



Biology & Biomedical Sciences

ACADEMIC PROGRAM GUIDELINES

Program in Chemical Biology

Division of Biology & Biomedical Sciences

Program in Chemical Biology

Academic Guidelines

Effective August 1998

The theme of the Chemical Biology program is the study of the chemical interactions and the catalytic strategies fundamental to the regulation of life processes. To this end, the program emphasizes chemistry as the intellectual framework and synthesis as the practical means for addressing biological problems.

1. Prerequisites

It is critical that students *completing* the program have a broad background in bioorganic chemistry. Students *entering* the program come from varied backgrounds; their undergraduate course programs will differ accordingly. Typical credentials for the program include an undergraduate degree in chemistry, biology, or biochemistry, including 2 semesters of organic chemistry, 1-2 semesters of physical chemistry, 1-2 semesters of biology, 1 semester of biochemistry. Advanced courses applicable to the chemical biology program include but are not limited to: advanced biology, biochemistry, advanced chemistry, advanced physics, advanced mathematics, statistics, computer science, and/or courses in computer science.

2. Program

2.1 Summary of program requirements

The chemical biology program requirements are similar to those of other divisional programs. Four academic courses are undertaken during the first year along with journal club. Laboratory rotations begin during the first year. During the summer following the second academic year, a candidacy examination is administered. Successful students will normally terminate their course program at that stage or, if necessary and on the advice of the examining committee, take additional courses during the third semester. After the course program is complete, students fulfill the divisional requirements of a thesis proposal, thesis research, and thesis defense.

2.2 Requirements of the Chemical Biology Program

As with all programs in the Division of Biology and Biomedical Sciences, the basic divisional requirements must be met. This includes requirements for minimum number of semester credit hours, residency, etc. In par-

ticular, however, the chemical biology program has the following requirements.

- A two-semester, four-course, core academic program
- Three laboratory rotations
- Participation in journal club
- Candidacy examination / proposal for original research
- Thesis research proposal
- Doctoral thesis

Four “**core**” academic courses will be required of students in the chemical biology program. These will ordinarily include

- [1] Bio 5068: Fundamentals of Molecular Cell Biology (4 cr)
- [2] Bio 5325: Protein Structure and Function (3 cr)
- [3] Chem 451: Organic chemistry III (3 cr)
- [4] Chem 453: Bioorganic Chemistry (3 cr)

During the summer following the second academic year, a qualifying examination will be administered as described below. Based upon this examination, the student will normally proceed to thesis research. If academic deficiencies are uncovered, additional study in the form of coursework, course audits, special readings, etc. may be recommended by the committee. The student demonstrating appropriate background, knowledge, competence, and accomplishment will normally be advanced to candidacy at this point. The pass/fail/re-examine judgment will be rendered by the examining committee.

A typical course program for a student presenting a major in chemistry, biology, or biochemistry and having the approximate background indicated above is as follows.

Semester 1

- Bio 5068: Fundamentals of Molecular Cell Biology (4 cr)
- Bio 5325 Protein Structure and Function (3 cr)
- Bio 5073 Bioorganic Chemistry journal club

Semester 2

Chem 453: Bioorganic Chemistry (3 cr)
Bio 5073 Bioorganic Chemistry journal club
Bio 5461 Principles of Molecular Recognition (3 cr)

Semester 3

Chem 451: Organic Chemistry III
Bio 5073 Bioorganic Chemistry journal club
Thesis research

Semesters 4-8

Thesis research
Bio 5073 Bioorganic Chemistry journal club

Additional electives may be taken if desired by the student and/or recommended by the thesis mentor. These include but are not limited to course(s) in biology, biochemistry, biophysics, chemistry, molecular biology, genetics, physics, math, statistics, computer science, etc.

2.3 Laboratory rotation

Each student in the chemical biology program will participate in the customary program of laboratory rotations in accord with normal Division regulations. This will normally involve three laboratory experiences.

2.4 Participation in journal club(s) and seminars

Students are expected to participate in Bio 5073, bioorganic chemistry journal club, each semester. The journal club currently involves a mixture of internal and outside speakers. The faculty member in charge of the journal club may assign students to make presentations based either on their own original research or on the published research of others.

2.5 Candidacy examination / proposal for original research

The purpose of the candidacy examination is twofold: to assess student progress and to assist his/her academic development. The examination will normally be administered during the summer following the second year. It is intended to be partly a device by which the student's competence and progress can be evaluated. It is not intended as a "hurdle" but rather as a vehicle to ensure that the student, when finished with his or her coursework program, will possess the tools necessary to be a successful scientist. In cases where the background was diverse or the research project will be multi-disciplinary, additional course work may be recommended by the committee. Advice concerning additional coursework may be sought from the thesis advisor.

A committee of three faculty members participating in the chemical biology program (not including the thesis advisor), will administer the candidacy examination. Other interested faculty may attend the examination but will not vote to pass or fail the candidate. The examination will be based upon a proposal for original research (see details for preparation below). The student will be expected to defend the proposal and to demonstrate his/her grasp of background in the chemical biology area. At least two of the three committee members must agree whether the student passes, fails, or whether revision, etc. is required. Normally, the committee members will assist the student at this stage, if necessary, in formulating the remainder of his/her academic program. Advice will also be sought from the thesis advisor.

The format of the proposal is as follows.

The title page will show (1) the title of the proposal, (2) the name and campus address of the candidate, (3) the date of submission, (4) the names of the voting committee members, and (5) the date, time, and location set for the examination.

The second page will be a summary of the candidate's background in the following format: (1) Previous academic training beyond the high school level (institution, location, dates attended, degree, if any); (2) courses taken at Washington University (course number, when taken, course title, grade if completed); (3) laboratory rotations and dates (indicate completed, in progress, or projected); (4) identity of research director if chosen; and (5) a list of scientific publications and/or presentations.

The proposal will begin on the third page. It should be printed in 10-12 point type on 8.5×11" white paper (1" margins on all sides) with no more than 6 lines of type per inch. The proposal may not exceed 10 pages in length including all tables, graphs, and figures but excluding notes and references (limited to 4 pages). The notes and references should be included in a separate section at the end of the proposal and should be cited either using the format of the *Journal of Biological Chemistry* or the *Journal of the American Chemical Society* except that full article titles should be included between the authors' names and the journal citation.

2.6 Candidacy examination meeting

The candidacy examination will be held at a time arranged by the candidate and agreed by voting members of the committee. The candidate will assure that each voting member of the committee has received a final copy of the proposal by 7 days prior to the assigned

meeting time. The student will request that one of the voting members serve as committee chair.

At the time of the meeting, the candidate may be asked to leave the room briefly so that the faculty can discuss organizational issues, if any. If such a discussion is not needed by the faculty, the candidate will begin the oral presentation, with appropriate visual aids, of his or her proposal. The presentation will normally be 30 minutes, if uninterrupted. Committee members may ask questions during the presentation but normally any questioning will begin at the end of the student's presentation. When discussion is complete, the faculty members will confer in the absence of the student to determine if the examination has been passed, failed, or if the examination should be retaken. The examination result will be communicated orally to the student immediately following the exam and the committee chair will notify the Program Director in writing of the result. If the result is other than "pass," the specific finding of the committee should be communicated to the student, the program director, and the other committee members in writing by the committee chair along with any requirements for further examination or specifications that affect the student's program.

3. Advisory committees

The Chemical Biology Program steering committee consists of Professors Covey (MB&P), Gokel (MB&P), Grant (MB&P), M. Gross (Chemistry) R. Gross (Medicine, MB&P, Chemistry), Moeller (Chemistry), and Welch (Radiology, MB&P, Chemistry). Prof. Gokel is program Director and Professor Covey is student advisor.

4. Thesis committee and thesis proposal

4.1 Purpose of the thesis committee

The purpose of the thesis committee is to assist, advise, and oversee the student's research work. The student's best interest is the primary concern of the committee. The student and preceptor should view the committee system as a source of objective criticism and expert advice. The thesis proposal meeting is intended to afford a student advice, encouragement, and guidance and is not a pass/fail "hurdle."

The thesis committee is formed to advise the student concerning his/her thesis research. The committee members constitute a resource for the student in the form of readily accessible scientific or professional advice and constructive criticism during the dissertation research project. Early formation and regular meetings between the candidate and the committee members enhance the value of the thesis committee. It is imperative that the committee meet with the student at least

once a year to offer suggestions and to assess progress. The thesis committee should actively monitor the student's progress toward completion of his/her thesis by no later than the end of the student's fifth year, and preferably sooner.

4.2 Constitution of the thesis committee

The thesis committee should be chosen during the second year. The committee consists of five faculty members (who are also members of the Division) and the thesis preceptor. The University requires that the final dissertation defense committee be composed of four faculty members from the student's program and two others from any of the other programs, or from departments outside the Division. All members of the committee must be members of the Washington University faculty and must hold regular academic appointments in the University. A quorum of four members including the thesis advisor is needed for any regular advisory meeting. Normally, the student and preceptor will suggest appropriate committee members; the final composition of the committee is subject to approval by the Program Director who should be informed by memorandum of the committee's composition. The committee members are selected for their research expertise and for their willingness to advise and help mentor the student. The committee is chaired by a faculty member other than the thesis preceptor, and the chairperson should be designated in advance of the proposal. At the time of the thesis defense, the thesis committee serves as the defense committee. The Program Director should approve any change in the composition of the thesis committee.

4.3 Timing of the Proposal

The thesis proposal should be presented by the end of the fifth semester. Failure to meet this deadline will result in students losing their good academic standing status and resulting in dismissal if not met within 6 months (second year for MSTP students).

4.4 Thesis Proposal

The thesis proposal should include: (1) a statement of purpose and rationale for the project; (2) a summary of the background and work performed to date; (3) a general indication of the expected results and alternative plans for high risk portions of the project. The proposal should be printed on 8.5×11" white paper, in type no smaller than 10 point. The maximum overall length of the proposal will be: 1 page cover sheet (student's name, preceptor's name, thesis project title, date of submission, etc.), 10 page (maximum) proposal description (see above), and reference citations (4 page limit). The notes and references should be included in a separate section at the end of the proposal and should

be cited either using the format of the *Journal of Biological Chemistry* or the *Journal of the American Chemical Society* except that full article titles should be included between the authors' names and the journal citation.

4.5 Thesis Committee Meetings

During the thesis proposal committee meeting, discussions between the faculty and student will attempt to ensure the student's understanding of the research project. The committee will also assess whether the project is likely to lead to a thesis in a timely manner. Normally, the thesis advisor will be present but will not participate in the discussion except when requested to do so by a thesis committee member. The committee may, at its discretion, choose to meet with the student in the absence of the thesis advisor. After the thesis proposal, the committee will meet with the student at least annually. The student is responsible to schedule annual meetings. The preceptor or committee chairperson may also schedule a meeting(s) when appropriate. After any meeting, the committee will meet in the absence of the student to formulate recommendations. The thesis committee chairperson is responsible for ensuring that recommendations of the committee are communicated to the student.

4.6 Doctoral research thesis

Doctoral research and the presentation of a final seminar and thesis will be accomplished in accord with procedures and requirements mandated by the Division of Biology and Biomedical Sciences. The degree obtained by participants who complete the program will be the "Doctor of Philosophy in Biology and Biomedical Sciences – Chemical Biology".

5. Divisional requirements

The requirements set forth above are in accord with Division regulations. Division guidelines take precedence over program guidelines in case of any conflict.

6. Students' Responsibility to Meet Program Requirements

Graduate students in the Program in Chemical Biology are responsible for completing the requirements of the program in a timely fashion. In particular, the requirements for courses, preliminary examinations, thesis proposals, and thesis committee meetings are important components of graduate training and should be regarded seriously. In the event that a student has trouble meeting any requirement, he or she should request consideration of the situation by the Steering

Committee, which may agree to waive or delay the requirement.

7. Transfer From and To Outside Programs

Students are free to transfer to the Program in Chemical Biology from any other program in the Division of Biology and Biomedical Sciences provided they are "in good academic standing". Students who transfer will be expected to meet all of the normal requirements of the programs, although special exceptions may be granted in rare cases by the Steering Committee. Students in the Program in Chemical Biology also are free to transfer from the program to another program, with the approval of both program directors and provided a qualifying examination committee or program steering committee has not recommended against the student continuing in the Ph.D. program. Transfer is accomplished most easily during the first year, but can be done at later times if necessary.

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Faculty participating in the program of chemical biology

Carolyn Anderson (Radiology)
Dave Cistola (Biochemistry)
Douglas Covey (Molec. Biol. & Pharm.)
Laura Dugan (Neurology & Neurological Surgery)
George Gokel (Molec. Biol. & Pharm.)
Gregory Grant (Molec. Biol. & Pharm.)
Michael Gross (Chemistry)
Richard Gross (Medicine/Chemistry)
Garland Marshall (Molec. Biol. & Pharm.)
Kevin Moeller (Chemistry)
Steve Moerlein (Radiology)
M. Alan Permutt (Medicine)
David Piwnica-Worms (Radiology)
Jay Ponder (Biochemistry)
John Taylor (Chemistry)
John Turk (Medicine)
Michael Welch (Radiology/Chemistry)
Karen L. Wooley (Chemistry)

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Course descriptions for the program in Chemical Biology

The chemical biology program is a three-semester sequence intended to cover basic physical organic chemistry principles, synthetic chemistry relevant to the bioorganic sub-discipline, basic concepts of enzyme chemistry, to introduce biological structures and organization, and to consider some of the methodology and models that have been used to understand them.

The first two semesters are relatively structured but the third semester will be flexible in content.

Bio 5071. Bioorganic Chemistry I. Fundamentals of molecular interactions and chemical catalysis (3 cr, Gokel and Covey). To be offered if a comparable Chemistry Department course is not available in the appropriate semester.

Bio 5073 Bioorganic Chemistry Journal Club (each semester, 1 cr)

To be offered each semester

This will be a standard journal club for those participating in the Bioorganic Chemistry Program.

Other University course offerings that may complement the Chemical Biology Program

In addition to the basic course offerings described above, courses related to the student's research interests may be taken. Other courses relevant to the program are available within the University. A student in the chemical biology program may undertake one or more of these with the advice and consent of his/her mentor and/or committee.

Bio 5261 *Molecular Mechanisms of Disease*

Bio 531 *Advanced Biochemistry*

Bio 536 *Physical Chemistry of Macromolecules*

Bio 5381 *Mech. of Protein Targeting and Inter. Transport*

Bio 5391 *Molecular Virology*

Bio 5392 *Molecular Microbiology and Pathogenesis*

Bio 5461 *Principles of Molecular Recognition*

Chem 520 *Nucleic Acid Chemistry*

Chem 556 *Kinetics and Mechanism*

Chem 558 *Spectral Methods in Organic Chemistry*