The B^3 Curriculum

Ph.D. degrees are awarded by CCNY and, for the Sciences, jointly by The CUNY Graduate School. The B^3 program supports a Molecular Biophysics track in Chemistry, Biochemistry, or Physics; our curriculum satisfies elective course requirements in Chemical Engineering and Biology. Our students undertake intensive curricula in their respective specialties and also common courses in biophysics, biomaterials, research design, and college teaching methods (highlighted below). Additional co-curricular activities include networking events, research seminars, ethics training, and curriculum design projects.

Macromolecular Assemblies: Hands-on Tours (Y1). Following brief poster and oral presentations by faculty members who are recruiting new Ph.D. students, 2-4 half-semester research rotations allow students to sample scientific investigation in each laboratory, to experience the dynamic of each research group, and to make a match with a dissertation supervisor by the end of the spring semester.

Polymer Chemistry: Materials and Biomaterials (Y2). Each offering of this course has three themes: basic polymer principles and history, synthesis and design applications of naturally based biomaterials and therapeutics, methods for characterization of structure-function relationships. Students are each assigned an investigative target at the kickoff session. Instructor(s) present modules on methods to study multiscale structure and function (e.g., X-ray diffraction, complex impedance spectroscopy, and differential scanning calorimetry for amorphous biosolids), alternating with rounds of short student talks that apply the technologies to their respective materials. The course culminates with original proposals presented at a poster session.

Molecular Biophysics (Y2). This lecture/discussion course has an interactive format in which students are assigned a macromolecular target (other than their dissertation topic) to study by various means. Students alternate with faculty in presenting purification strategies, functional assays, computational analyses, and crystallographic, NMR, or MS methods as applied to their respective assemblies of interest. The course culminates with oral and written presentations of an original research proposal, designed to enhance critical thinking, creative skills and development of an Advancement-to-Candidacy Proposal.

Effective Instructional Techniques (Y2). Students participate in a 10-session series of two-hour pedagogy workshops complemented by a videotaped lecturing practicum. Sessions include: (1) orientation (What does effective teaching look like from a student's perspective?); (2) guest lectures (How do Master Teachers use primary source material, peer-assisted online homework, web-enabled mathematical exercises, problem solving and visualization software? What special challenges are associated with classes in which students have diverse academic or cultural backgrounds?); (3) student lectures (How does a new teacher balance student participation with the forward momentum needed to get through the material?).

Path to the Professions (Y5). To try out prospective careers, each student does a 6-week research internship: industrial, government, or academic formats are possible. Alternatively, students design an educational 'product': e.g., an undergraduate curriculum for protein expression, purification, spectroscopic characterization, or *in silico* analysis; an 'Art of Science' display that communicates the visual beauty of virus nanostructures to a non-science audience; an annotated video that trains Teaching Assistants to use a tricky piece of Engineering apparatus.

Research in National Needs Areas

We conduct research and educational training at the interface of chemistry, biology, physics, and engineering to understand and design the molecular machines of life. Specific efforts directed toward U.S. national needs include:

- Computational and biochemical studies of drug targeting for cancer, cystic fibrosis, diabetes, and microbial infection
- Synthesis and molecular characterization of environmentally benign materials for oil spill recovery, industrial coatings, and agricultural engineering
- Design and assembly of peptide, protein, nucleic acid, and lipid assemblies for biosensing, drug delivery, and oxygen transport
- Modeling and construction of proteins for solar energy storage and molecular electronics
- Development of emerging technologies for biomacromolecular targets: molecular modeling, synthetic biology, solid-state and dynamic NMR, neutron and X-ray scattering, cryoelectron microscopy

Teaching Opportunities

Concurrently with or following after the Effective Instructional Techniques workshops, Ph.D. students serve as Teaching Assistants in discipline-specific undergraduate laboratories, recitation sections, peer-led undergraduate study halls, or walk-in tutoring centers. Senior students may have opportunities to co-teach a course with a faculty mentor. All students are observed regularly, receiving both oral and written feedback.

Graduate Fellowships

CUNY guarantees 5 years of tuition, health insurance, and a minimum annual stipend (currently $25,000, shortly scheduled to rise to $30,000), for doctoral students in good standing in Biochemistry, Biology, Chemistry, Physics, and Engineering. First-year students do not teach, allowing them to move rapidly through their coursework and basic laboratory training.

Together with CUNY and the U.S. Department of Education, the B^3 program also offers augmented 2-year Graduate Assistance in Areas of National Need (GAANN) stipends along with tuition support. To be eligible, domestic students must have strong academic credentials, career goals in teaching and/or research, and demonstrated financial need. Funding is provided by research mentors and academic departments for the remainder of the doctoral training period. Additional fellowships are available to U.S. students from underrepresented minority groups.

INFORMATION RESOURCES

Biology/Molecular Machines:
Dr. Anuradha Janakiraman
Email: anuj@ccny.cuny.edu

Biochemistry/Molecular Biophysics:
Dr. Reza Khayat
Email: rkhayat@ccny.cuny.edu

Chemistry/Molecular Biophysics:
Dr. Zimei Bu
Email: zbu@ccny.cuny.edu

Physics/Molecular Biophysics:
Dr. Marilyn Gunner
Email: gunner@sci.ccny.cuny.edu

Chemical Engineering/Biomaterials:
Dr. Raymond Tu
Email: tu@ccny.cuny.edu

GAANN Fellowship Program:
Dr. Themis Lazaridis tlazaridis@ccny.cuny.edu
Dr. Raymond Tu tu@ccny.cuny.edu

Louis Stokes Alliance for Minority Participation Fellowships:
Dr. Claude Braithwaite
Email: cbrathwaite@ccny.cuny.edu

Research Initiative for Scientific Enhancement of Minority-serving Institutions Fellowships:
Dr. Mark Steinberg
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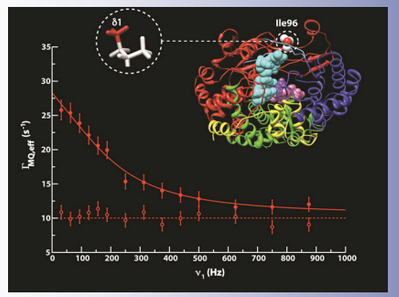
CUNY Institute for Macromolecular Assemblies (MMA):
Dr. Ruth E. Stark
Email: rstark@ccny.cuny.edu

B^3 Program and MMA Administration:
Ms. Lauren Gohara
Email: lgohara@ccny.cuny.edu

The City College of New York

Ph.D. Concentration in Biochemistry Biophysics Biodesign (B^3)



www.ghoselab.org/B3/B3_brochure.html
http://www.ghoselab.org/GAANN/gaann.html

The City College of New York

CUNY Chancellor: James B. Milliken
CCNY President: Lisa S. Coico
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http://forum.sci.ccny.cuny.edu/

Why City College @CUNY?

1. Exciting Scientific Research!

B^3 researchers in 15 faculty-led teams of The City College of New York (CCNY) are pursuing both laboratory and computational projects at the interface of biology, biophysics, chemistry, and chemical or biomedical engineering. Tantalizing opportunities for cross fertilization are inherent in our scientific aims: to delineate functionally critical interactions in natural biological systems and to engineer sophisticated biomimetic devices. We are developing new NMR, X-ray, cryo-EM, scattering, and computational technologies for the study of macromolecular assemblies of peptides, proteins, nucleic acids, lipids, and polysaccharides. Our cohesive community of ~150 researchers, from high schoolers to senior postdoctorals, includes scientist-educators who publish and present widely, garner national honors, serve on review panels and editorial boards, and obtain external grant support of ~$5 million annually.

2. Flagship Institution

Since its founding in 1847, The City College of New York has provided world-class higher education to an increasingly diverse student body -- serving as one of the single most important avenues to upward mobility in the nation. Access to excellence remains the vision of the College today. Jointly with the CUNY Graduate Center, CCNY awards Ph.D. degrees in biochemistry, biology, chemistry, and physics; CCNY's Grove School awards the Ph.D. degree in Engineering.

3. Research Institutes and Centers

CCNY is home to several University Institutes and College Centers that bridge disciplinary boundaries and build on the complementary strengths of individual research groups. B^3 researchers lead and participate in CUNY Institutes that study macromolecular assemblies and energy. CCNY Centers with B^3 involvement focus on the cellular and molecular basis of development, cancer research, and metamaterials.

4. Facilities

On our South Campus, the new CCNY Center for Discovery and Innovation (CDI) and CUNY's Advanced Science Research Center (ASRC) stand side by side. The CDI features state-of-the-art laboratories, offices, and social space; also shared facilities for solid- and solution–state nuclear magnetic resonance, calorimetry, computational biophysics, small animals, X-ray diffraction, and confocal microscopy. The ASRC supports university-wide efforts in five focus areas (Structural Biology, Nanoscience, Neuroscience, Photonics, Environmental Science), boasting facilities for NMR, cryo-EM, macromolecular crystallization, mass spectrometry, biochemistry and spectroscopy, nanofabrication, fMRI, and research symposia. In the Marshak Science Building and Steinman Hall are classrooms, laboratories, core facilities for electron, confocal, and atomic force microscopy, mass spectrometry, and animals. Along with the adjacent NY Structural Biology Center, these sites form a research hub with outstanding opportunities for faculty and students.

5. Location

Located in the up-and-coming Hamilton Heights section of Manhattan, CCNY is accessible by major subway and bus lines. Walk to the NY Structural Biology Center or Columbia University, hop a train to the CUNY Graduate Center or Columbia Medical School, attend seminars at top institutions, explore NYC's cultural and recreational treasures.

6. Collaborations

B^3 researchers cooperate closely with colleagues in their respective CCNY schools and their counterparts in CUNY's Advanced Science Research Center, Macromolecular Assemblies Institute, and Energy Institute, all based on our campus. We have easy access to 9 high-field NMR spectrometers operating at 500-900 MHz, 5 advanced electron microscopes, and a high-intensity X-ray beam line for crystallography through the New York Structural Biology Center, a world-class consortium of 9 NY research institutions. In addition to numerous individual collaborations, B^3 researchers benefit from the NIH CCNY-Memorial Sloan Kettering Cancer Research Partnership and organize regional symposia in Protein Design and Structural Biology.

7. Job Placement

CCNY's Ph.D. students and postdoctorals have secured academic appointments at CUNY, Brown, U. of Houston, Amherst, Howard, Interamerican U. of Puerto Rico, and the Tata Institute (India); they also work at NIH, FDA, and Lawrence Livermore National Laboratories, and at industrial firms: IBM, Bristol-Myers Squibb, Intel, Boeing, Lockheed Martin, Con Edison, and Raytheon.

8. Housing and Food

The Towers campus residence hall is located at St. Nicholas Terrace and West 130th Street, housing 600 students in furnished, air-conditioned, wireless Internet-equipped apartment-style units with private or shared bedrooms. CCNY also refers students to International House (500 Riverside Drive, 212-316-8436) and The Student Housing Center, a no-fee brokerage service (212-977-9099). Our Ph.D. students typically reside in Upper Manhattan, Queens, the Bronx, Brooklyn or NJ.

In addition to CCNY's student and staff cafeterias, the Marshak Science Building and ASRC have cafés with coffees, teas and snacks. West Harlem's nearby restaurant lineup features Coccola, Clove, Grange, Dinosaur Bar-B-Que, Hudson River Café, Covo, and Maison Harlem. Within a few blocks of campus you can also find Dominican, Mexican, Puerto Rican, Ecuadorian, Chinese, and Japanese delights, all reasonably priced!

9. Teaching and Mentoring

Professional training of our Ph.D. students typically includes part-time teaching duties for undergraduate lab courses, problem-solving sessions, and/or exam grading. Additional teaching opportunities with high school students include research mentoring, fellowships, and curriculum design coordinated with CUNY's College Now program and the NY Academy of Sciences.

10. Camaraderie

The CCNY Science Division Forum (http://forum.sci.ccny.cuny.edu/) maintains up-to-date information on seminars and symposia, faculty and staff, core equipment facilities, building services, course schedules, research opportunities, and Division administration. All-division parties and Town Hall meetings are held several times a year.

We trade research tips at group meetings, share usage of exotic equipment, critique grant proposal drafts, and prep one other for upcoming Qualifying Exams. Senior graduate students and postdoctorals introduce their projects at broad-access 'Supercluster' short talks twice monthly. Networking and professional development activities are sponsored by CUNY's Institute for Macromolecular Assemblies and by student-run CCNY Science Alliance, Women in Science, and Society for Women Engineers groups. Our community aims to pull together!

DOCTORAL FACULTY

Biochemistry/Biophysics/Biodesign (B^3) Concentration

Ph.D. study is supervised in Biochemistry (BC), Biology (B), Biomedical Engineering (BE), Chemistry (C), Chemical Engineering (CE), and Physics (P).

Zimei Bu (BC): protein-based molecular machines and switches; SAXS, quasielastic neutron scattering

Kevin Gardner (BC,B): Environmentally regulated protein-protein interactions; NMR, MS

Ranajeet Ghose (C,BC,P): cell signaling, protein-protein and protein-nucleic acid interactions; NMR, X-ray crystallography

M. Lane Gilchrist, Jr. (CE,BE,BC): supported biomembrane systems for microdevices, 3D biomaterials, recreated enzyme microenvironments

Paul Gottlieb (B,BC): viral pathogenicity, structure, and assembly; cryo-EM; assembly of bacterial biofilms in clay

Marilyn Gunner (P,C,BC,B,BE): thermodynamics and kinetics of photosynthesis; computational biology

Anuradha Janakiraman (B,BC): molecular regulation of bacterial cytokinesis, structure-function analysis of bacterial tyrosine kinase signaling

David Jeruzalmi (BC,C): initiation of DNA replication and nuclear excision repair; X-ray crystallography, EM

Reza Khayat (BC,C): host-pathogen interactions, cytoskeletal regulation; cryo-EM, X-ray crystallography

George John (C): biomass-based molecular design and synthesis; oleogels, antibacterial paints, oil spill recovery materials

Ronald Koder (P,BC,C): protein design, bionanotechnology, biomaterials, solar energy conversion, enzyme design, synthetic biology

Themis Lazaridis (C,BC,P): molecular recognition of peptides & proteins by membranes; molecular dynamics

Kevin Ryan (BC,C): RNA processing, nucleic acid therapeutics, olfactory molecular recognition; chemical biology

Ruth Stark (C,BC,B,P): structural biology of lipid metabolism; structure and assembly of protective plant polymer membranes and fungal melanins; NMR, AFM

Raymond Tu (CE,C): biomolecular self-assembly; biosensors, drug delivery, molecular electronics, or optics