A training program that provides comprehensive training to bridge the gap between chemistry and biology in addressing important questions in human health and disease and provides funding for the second & third years of graduate school.

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Trainees gain understanding and experience in transdisciplinary collaboration as an essential component in solving complex problems across the spectrum of health and disease.

Program Features

Dual Mentors
Each Trainee selects two mentors, one with a background in chemistry and the other in the life sciences. The primary mentor fulfills the role of a graduate thesis advisor while also ensuring the trainee is fully participating in program activities and completing requirements. The secondary mentor operates in collaboration with the primary mentor, providing insights and strategies for problem-solving the trainee's project from a different disciplinary perspective.

Immersive 10-week Cross-Disciplinary Rotation
Trainees spend 10 weeks in the research group of their secondary mentor after their graduate program's Qualifying Exams and before the end of their third year. This provides Trainees new analytical tools, model systems, and language for applying chemical approaches to research topics in the life sciences. The rotation can be split into (2) five-week periods.

Seminar Series
These seminars feature topics that deepen Trainees’ understanding of research at the interface of chemistry and biology. Up to ten required seminars are selected by program leadership to augment Trainees' graduate programs' seminars.

Additionally, the Trainees select and invite three external speakers annually from academia, and the pharmaceutical and biotech industries to be sponsored by the CLP training program. They meet with the speakers over lunch and dinner to engage in more in-depth discussions of research approaches and methodologies.

Monthly Research Forum
Trainees present twice each year at the CLP Research Forum to their peers and program preceptors. Mentors of the Trainees’ attend both of their trainee’s presentations. Presentations not only enable Trainees to gain experience in public presentation of their work; they also provide a mechanism for gauging trainee progress and for identifying potential obstacles to the trainee’s project.

First-in-class Laboratory Course
Chem 415: Practical Training in Chemical Biology Methods and Experimental Design covers topics high throughput testing, cheminformatics, chemical synthesis and purification, biologics production, in vitro testing, proteomics analysis, and preclinical in vivo testing for efficacy and toxicity, plus in vitro and in vivo imaging techniques for targeting drug delivery, visualizing tumors, and documenting drug uptake and localization.

Entrepreneurship Training
Through quarterly meetings with CLP’s Entrepreneur-in-Residence, Dr. Andrew Mazar, and the Center for Developmental Therapeutics Trainees' gain insight and training into how discoveries with implications for health and treatment of disease are moved into the public realm.

Breakfast with the Program Directors
Trainees have the opportunity to meet with the program directors over breakfast each quarter to discuss project progress and career development.
Graduate Program Timeline

First Year:

• Work with Interim Advisor to identify training needs
• Complete at least (2) four-week Intra-disciplinary Rotations in CLP Preceptor research groups
• Graduate program coursework
• Recommended completion of Chemistry 405: Chemistry of Life Processes
• Select primary and secondary mentors

Second Year:

• Appointment to CLP Training Grant
• Complete graduate program coursework and CLP electives
• Present thesis project at CLP Research Forum
• Immersive 10-week Cross-Disciplinary Rotation
• Participate in program activities
• Meet with Primary and Secondary Mentors at least quarterly
• Course Chem 415: Practical Training in Chemical Biology Methods and Experimental Design

Third Year:

• Complete CLP electives
• Continue dissertation research
• Present results to CLP Student Forum
• Attend a national research conference
• Continue meeting with mentors
• Participate in program activities

Following Years:

• Continue dissertation research
• Engage in career development training
• Engage in grants writing training
• Present research at national research meetings
• Present results at CLP Research Forum
• Continue regular meetings with mentors
• Participate in program activities
• Present results at national conferences

When to Apply?
Application due end of First year

May
Application forms sent out to First-year students
Forms and instructions posted on CLP website

July 1st
Application package due

July-August
Ad Hoc Trainee Evaluation Committee selects Trainees
Candidates and preceptors notified of award by email

September 1st
Appointment starts (8 quarters) subject to annual review

Gain a competitive edge over your peers in funding your biomedical research

Finish your program on time with your peers

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Integration with Graduate Programs

Given the broad range of degree requirements and variance in the schedules of the graduate programs that enroll CLP Trainees we have been careful to construct the program’s training requirements in such a way as to enable you to stay in sync with your parent graduate program. The course requirements for the CLP training program have been designed with sufficient flexibility so as to enable you to use CLP-required courses to help fulfill the requirements of your degree granting programs.

Biomedical Engineering Graduate Program

Program Track

The **Tissue Engineering** track is most compatible with the CLP Training Program.

Rotations

- Complete (2) four-week rotations in the research groups of CLP Biomedical Engineering preceptors before starting in your advisor’s research group.
- Immersive 10-week Rotation in the research group of the secondary mentor must be completed before the end of the third year and can be divided into (2) 5-week periods.

Selection of Thesis Advisor and Program Mentors

Candidates for CLP traineeships are expected to choose a thesis advisor/ primary mentor from among the CLP Biomedical Engineering preceptors and a secondary mentor from among the CLP Chemistry or Chemical & Biological Engineering preceptors. The secondary mentor also sits on the graduate student’s thesis committee.

COURSEWORK

1. Chem 405: *Chemistry of Life Processes*
2. (1) Elective from the CLP Training Program Electives
3. Chem 415: *Practical Training in Chemical Biology Methods and Experimental Design*
Chemistry Graduate Program

Program Track

The *Life Processes* track within any of the department’s three divisions: Organic Chemistry, Physical Chemistry, and Physical/Analytical Chemistry is the most compatible with the CLP Training Program.

Rotations

- Complete (2) four-week rotations in the labs of CLP Chemistry preceptors before starting in your advisor’s lab.
- Immersive 10-week Rotation in the research group of the secondary mentor must be completed before the end of the third year and can be divided into (2) 5-week periods.

Selection of Thesis Advisor

Candidates for CLP traineeships are expected to choose a thesis advisor/primary mentor from among the program’s chemistry-affiliated preceptors and a secondary mentor from among the CLP life science preceptors. The secondary mentor also sits on the graduate student’s thesis committee.

Chemical & Biological Graduate Program

Rotations

- (2) Four-week rotations in the research groups of CLP Chemical & Biological Engineering preceptors before starting in your advisor’s research group.
- Immersive 10-week Rotation in the research group of the secondary mentor must be completed before the end of the third year and can be divided into (2) 5-week periods.

Selection of Thesis Advisor

Candidates for CLP traineeships are expected to choose a thesis advisor/primary mentor from among the program’s Chemical & Biological Engineering preceptors and a secondary mentor from among the CLP Life Sciences preceptors. The secondary mentor also sits on the graduate student’s thesis committee.
Driskill Graduate Program in the Life Sciences

Program Track

Participation in the program activities for the Chemical Biology and Drug Discovery Research Cluster, chaired by CLP preceptor, Karl Scheidt, is highly recommended.

Rotations

- Two of the First year rotations should take place in the research groups of CLP life sciences preceptors.
- Immersive 10-week Rotation in the research group of the secondary mentor must be completed before the end of the third year and can be divided into (2) 5-week periods.

Selection of Thesis Advisor and Program Mentors

Candidates for CLP traineeships are expected to choose a thesis advisor/primary mentor from among the program’s life sciences-affiliated preceptors and a secondary mentor from among the CLP Chemistry or Chemical & Biological Engineering preceptors. The secondary mentor also sits on the graduate student’s thesis committee.

Interdepartmental Biological Sciences Graduate Program

Program Track

Participation in the program activities for the Chemical Biology and Drug Discovery Research Cluster, chaired by CLP preceptor, Karl Scheidt, is highly recommended.

Rotations

- Two of the First year rotations should take place in the research group of CLP life sciences preceptors.
- Immersive 10-week Rotation in the research group of the secondary mentor must be completed before the end of the third year and can be divided into (2) 5-week periods.

Selection of Thesis Advisor

Candidates for CLP traineeships are expected to choose a thesis advisor/primary mentor from among the program’s life sciences-affiliated preceptors and a secondary mentor from among the CLP Chemistry or Chemical & Biological Engineering preceptors. The secondary mentor also sits on the graduate student’s thesis committee.
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<th>Chemistry</th>
<th>Chemical &amp; Biological Engineering</th>
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<td>Licht, Jonathan A,T</td>
<td>Wertheim, Jason</td>
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Additional Affiliations: A Chemistry of Life Processes Institute; B Molecular Biosciences; C Chemistry; D Chemical & Biological Engineering; E Materials Science & Engineering; F Neurobiology; G Biomedical Engineering; H Medicine; I Surgery; J Radiology; K Physics; L Interdepartmental Biological Sciences (IBiS); M Driskill Graduate Training Program in Life Sciences (DGP); N Microbiology-Immunology; O Pathology; P Dermatology; Q Neurology; R Psychiatry and Behavioral Sciences; S Psychology; T Hematology-Oncology
CLP Training Program Electives

<table>
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<th>Course Code</th>
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<td>Principles of Organic Chemistry</td>
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<td>IGP 442</td>
<td>Microbiology</td>
<td>Chem 402</td>
<td>Principles of Inorganic Chemistry</td>
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<td>IBIS 406</td>
<td>Cell Biology</td>
<td>Chem 403</td>
<td>Principles of Physical Chemistry</td>
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<tr>
<td>IGP 410</td>
<td>Molecular Biology &amp; Genetics</td>
<td>Chem 406</td>
<td>Environmental Chemistry</td>
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<tr>
<td>IGP 426</td>
<td>Signal Transduction and Molecular Pharmacology</td>
<td>Chem 410</td>
<td>Physical Organic Chemistry</td>
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<tr>
<td>IGP 435</td>
<td>Receptors and Signaling Mechanisms</td>
<td>Chem 411</td>
<td>Organic Spectroscopy</td>
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<td>IGP 475</td>
<td>Virology</td>
<td>Chem 413</td>
<td>Advanced Organic Chemistry</td>
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<td>IBIS 402</td>
<td>Eukaryotic Molecular Biology</td>
<td>Chem 414</td>
<td>Chemical Biology</td>
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<td>IBIS 405</td>
<td>Chemistry, Physics, and the Biology of Molecular Machines</td>
<td>Chem 415</td>
<td>Advanced Organic Chemistry</td>
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<td>Immunology</td>
<td>Chem 416</td>
<td>Medicinal Chemistry</td>
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<td>IGP 450</td>
<td>Tumor Cell Biology</td>
<td>Chem 417</td>
<td>Photochemistry</td>
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<td>IGP 486</td>
<td>Structural Basis of Signal Transduction</td>
<td>Chem 418</td>
<td>Organometallic Chemistry &amp; Homogeneous Catalysis</td>
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<td>Principles and Methods of Animal Development</td>
<td>Chem 433</td>
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<td>IGP 462</td>
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<td>IGP 480</td>
<td>Molecular Mechanisms of Carcinogenesis</td>
<td>Chem 435</td>
<td>Advanced Inorganic Chemistry</td>
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<td>IBIS 408</td>
<td>Fundamentals of Macromolecular Crystallography and NMR</td>
<td>Chem 442</td>
<td>Quantum Chemistry</td>
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<td>IBIS 409</td>
<td>Biophysical Methods for Macromolecular Analysis</td>
<td>Chem 442</td>
<td>Quantum Chemistry</td>
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<td>IBIS 417</td>
<td>Cell and Structural Biology of Alzheimer's Disease</td>
<td>Chem 443</td>
<td>Kinetics</td>
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<td>Macromolecular Structure and Function</td>
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<td>IBIS 401</td>
<td>Molecular Biophysics</td>
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<td>Molecular Basis of Drug Action</td>
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<td><strong>Quantitative Biology</strong></td>
<td>IGP 422</td>
<td>Introduction to Translational Research</td>
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<td>IGP 430</td>
<td>Genetics</td>
<td>IGP 425</td>
<td>Advanced Topics in Drug Discovery</td>
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<td>IBIS 403</td>
<td>Proteomics, Genomics, and Variation</td>
<td>IGP 433</td>
<td>Advanced Microbial Pathogenesis</td>
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<td>IBIS 407</td>
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<td>Topics in Developmental Biology</td>
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<td>Advanced Immunology</td>
<td>IGP 460</td>
<td>Cellular and Molecular Aspects of the Cytoskeleton</td>
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**Eligibility**

Eligibility for NIH training grant support will be determined by the following criteria:

1) Candidates must meet NRSA qualifications as US citizens or permanent residents.

2) Candidates must meet criteria of departmental programs plus provide tangible evidence of interest in transdisciplinary programs through undergrad coursework, undergrad research or internships.

3) Candidates must have taken undergraduate courses in general chemistry and organic chemistry. Additional course work in biology (organismal and cellular) and biochemistry is desirable, but not required.

Outstanding nominees who have not been appointed to the training grant due to lack of space or ineligibility for NRSA support will be considered for support through institutional commitments to the CLP program. The Ad Hoc Trainee Evaluation Committee will select one to two new students each year from the nominee pool for support through their second and third years of graduate school.
Application

The CLP Predoctoral Training Program traditionally supports up to 7 new Trainees (4 funded by NIGMS, 3 funded by Institutional support) annually for a period of two years. Application packages are due on July 1st by 5:00pm to the CLP Program Coordinator.

The application package consists of:

1) Completed CLP Training Program Nomination Form.

2) A one-page statement from the nominee describing career goals, commitment to and a detailed plan for completing the curricular requirements of the training program.

3) A one-page research project description including background and biomedical significance of the research, a list of project goals and specific plans to achieve these objectives. The biological and chemical approaches to problem solving must be emphasized.

4) CLP Training Program Candidate Home Department Rotation Form.

5) Copies of undergraduate and graduate transcripts. Official transcripts are not required.

6) A short CV, including honors, presentations, research experience, publications, etc.

7) Copies of GRE (or MCAT) scores that were submitted to the home department.

8) Two signed letters of recommendation on letterhead. One letter should be submitted by the candidate’s primary CLP preceptor/mentor. The letter must include a statement from the mentor reaffirming their commitment to the training program and agreeing to allow their mentees to satisfy all training program requirements. The second letter should be obtained from the candidate’s secondary CLP preceptor/mentor who is familiar with the applicant’s academic accomplishments, research potential, and collaborative research project.

Further application instructions and forms can be found on the CLP website (http://clp.northwestern.edu).

Stefan Kathman
Primary Mentor: A. Statsyuk
Secondary Mentor: A. Rosenzweig
Trainee Year 2013-2014

Kathman has led the Statsyuk research group’s efforts to develop a new approach to covalent drug development, referred to as "irreversible tethering" technology, and was the first to demonstrate its application in discovering novel types of inhibitors of cysteine proteases. These discoveries have resulted in first author publications and presentations at national meetings. Following his CLP traineeship he was awarded an ACS predoctoral fellowship.

In course of his graduate research Kathman has also discovered a small molecule covalent inhibitor of the Nedd4-1 enzyme. Working in collaboration with his secondary mentor, Amy Rosenzweig (Molecular Biosciences), he was able to obtain a crystal structure of the Nedd4-1 protein bound to this inhibitor. The resulting crystal structure was subsequently used to obtain a more potent inhibitor of Nedd4-1 enzyme. “It wouldn’t have been possible to move forward in my project without the crystal structure. The ability to get the crystal structure is a unique expertise of the Rosenzweig lab. Before my rotation in their lab, no one in the Statsyuk group knew how to grow a crystal structure,” said Stefan.
Reports

Reappointment Evaluation

Second-year CLP Trainees’ progress is evaluated prior to reappointment to the training grant. Trainees and Primary and Secondary Mentors are required to submit materials to the CLP Program Coordinator for record keeping and in support of the evaluation.

Trainees are asked to submit the following evaluation materials by July 1st:

1) Completed CLP Training Program Renewal Form.
2) Official Graduate School transcript showing completed coursework.
3) One page summary of trainee’s research accomplishments, techniques acquired and plans for the coming year.
4) Copies and citations of all published papers, manuscripts submitted, meeting abstracts for talks and poster presentations, and awards received.
5) Copy of Individual Development Plan updated from start of appointment.
6) Letter from trainee’s primary mentor concerning progress in trainee’s research and academic standing.
7) Letter from trainee’s secondary mentor describing trainee’s progress in applying transdisciplinary approaches to their research and the growth of the trainee’s capabilities in applying orthogonal approaches to research problems.

The CLP Evaluation Committee will consider all of these materials and make the decision to reappoint based on the following criteria: first, that the trainee be in good standing with their graduate program; second, that the trainee has completed all CLP program requirements or have presented a feasible plan to do so; and third, that progress in research is clearly demonstrated.

Major changes in the trainee’s research project must be reviewed by the Evaluation Committee for applicability within the parameters of the program. Failure to meet program criteria will result in loss of training grant support.

Training Completion

Trainees will be required to provide documentation of their completion of all program requirements for final review by program leadership at the end of their second year of support. Trainees will retain a close affiliation with the program after the termination of their formal appointment. They will continue to be a vital component of the training program and are encouraged to participate in all program activities, including the seminars, Research Forums, and social activities throughout their graduate career. Trainees’ will continue to receive advice and support from their primary and secondary CLP mentors who will actively monitor the trainee’s progress towards their degree. Additional oversight will be provided by the trainee’s thesis committee, which includes the trainee’s secondary mentor.
Established by Northwestern University in 2004, the Chemistry of Life Processes Institute (CLP) fosters the transdisciplinary collaborations among physical and life scientists and clinicians that are required to address the complexity of the “big questions” underlying human health and disease. The Institute has created an ecosystem that enables basic and translational research and training that transcends disciplinary boundaries built upon a custom designed physical environment in the Richard and Barbara Silverman Hall for Molecular Therapeutics and Diagnostics. A critical component of the CLP ecosystem is the capacity to move discoveries from the laboratory bench into the hands of society. The Institute provides researchers with the tools needed to translate their discoveries through its Entrepreneur-in-Residence program. This unique program bridges the academic and commercial environments.

The Institute’s 52 tenure-track faculty, while representing ten departments spanning the schools of arts and sciences, engineering, and medicine, are renowned for team-based, multi-disciplinary approaches to biomedical research. In addition, a 50 member PhD-level technical staff maintains and develops cutting edge instrumentation and services, provides training, and collaborates with researchers to advance their research programs.

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