Distinguished Professor of Chemistry and Chemical Biology
Director, Center for Integrative Proteomics Research
Director, RCSB Protein Data Bank
Co-Leader, Cancer Pharmacology Research Program and Member
Rutgers Cancer Institute of New Jersey

Gail Ferstandig Arnold, Ph.D.

IQB@R Roles:
Associate Director
Associate Director, Graduate Program in Quantitative Biomedicine

Rutgers Affiliation:
Research Professor of Chemistry and Chemical Biology

Eduardo Sontag, Ph.D.

IQB@R Role:
Director, Graduate Program in Quantitative Biomedicine

Rutgers Affiliation:
Distinguished Professor of Mathematics

Shridar Ganesan, M.D., Ph.D.

IQB@R Role:
Co-Chair, Research Working Group in Cancer Genomics and Proteomics

Rutgers Affiliations:
Omar Boraie Chair in Genomic Science
Associate Director of Translational Science and Member, Rutgers Cancer Institute of New Jersey
Associate Professor of Medicine and Pharmacology, Robert Wood Johnson Medical School

David S. Perlin, Ph.D.

IQB@R Role:
Co-Chair, Research Working Group in Antimicrobial Resistance

Rutgers Affiliations:
Executive Director, The Public Health Research Institute
Director, Rutgers Regional Biocontainment Laboratory
Professor of Microbiology and Molecular Genetics, Rutgers New Jersey Medical School

Summary of the IQB@R Initiative

Vision:

Rutgers system-wide center-of-excellence for interdisciplinary quantitative biomedical research.

Mission:

1) To foster a vibrant, cohesive community of Rutgers basic, applied, and clinical scientists committed to application of tools from biology, chemistry, computer science, engineering, linguistics, materials science, mathematics, physics, and statistics to grand challenges in biomedical research.
2) To train the next generation researchers expert in the quantitative sciences for careers working at the interface with biology and medicine.
3) To enable research collaborations among Rutgers basic and applied scientists and clinicians.
4) To promote partnerships between the Rutgers community and pharmaceutical and biotechnology companies and enhance employment opportunities for Rutgers graduates.

Institute History/Logistics:

Formation:
The Institute for Quantitative Biomedicine at Rutgers (hereafter the Institute) was established following the historic merger of Rutgers, The State University of New Jersey, with the University of Medicine and Dentistry of New Jersey (UMDNJ) as part of the university-wide strategic planning process initiated by President Robert L. Barchi. A competitive proposal to establish IQB@R, submitted in response to a call from the Office of the New Brunswick Chancellor, Dr. Richard L. Edwards, was formally approved by the University Board of Governors in December 2014.

The Institute was officially launched on July 1st 2015 to engage scientists from across the entire Rutgers system and foster creation of a biomedical research university of the future. This new initiative occurs in the midst of an unprecedented period of growth in access to patient genome sequences and complementary data coming from high-throughput measurements of biological systems.

The “perfect storm” of institutional change at Rutgers and the Data Science revolution provided the opportunity to establish a broadly inclusive center-of-excellence dedicated to collaborative application of tools from the quantitative sciences to grand challenges in biology and medicine.

Rutgers educators, researchers, and clinicians participating in various Institute activities are working together to redefine how the quantitative sciences of a traditionally structured research university will interoperate with the basic and applied sciences and clinical departments of our two medical schools and the School of Health Related Professions.

Membership Eligibility:
IQB@R Membership is open to faculty members from the Schools of Arts and Sciences (SAS), Engineering (SOE), Environmental and Biological Sciences (SEBS), and Pharmacy (SOP), the Rutgers Cancer Institute of New Jersey (CINJ), the Brain Health Institute (BHI), the Center for Advanced Biotechnology and Medicine (CABM), the Child Health Institute of New Jersey (CHINJ), the Environmental and Occupational and Health Sciences Institute (EOHSI), the Human Genetics Institute of New Jersey (HGINJ/RUCDR Infinite Biologics), the New Jersey Institute for Food, Nutrition, and Health (NJIFNH), the New Jersey Medical School (NJMS), the Public Health Research Institute (PHRI), the School of Health Related Professions (SHRP), the Robert Wood Johnson Medical School (RWJMS), the Waksman Institute of Microbiology (WIM), and the Office of Research and Economic Development (ORED).

Administrative Offices and Support:
The Institute is housed within the Center for Integrative Proteomics Research (Proteomics; Rooms 105 and 106). Administrative support is provided at no charge by Proteomics.

Sustainable Business Model:
The Office of the New Brunswick Chancellor, the Rutgers Cancer Institute of New Jersey, and the Center for Integrative Proteomics Research are providing seed funding for IQB@R. Within three years, the Institute is expected to be fully self-funded from indirect cost returns derived from collaborative grant applications submitted by members of the Research Working Groups.

Status Update:

During the Year One of Institute operations (July 1st 2015-June 30th 2016), efforts were focused at the following activities:

1. *Institute Website.*
   The Institute website can be found at IQB.Rutgers.edu.

2. *Formation of the IQB Research Working Group in Cancer Genomics and Proteomics.*

   The Working Group was officially launched with a symposium held on Monday September 21st 2015. There were 84 registrants drawn from across the Rutgers system. New collaborations are developing among Institute members.

3. *Formation of the IQB Research Working Group in AntiMicrobial Resistance.*

   The Working Group was officially launched with a symposium held on Monday September 28th 2015. There were 95 registrants drawn from across the Rutgers system. New collaborations are developing among Institute members.

4. *Instrument Selection/Acquisition/Installation/Commissioning for the Rutgers New Jersey Core Facility for Cryo-Electron Microscopy and Tomography.*

   The Facility will be the first of its kind in the State of New Jersey, providing access to transformative capabilities in structural biology. Following setting of technical requirements and evaluation of competing manufacturer's products, carried out in collaboration with the Office of Research and Economic Development, a Talos Arctica was purchased on a sole-source basis from the world-leading manufacturer FEI in September 2015. The instrument, a state-of-the-art 200kV cryo-electron microscope, is equipped with phase plate optics (for contrast enhancement), an automated cryogenic sample changer, and a GATAN K2 direct electron detector with electron energy filter (for work with thicker tomographic samples). At the time of writing, the instrument has been installed, and commissioning is nearly complete. Additional items of small equipment required to operate the Facility, including a cryogenic correlative fluorescent light microscope and sufficient disk storage for user images, have been purchased. A highly experienced cryo-electron microscopist has been recruited from the Max Planck Institute in Martinsreid, Germany to manage the Facility, train and advise users, and operate the new instrument.

5. *3rd Annual Interdisciplinary Quantitative Biology Boot Camp.*

   Our highly successful 3rd Annual Boot Camp was held January 4th-15th 2016 on the Busch Campus. The focus of this year's Boot Camp was discovery/development of small-molecule inhibitors of protein kinases for treatment of cancer. Boot Camp instructors were drawn from the Institute membership and research scientists working at nearby pharmaceutical and biotechnology companies, including Bristol-Myers Squibb, Colgate-Palmolive, Merck Research Laboratories, and the Novartis Institutes for Biomedical Research. More than 50 graduate/undergraduate students and postdoctoral researchers participated in the entire program, with morning lectures, afternoon dry-lab exercises, and daily career development and networking opportunities over ten full days during the Winter Session; dozens more, including faculty, attended selected portions of the program. Boot Campers were divided into nine

teams and organized into a hypothetical biotechnology company (Organic Dynamics). Together, they collected and analyzed public domain information and assembled a retrospective "New Drug Application" for 1st line treatment of metastatic non-small cell lung cancer with erlotinib. The data package was presented on the final day in a simulation of a US FDA Oncologic Drugs Advisory Committee Meeting (with instructors and high-profile visitors taking on the roles of FDA officials and experts in oncology drug discovery/development and patent law).

6. *Rebranding of the BioMaPS Graduate Program in Computational Biology and Molecular Biophysics (CBMB) as the Institute Graduate Program in Quantitative Biomedicine.*

   Effective June 30th 2015, the BioMaPS Institute for Quantitative Biology ceased operations. A formal application was made to change the name of the graduate program from CBMB to Quantitative Biomedicine (QB) on July 6th 2015. Notification of approval was received on May 20th 2016. Shortly thereafter, all extant CBMB faculty members were invited to join the new QB graduate program. An additional 105 Rutgers faculty members were invited to join the rebranded program. Design of the new program curriculum is underway.

7. *Launch of the IQB Crash Course Program.*

   To address unmet educational and training needs of the Rutgers community, the Institute has initiated a program of one-day/half-day symposia on specialized topics. The first of these Crash Courses was held on the Busch Campus on January 28th 2016. Working with the Marine and Coastal Sciences Center, a One-Day Crash Course was organized (Co-chairs: Stephen K. Burley and Paul Falkowski) to educate interested members of the Rutgers community together with an esteemed group of geochemists, mineralogists, and micropaleontolgists (focused on the co-evolution of the geosphere and biosphere, from the Carnegie Science Center, University of Arizona, Rensselaer Polytechnic Institute, Harvard University, and Johns Hopkins University). Nearly 100 individuals were exposed to fundamental principles of protein structure, design, and function, plus the roles of proteins in evolution, particularly with respect to how proteins "tune" the redox chemistry of a mineral motif.

8. *Joint Proteomics/IQB Seminar Series.*

   Together with the Center for Integrative Proteomics Research, the Institute operates a Wednesday Noon Seminar Series, which meets three times/month during the Fall and Spring Semesters (excluding the first Wednesday of each month). Following each seminar, Quantitative Biomedicine graduate students meet informally with the speaker for lunch and lively discussions. The 2015-2016 seminar series was chaired by a tenure-track member of the Institute, Sagar Khare. In all, 19 invited speakers gave seminars

during the past academic year (5 Rutgers/14 External). This high profile series is one of the most popular seminar offerings available on the Busch Campus.

Priorities for 2016/2017:

During Year Two of Institute operations, efforts will be focused on the following activities:

1. *Research Working Group in Cancer Genomics and Proteomics.*
   Additional meetings of the Working Group will be convened to promote further collaborative activities, and develop interdisciplinary grant applications in response to appropriate Requests for Applications. The Institute will provide administrative support to host meetings and submit grants for Working Group participants.

2. *Formation of the Research Working Group in Antimicrobial Resistance.*
   Additional meetings of the Working Group will be convened to promote further collaborative activities, and develop interdisciplinary grant applications in response to appropriate Requests for Applications. The Institute will provide administrative support to host meetings and submit grants for Working Group participants.

3. *Rutgers New Jersey Core Facility for Cryo-Electron Microscopy and Tomography.*
   Dr. Dennis Thomas (who trained at Brandeis University and EMBL Heidelberg) will join the University as an Associate Research Professor and Facility Manager on August 1st 2016. User orientation/training and data collection activities will commence shortly thereafter. Sometime during the academic year, an intensive, one-week course on single-particle cryo-electron microscopy with morning lectures and afternoon hands-on computational exercises will be developed and offered to Rutgers users and pharmaceutical and biotechnology company structural biologists.

4. *4th Annual Interdisciplinary Quantitative Biology Boot Camp.*
   Curriculum planning for the 2017 Boot Camp, scheduled for January 2nd-13th, is underway. Invitations to the teaching faculty drawn from Rutgers and nearby pharmaceutical and biotechnology companies will be made in July/August. Building on the success of our 2016 offering, this year's focus will be on discovery/development of therapeutic antibodies for treatment of cancer.

5. *Graduate Program in Quantitative Biomedicine.*
   Design/implementation of the new graduate curriculum will be completed during the coming months with input from our expanding graduate faculty. An outreach campaign will be developed to raise the profile of the program, with the

goal of attracting quality applicants with undergraduate training in computer science, engineering, linguistics, materials science, mathematics, physics, and statistics.

6. *Institute Crash Course Program.*
   A Crash Course on the Immunology, Structural Biology, and Clinical Medicine of Anti-Cancer Checkpoint Antibody Therapies has been organized jointly with the Rutgers Cancer Institute of New Jersey (Co-Chairs: Stephen K. Burley and Edmund C. Lattime) for October 4th 2016, featuring speakers from the RCSB Protein Data Bank, the Cancer Institute, and the pharmaceutical industry. The symposium will provide a state-of-the-art understanding of the value of checkpoint antibody therapies for the treatment of various cancers. The course is aimed at Rutgers basic and applied scientists and clinicians and colleagues in the pharmaceutical industry. To the best of our knowledge, this will be the first interdisciplinary meeting on this subject that combines perspectives from immunology, structural biology, clinical oncology, and drug discovery. Additional Crash Courses will be organized as warranted later in the academic year.

7. *Joint Proteomics/IQB Seminar Series.*
   Together with the Center for Integrative Proteomics Research, the Institute will continue to operate the Wednesday Noon Seminar Series. The 2016-2017 series will be co-chaired by two tenure-track members of the Institute, Sang-Hyuk Lee (Fall) and Lu Wang (Spring).