



THE VANDERBILT UNIVERSITY

Ph.D. PROGRAM

IN

CHEMISTRY

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THE VANDERBILT Ph.D. PROGRAM IN CHEMISTRY

I. INTRODUCTION

The following procedures, rules, and regulations apply to all students who begin graduate work in the Fall of 2008. All students should also be aware of and comply with University requirements as outlined in "The Bulletin of Vanderbilt University, The Graduate School" and in the "Student Handbook," which are available at the following University websites <http://www.vanderbilt.edu/catalogs/grad/Grad01.html> & http://www.vanderbilt.edu/student_handbook/. University policies and procedures relating to misconduct in research by faculty and students are also specified in the "Faculty Manual" which is available in electronic form at (<http://www.vanderbilt.edu/facman/>). Graduate students are responsible for being fully informed about the Vanderbilt Honor Code and about the policies and expectations of the Graduate Honor Council (see appropriate sections in the "Student Handbook" and <http://studentorgs.vanderbilt.edu/gsc/honor-council/>). Students should also be aware of any additional rules or conditions specified in their award letters or other correspondence.

The program of study outlined below is designed to emphasize the importance of research and advanced critical thinking in graduate study, with an overall objective of enabling each student to carry out and defend an independent, successful research project at the Ph.D. level. To accomplish this objective, students must (1) advance their broad understanding of chemical knowledge, (2) master the subject material relevant to their field of study, (3) complete a successful Ph.D. research dissertation, and, (4) advance their communication skills, particularly in regard to effective communication of

chemical knowledge and the defense of proposed research. Close interaction between graduate students and their Research Directors is critically important in designing and completing an appropriate program of study and a successful research project. Coursework and research programs undertaken by students will be individually tailored for students in consultation initially with a faculty advising committee, and, subsequently, with their Research Director. Student progress in all areas of graduate study, particularly research performance, will be monitored regularly by the student's Research Director, faculty committees, and the Director of Graduate Studies.

A year-by-year outline of a typical graduate career is given below with requirement deadlines specified only for students who would begin their graduate study in the Fall Semester. Topics underlined are described in more detail in Part III. Students are encouraged to complete their Ph.D. program of study as soon as possible. It should always be remembered that successful research progress is the central aim of the chemistry Ph.D. program.

II. OUTLINE OF A TYPICAL Ph.D. PROGRAM OF STUDY*

First Year

1. Take all four Placement Examinations before coursework is undertaken. Students may qualify to complete specified courses for credit and letter grade by examination.
2. Enroll in Chemistry 380 (Introduction to Research) and complete three research group rotations.
3. Enroll in the Chem. 301 (A and B) Seminar courses offered in Fall and Spring semesters.
4. Attend all Faculty Research Presentations.
5. Finish as much of the Course Program as possible.
6. Join a Research Group by ca. 1 April and begin Research as soon as possible.
7. Attend the Graduate Research Seminars and all other Departmental seminars.

Second Year

1. Continue Research at an accelerated pace.

2. Complete Course Program.
3. Select members of student Academic and Research Monitoring (ARM) Committee in consultation with Research Directors and complete the Preliminary Examination requirement by 31 October.
4. Attend the Graduate Research Seminars and participate in all Departmental seminars.

Third Year

1. Continue Research as a major effort.
2. Enroll in Chem 301(A or B) to present a Seminar based on your research project and participate in all Departmental seminars.
3. Select additional members of student Ph.D. Committee in consultation with Research Director and complete the Ph.D. Qualifying Examination requirement by 15 October.
4. Complete an ARM Committee review immediately following the research seminar.

Fourth and Subsequent Years Until Completion of the Degree Requirements

1. Participate in all Departmental seminars.
2. Present and defend an Independent Research Proposal by 15 October of the fourth year.
3. Write a Dissertation and complete a public Final Defense of the dissertation before the student's Ph.D. Committee (final year).

* This Program is based on student admission in Fall Semester (with an academic year beginning at the start of Fall Semester); underlined terms are discussed further in Part III. To minimize scheduling conflicts, students will be requested to conform to staggered deadlines for date-specific requirements.

The following terms are discussed in more detail on the following pages:

<u>Term</u>	<u>Page</u>
A. Placement Examinations	5
B. Faculty Advisor	6
C. Research Director	6
D. Research	8
E. ARM and Ph.D. Committees	9

F. Course Program	11
G. Preliminary Examination	14
H. Ph.D. Qualifying Examination	15
I. Independent Research Proposal	16
J. Dissertation	17
K. Financial Support	18
L. Seminars	18
M. Vacation Policy	19
N. Outside Employment	20

III. DETAILED REQUIREMENTS

A. Placement Examinations

A student must establish sufficiently broad competence in chemistry, comparable to that obtained from a strong undergraduate curriculum of study, to successfully master the subject material of the area chosen for doctoral research. As an indication of this level of competence, each student must take four placement examinations, one in each of the four classical areas of chemistry (analytical, inorganic, organic, and physical chemistry), just prior to registration for their first semester of graduate study. These examinations provide evidence that the student is ready for graduate-level course work or that the student may need to take, or in some cases attend, selected undergraduate-level courses as preparation for graduate courses needed to complete the Ph.D. degree. The choice of courses to be taken is made in consultation with the Faculty Advisor (Section B), who will use the Placement Examination results as an advisory source. Placement Exams are given in the fall prior to student registration for the Fall Semester, and in January prior to student registration for students entering the graduate program in the Spring Semester.

The Placement Examinations are based on material treated in standard undergraduate texts. A review by the student of the texts suggested below will be helpful in preparing the student to take the Placement Exams. Although other similar textbooks would also be helpful for your review, those texts listed below are examples of chemistry textbooks recommended for your study. More recent editions of these or comparable textbooks are likely available.

Analytical: "Principles of Instrumental Analysis," by Skoog, Holler, and Nieman (5th Ed., Brooks/Cole, 1998).

Inorganic: "Inorganic Chemistry: Principles of Structure and Reactivity," by Huheey, Keiter, and Keiter (4th Ed., Addison-Wesley, 1997), "Inorganic Chemistry" by Atkins and Shriver (3rd Ed., Freeman, 2001), "Inorganic Chemistry" by Miessler and Tarr (3rd ed., Prentice Hall, 2003), and "Concise Inorganic Chemistry" by Lee (5th Ed., Chapman and Hall, 1996).

Organic: "Introduction to Organic Chemistry" by Streitwieser, Heathcock, and Kosower (4th Ed., Prentice Hall, 1992), or "Organic Chemistry" by Solomons (6th Ed., Wiley, 1996), or "Organic Chemistry" by McMurry (4th Ed., Brooks/Cole, 1996), or "Organic Chemistry" by Loudon (3rd Ed., Benjamin/Cummings, 1995).

Physical: "Physical Chemistry" by Alberty and Silbey (1st Ed., Wiley, 1992), Chapters 1-8, 10-12, 14-15, 17-21 or "Physical Chemistry" by Alberty and Silbey (2nd Ed., Wiley, 1997), Chapters 1-7, 9-11, 13-14, 16-20, or "Physical Chemistry," by Atkins (5th Ed., Freeman, 1994) Chapters 1-14, 16-17, 20, 24-27, or "Physical Chemistry" by Levine (5th Ed., McGraw-Hill, 2002). Topics covered on the Physical Chemistry Placement Examination are classified as thermodynamics, quantum mechanics, and kinetics.

Students who score 80 percentile or higher on any Placement Exam may qualify to take an additional examination in that subject area to earn credit and letter grades in approved courses, such as the following:

<u>Subject Area</u>	<u>Course for Credit & Letter Grade by</u>
<u>Exam</u>	
Analytical Chemistry	Chemistry 211 (if appropriate)
Inorganic Chemistry	Chemistry 203
Organic Chemistry	Chemistry 220C
Physical Chemistry	Chemistry 232

Sitting for the Chemistry 211 examination is inappropriate for those students who have taken a related course as an undergraduate student. These specific-area examinations will be offered only during the first two weeks of classes in the Fall and Spring Semesters. Students must decide whether to accept or decline letter grades earned by

exam before the end of change period. Students must officially register for all courses in which they have accepted letter grades by exam; however, they do not need to attend such courses nor complete any graded work assignments. Time normally devoted to such courses should be used to accelerate student progress in graduate research. To make the most efficient use of this opportunity, registration in courses passed by exam should be deferred until the second semester of study or later.

B. Faculty Advisor

For those students who do not yet have a Research Director, a faculty advising committee will serve to advise these students based on the research interests and academic background of the student. Otherwise, the student's Research Director serves as the Faculty Advisor.

C. Research Director

Joining a research group is an important part of a graduate student's career. Selection of a Research Director is a process involving mutual interaction and decision-making on the part of students and faculty. To facilitate this process, all incoming students who are admitted to the department through the normal recruiting process are required to attend faculty research presentations, enroll in Chemistry 380 (Introduction to Research), and follow the procedure described below. **No incoming graduate student admitted through the normal recruiting process may sign up with a research group until the entire process for the selection of a Research Director has been completed.** [Entering graduate students who participated in the departmental Summer Research Program for Early Admission during two summers prior to entering the departmental graduate program have the option of requesting either immediate assignment of a Research Director or participation in the general Research Director selection process. Students in this Early Admission Program earn a total of 3 hours of Chemistry 380 credit for their effort during these two summers of research

experience.] Official assignment of graduate students to research groups is made by the Chair of the department.

Faculty research presentations will be scheduled in August during the new student orientation period at which time faculty will make scheduled research presentations to the entering class of students. Students are encouraged to talk individually with those faculty members who made presentations in whose research they have interest.

Enrollment in Chemistry 380 (for a total of 3 quality hours) provides students with an opportunity to spend time in three faculty research groups during their first year of graduate study. Following faculty research presentations, students will provide the Director of Graduate Studies by a designated deadline with a list of three faculty with whom they would like to spend their first research group rotation (**ranked in the order of preference**). Students will then be assigned to their first research group rotation. A sincere effort will be made to accommodate the preferences of each student. One week prior to the end of the first and the second research group rotation periods, students will provide the Director of Graduate Studies with a listing of three faculty (**ranked in order of preference**) with whom they would like to spend their next upcoming research group rotation. Students who have previously participated in a summer research opportunity with Vanderbilt chemistry faculty may elect to have that experience count as one of their three required research group rotations. Each rotation will be in a different research group and will last for eight weeks. A typewritten report of each rotation experience not to exceed 2000 words of text must be submitted near the end of each research group rotation period to the faculty member who supervised the rotation experience and copied to the Director of Graduate Studies. For students entering in Fall Semester, research group rotation reports will be due 27 October, 22 December, and 9 March. Grades awarded to students in Chemistry 380 will be determined from grade recommendations provided by the faculty mentors of each rotation experience. A similar research group rotation experience will be scheduled

during Spring Semester and the first Summer Session for students entering the chemistry graduate program at Spring Semester. Students entering in Fall Semester should register for 2 hours of Chemistry 380 in their first Fall Semester and for 1 hour of Chemistry 380 in the following Spring Semester. Students entering in Spring Semester should register for 2 hours of Chemistry 380 in their first Spring Semester and for 1 hour of Chemistry 380 in the following First Summer Session.

After completion of the research group rotation experience, the Chair of the department will meet with the entering class of graduate students to discuss the process of Research Director selection. By 15 March (for fall admission) or 15 July (for spring admission), students must submit to the Chair a list of three names of possible Research Directors (**ranked in the order of preference**), those faculty with whom the student spent a research rotation, and those faculty with whom the student discussed research on an individual basis. Student choices of Research Director are not limited to those faculty members with whom students spent a research group rotation. With this information, the Chair of the department will make the official assignments of Research Director in a timely fashion. A sincere effort will be made to accommodate the preferences of each student.

Thesis work may be supervised jointly by several faculty, sometimes including those from more than one area and even from other departments; however, a single major professor is the most common choice. One faculty member must be designated as the Faculty Advisor of record.

D. Research

The major part of time and effort in graduate school will be spent in graduate-level research. For research requirements, the student should refer to Sections E, G, H, I and J of this document. The normal expectation is that a graduate student once joining a research group will remain in that research group until completion of a graduate degree program with thesis. Should that degree be the M.S. degree and

should that graduate student wish to continue in the Ph.D. program of the department in another research group, it will be necessary for the student to re-apply for admission to the chemistry graduate program. Only under situations of exceptional circumstance will the Chair permit graduate students to switch groups without completing a M.S. degree with thesis and without following this re-application procedure. Students who have completed a M.S. degree with thesis in the department and who have re-entered the Ph.D. track should expect an increase in the time required to complete the Ph.D. degree. For such students, an accelerated schedule of deadlines for Ph.D. degree requirements might be specified as conditions of re-admission.

E. ARM and Ph.D. Committees

The evaluation and monitoring of the academic and research progress of each graduate student is conducted through interactions between the student and two faculty committees. These faculty committees are the Academic and Research Monitoring (ARM) Committee and the Ph.D. Committee. The members of these committees are chosen by the student's research director in consultation with the student subject to the approval by the Chair of the Department. The Dean of the Graduate School formally appoints faculty to Ph.D. Committees. In all decisions rendered by these committees, a simple majority vote of committee members must agree to each decision.

The selection of faculty members for the ARM Committee must be completed prior to taking the Preliminary Examination. The ARM Committee is composed of the student's Research Director and two other graduate faculty members who have expertise closely related to that of the student's research area of interest. The responsibility of the ARM Committee is to monitor the academic and research progress of the student. This includes monitoring student responsibility in following directives from their Research Directors in a timely fashion with respect to safety, laboratory practice, experimental direction and protocols, and ethical conduct in research. Both

students and their ARM Committees have the right to schedule additional reviews to ensure that students receive appropriate guidance in their research.

Students are required to meet with their ARM Committee at the Preliminary Examination (see Section H) and immediately following the research seminar presented in their third year of graduate study. At least two members of the student ARM Committee should be present at the third-year ARM Committee review of student research progress. Should the scheduling of the third-year ARM Committee review immediately following the student research seminar not be practical, then a separate review meeting should be scheduled as soon as possible."

A written description of the research accomplished by the student should be provided to the members of the ARM Committee at least one week in advance of each ARM Committee review. This description should include the specification of the experimental or theoretical methods used by the student and a summary of the results obtained by the student. Possible outcomes of an ARM Committee review are the following: pass; conditional pass; or failure. When students earn a conditional pass or a failure grade based on an ARM Committee review, the Director of Graduate Studies will be informed of this outcome in writing by the Research Director. If the student earns a grade of conditional pass, then the ARM Committee could decide to require additional work of the student and/or schedule additional ARM Committee meetings to reexamine the research progress of the student as deemed necessary. When a student earns a grade of failure at an ARM Committee review, the student is immediately placed on research probation. Additional work and/or ARM Committee meetings may be required of the student. The student will be terminated from the Ph.D. program if satisfactory progress in research has not been demonstrated to the student's ARM Committee by 31 August of that year or any earlier date specified by the ARM Committee.

"The student's Ph.D. Committee consists of not fewer than four members of the graduate faculty and must include the three members of the student's ARM committee and at least one additional faculty member. One member of the Ph.D. Committee

should be from another department or be a participating faculty member in a Vanderbilt Program or Institute having a research focus different from that of the thesis project. Ph.D. Committees already constituted with more than four faculty members will remain in effect. Should an existing Ph.D. Committee lose one or more faculty members, the new minimum of four faculty members will automatically apply.

The responsibility of the Ph.D. Committee is to administer the Ph.D. Qualifying Examination, monitor the progress of the dissertation, and administer the final Ph.D. dissertation defense. The Ph.D. Committee will meet with each student for the Ph.D. Qualifying Examination. A description of this examination is provided in Section I. The final meeting of the Ph.D. Committee is usually at the public defense and final examination of the thesis, with a private meeting of the student with the Ph.D. Committee occurring immediately following the public presentation.

F. Course Program

The Graduate School requires a total of 72 graduate credit hours of which at least 24 must be in formal course work. These 24 hours must be in courses that carry graduate credit (see the Graduate School Bulletin). Graduate students who have earned graduate credit in lecture or seminar courses elsewhere with grades of B or above should decide, in consultation with their Research Director, no later than the beginning of the student's second year about transferring course credit to their Vanderbilt record. Following Graduate School policy, such transfer credit is usually applied to research hours only.

Chemistry 301a/301b (the graduate chemistry seminar) is required for three registrations for each Ph.D. student as described in Section L. The last seminar credit hour earned could be the final Ph.D. dissertation defense (only if the Final Defense is scheduled during the student's third academic year and can be evaluated as graded work for Chemistry 301a/301b).

Students are required to register for Chemistry 360 (Practicum in Chemistry Instruction) for zero hours, non-credit for each semester that they serve as a teaching assistant. Letter grades in Chemistry 360 will be awarded by the faculty who supervise the teaching assistant assignment. These letter grades will appear on student transcripts but will not be used in grade point average (GPA) calculations.

Enrollment in Chemistry 385 (Readings in Advanced Chemistry) is restricted to qualified students only. Students who have earned 24 total hours minimum of graduate credit and who have a cumulative GPA of at least 3.700 can, with permission of their Research Advisor, enroll in 3 hours of Chemistry 385. Students enrolled in this course must complete demonstrable advanced work, such as literature reviews, intra-group or inter-group seminars, or participation in proposal development.

The Graduate School requires at least a B average in formal course grades for a student to remain in academic good standing on the basis of GPA. Grades in the research courses Chemistry 369 and 399 are excluded from the computation of this average. The Graduate School has adopted a grading system based upon a 4.0 - point scale with adjustment of quality point values for "+" and "-" grade designations. A student whose cumulative grade point average falls below B (3.0) is not in academic good standing and will be notified by the Graduate School that he or she must show substantial progress toward achieving academic good standing during the next semester. To demonstrate substantial progress by the student in such a situation, the Department of Chemistry will expect that the student perform with a semester GPA of 3.0 or greater during that semester and will have brought his or her cumulative GPA up to at least the level of B- (2.7) by the end of that semester. Any student not meeting these conditions will be dropped from the chemistry graduate program. For students meeting those conditions but who have not yet achieved academic good standing, the department will indicate to the Graduate School that satisfactory progress is being made and will request that the student be allowed one additional semester to achieve academic good standing. We anticipate, but we cannot guarantee, that this request will

be granted. In addition, no student may have a cumulative GPA average below the B (3.0) average required by the Graduate School for a total of more than two semesters during his or her graduate career. Students who complete three semesters of study (not necessarily in consecutive order) each with a cumulative GPA below 3.0 will be dropped from the graduate program immediately at the end of the third term below academic good standing. Intermediate summer sessions are ignored in these calculations, provided that no course work is taken during the summer terms.

Chemistry graduate students are not allowed to retake courses, and courses may not be dropped after the initial course change period each term. Students wishing to drop any course during change period are permitted to do so only with the approval of their Faculty Advisor (or the Director of Graduate Studies if a Faculty Advisor has not been chosen yet). Students earning a grade of failure in any course will be recommended to the Chair by the Director of Graduate Studies for immediate dismissal from the chemistry graduate program.

Courses carrying graduate credit as formal course offerings of the Department of Chemistry are listed below. Some of these courses may not be currently offered, as indicated in "The Bulletin of Vanderbilt University, The Graduate School" and the published "Schedule of Courses."

Course Number	Title
202	Introduction to Bioinorganic Chemistry
203	Inorganic Chemistry (if no previous similar course)
204	Inorganic Preparations
207	Introduction to Organometallic Chemistry
211	Instrumental Analysis (if no previous similar course)
221	Laboratory Techniques in Organic Chemistry
222	Physical Organic Chemistry
223	Advanced Organic Reactions
224	Bioorganic Chemistry

225	Spectroscopic Identification of Organic Compounds
232	Quantum Chemistry
233	Molecular Modeling Methods
234	Spectroscopy
238	Data Analysis
250	Chemical Literature
301a	Chemistry Seminar
301b	Chemistry Seminar
304	Special Topics in Inorganic Chemistry
306	Physical Methods in Inorganic Chemistry
311	Advanced Analytical Chemistry I
313	Advanced Analytical Chemistry II
314a	Special Topics in Analytical Chemistry
314b	Special Topics in Analytical Chemistry
316	Problem Solving in Analytical Chemistry
323	Stereoisomerism and Structure Theory
324	Special Topics in Organic Chemistry
330	Advanced Quantum Chemistry
331	Statistical Thermodynamics
332	Special Topics in Chemical Physics
334a	Special Topics in Physical Chemistry
334b	Special Topics in Physical Chemistry
335	Thermodynamics and Kinetics of Inorganic and Organic
Materials	
336	Biochemical Toxicology and Carcinogenesis
340	Applications of Group Theory
350	Materials Chemistry (two independent formats)
360	Practicum in Chemistry Instruction (0 hours, non-credit)

380	Introduction to Research
385	Readings in Advanced Chemistry

Students should consult the Bulletin of the Graduate School for listings of graduate courses in other departments. The specific course program appropriate for each student should be determined in close consultation with the student's Research Director.

G. Preliminary Examination

Students must complete a Preliminary Examination requirement by 31 October of their second year of graduate study (or 31 March for students entering Spring Semester). The Preliminary Examination represents the student's first experience to defend his or her research in both written and oral formats. Students will provide their ARM Committee members with a written summary of their research progress to date. The written document should consist of an introduction to the rationale of their research project, a background review of relevant literature, a detailed progress report of their research results, and should summarize their proposed thesis research. Students will meet with their ARM Committee no sooner than one week following the distribution of their written summary to give an oral presentation of their research summary followed by discussion with their committee members.

Outcomes of this Preliminary Examination are Pass, Conditional Pass, or Failure and are communicated to the Director of Graduate Studies (or designee) via email correspondence. Students earning a Conditional Pass must remove any imposed conditions by the date stipulated by the ARM Committee or by completion of their Ph.D. Qualifying Examination or else they will be dropped from the Ph.D. program. Students earning a grade of Failure will be immediately placed on research probation and must attain good standing in their research by the date stipulated by the ARM Committee or by completion of their Ph.D. Qualifying Exam or else they will be dropped from the chemistry graduate program.

H. Ph.D. Qualifying Examination

Students must complete their Ph.D. Qualifying Examination requirement by 15 October of their third year of graduate study (15 March for students entering in Spring Semester). Students should complete all of their minimum formal course work (with the possible exception of one credit hour of seminar) and a total of at least 24 credit hours of graduate work prior to taking this examination. The Ph.D. Qualifying Examination must be completed within a period of four weeks, and a student is permitted only two opportunities to pass this examination. Students present their Ph.D. Qualifying Examination to their Ph.D. Committee. The Research Director will inform the Director of Graduate Studies (or designee) of the faculty members recommended to serve on the student's Ph.D. Committee and the date, time, and location of the Ph.D. Qualifying Examination to be scheduled. The department will then recommend to the Graduate School that a Ph.D. Committee be established for the student and that the Ph.D. Qualifying Examination be scheduled officially. The Dean of the Graduate School approves the formation of the student's Ph.D. Committee, the scheduling of the Ph.D. Qualifying Examination, and notifies each Ph.D. Committee member of the time, date, and location of the exam.

The Ph.D. Qualifying Examination consists of a written and oral defense by the student of their research project and their research progress to date. At least one week prior to the scheduled date of the examination, candidates will distribute a written summary of their research project to the members of their Ph.D. Committee. This written summary should follow an ACS journal style format and should include an introduction and background to the research project and a detailed summary of research progress to date. A justification of the research project should be clearly stated, and an appropriate discussion of the meaning of research results should be included. Students should summarize their future research objectives. The candidate

will make an oral presentation of this report at the scheduled examination and will orally defend the contents of this report.

Outcomes of the Ph.D. Qualifying Examination are grades of Pass or Failure and are indicated to the Director of Graduate Studies (or designee) by completing and signing the Results of Qualifying Examination form provided by the Graduate School. Once signed by the Director of Graduate Studies, the form is then sent to the Graduate School. Candidates receiving a Failure will be given a second chance to pass this requirement usually within a four-week period. This period is to be included within the stated deadline for completion of this degree requirement. Students who do not meet this deadline will be dropped from the Ph.D. program.

When a student passes the Ph.D. Qualifying Examination, the student is admitted to candidacy for the Ph.D. degree by the Graduate School, having fulfilled all of the requirements for that status, and the Director of Graduate Studies (or designee) so informs the chemistry administrative office. Students admitted to candidacy for the Ph.D. degree must satisfy all remaining requirements of the Ph.D. degree.

I. Independent Research Proposal

By 15 October of their fourth year of study, students must complete a mock written submission and subsequent defense of a research project original to their own thinking. In consultation with their Research Director, students should choose to follow either relevant parts of the PHS 416 Research Training Plan format or the complete Petroleum Research Foundation Doctoral New Investigator Proposal format for their written proposal (see Appendix A). This requirement gives students experience in formulating and presenting a formal research proposal and develops the independent and creative thinking skills of the student. The Independent Research Proposal is a graduation requirement rather than a formal degree requirement.

Students present their Independent Research Proposal and associated oral defense to their Ph.D. Committee. The research proposal should be original to the student and shall always be in chemistry. Early during the development of this proposal, students should provide the title and a 1 or 2 page summary to the members of the student's ARM Committee. If any member of the ARM committee should consider that the proposal described by this summary might be inappropriate, then the ARM committee will meet with the student to discuss the choice of this research proposal. The independent proposal should deal with a problem of sufficient scope and quality that, if successful, the results could be published in reputable journals. Hence, the independent proposal will require defense of both merit and feasibility. In the development of the proposal, originality in concept or in problem solving should be stressed. The proposal should not be a routine extension of the dissertation or known chemistry.

Students should distribute their written proposal to their Ph.D. Committee at least one week in advance of the oral examination. Reference materials cited in the proposal must be returned to the library for the use of the committee. The oral examination assesses the originality, knowledge, and capacity for independent critical analytical thought by the student, as well as his or her ability as a scholar. This examination usually lasts about two hours, but the student's oral presentation of the original proposal is limited to approximately 25 minutes. Outcomes of this examination include earned grades of Outstanding, Excellent, Very Good, Good, Fair, or Flawed. Proposals earning a grade of "Flawed" by a majority of Committee members are unacceptable and are to be revised or repeated as dictated by the student's Ph.D. Committee. Following the oral examination, the Research Director should inform the Director of Graduate Studies of the outcome.

J. Dissertation

After having been admitted to candidacy, students should complete the remaining 72 hours of required graduate work and all remaining degree requirements. Near the completion of the research project, Ph.D. candidates normally begin to write their Ph.D. dissertation. Detailed instructions available from the Graduate School (http://www.vanderbilt.edu/gradschool/current_students/index.html#eformat) should be consulted before writing the dissertation.

The final steps in the dissertation defense and approval process, as stipulated by the Graduate School, are the following:

- (1) At least two weeks prior to the final examination, the candidate should distribute a copy of the dissertation to each member of the candidate's Ph.D. Committee. Committee members are invited to review the dissertation and to provide comments.
- (2) At least two weeks prior to the final examination, the Chair of the Candidate's Ph.D. Committee, in consultation with the candidate, shall notify the Graduate School (via the Director of Graduate Studies or designee) in advance of the place and time of the final examination and the title of the dissertation. The Dean of the Graduate School then notifies the members of the Ph.D. Committee of the scheduled final examination and invites attendance by the university community.
- (3) At least one week prior to the final examination presentation, the candidate and the Research Director must notify the Chair of the Department and the Department office (via the Director of Graduate Studies or designee) of the public presentation and defense of the dissertation by the student.
- (4) A corrected final draft of the thesis, if any, is to be delivered to each committee member at least four days prior to the final examination.
- (5) Immediately following the public presentation, the candidate and the Ph.D. Committee meet to complete the final examination. The Ph.D. Committee meets in closed session to formulate a decision regarding the final examination and then informs

the candidate of their decision. The Research Director informs the department and the Dean of the Graduate School (via the Director of Graduate Studies or designee) of the final decision of the Ph.D. committee by completing and signing the Results of Dissertation Defense form provided by the Graduate School. After obtaining the Director of Graduate Studies' signature, the form is then sent to the Graduate School.

K. Financial Support

A graduate student in good standing can expect up to four years of Departmental financial support as a Teaching Assistant, but no more than six years of total support. The purpose of this rule is to encourage students to finish their Ph.D. work in a reasonable time. Continuation of support and the level of support, depends at all times on the student satisfactorily fulfilling all assigned responsibilities, registering for all advised course work, making satisfactory progress toward the degree, and the availability of financial resources.

L. Seminars

All graduate students are to attend the Departmental Graduate Seminars in addition to all other Departmental seminars. Students need to possess adequate English proficiency to benefit from attendance at Departmental seminars and to develop the written and oral skills expected of professional scientists. By the end of their first year of study, students must possess, as a minimum, sufficient English proficiency to pass certification for laboratory instruction by the Vanderbilt Center for Teaching. Students failing to attain this minimum level of English certification will be dropped immediately from the chemistry graduate program by the Director of Graduate Studies.

Students in their first year of study will register for Chemistry 301A in the fall semester **and** for Chemistry 301B in the spring semester. Taken together, these courses introduce students to the breadth of contemporary chemical research and help

students develop critical thinking skills using Departmental seminars as a learning tool. During the third year of study, students will register for either Chemistry 301A or B and will present a departmental seminar on their research. As described in Section F, Course Program, this seminar could be the student's final thesis defense (only if the final defense is scheduled during the student's third academic year and can be evaluated as graded work for Chem. 301A/301B).

M. Vacation Policy

The Departmental policy for graduate student vacation (both for RA's and TA's) is that students are entitled to two weeks of vacation during each twelve-month period they are in residence in addition to the normal faculty/staff holidays (NOTE 1: Faculty/staff holidays are specified on the University Holiday Schedule and do not follow the holiday and break times designated on the Vanderbilt University Academic Calendar. NOTE 2: Labor Day is listed as a University Holiday; however, it is not a holiday for the College of Arts & Science. Faculty and graduate students are required to fulfill all teaching-related responsibilities on Labor Day). Students may choose to take these two weeks of vacation at any time during the year as long as it does not conflict with their assigned teaching and/or research duties and if the chosen period(s) are approved by their Research Director. Students, especially those from abroad for whom travel is lengthy and expensive, may wish to forego the two-week vacation in one year and take a four-week vacation in a later year. Unlike undergraduate school where the summer is vacation time, in graduate school the summer is part of the standard appointment and is a prime time for making research progress.

Any circumstance that requires the student to be away from the University for prolonged periods, even without pay, must be made known to and discussed with the student's Faculty Advisor and the Director of Graduate Studies in advance. Failure to do so could lead to termination of the student from the graduate program in chemistry.

N. Outside Employment

Graduate students in chemistry who wish to seek employment for any activities outside of those related to their duties as graduate students or as required by their financial award are required to follow Graduate School policy for approval of such employment. This policy states that such requests are to be submitted by the student in writing for approval by the student's Faculty Advisor and by the Chair of the Department and, upon receiving such departmental approval, must be submitted in writing to the Dean of the Graduate School for official approval.

Tutoring students in chemistry courses for hire is a special type of employment opportunity. Current policy regarding such tutoring for hire is the following; (1) teaching assistants shall not tutor for hire in courses in which they are employed as teaching assistants, (2) graduate students interested in tutoring for hire must receive written approval to do so (with copy to the Director of Graduate Studies) from either their Faculty Advisor or the Director of Graduate Studies if they have not yet chosen a faculty supervisor, and, (3) graduate students who have been approved for tutoring for hire as described above should submit their name to the Director of Undergraduate Studies for referral by students in those courses.

Appendix A

PHS 416 Research Training Plan format for the Independent Research Proposal Requirement Format:

Research Training Plan

Title (85 letters maximum)

A. Specific Aims

Summary of proposal and goals

Specific Aim 1.

Specific Aim 2.

B. Background and Significance

Background leading to the proposed work and direct health-relatedness of the project (for NIH).

C. Preliminary Studies

No preliminary studies by the applicant have been initiated concerning the project described in the research proposal or add if previous work by the applicant has been accomplished in this area and describe briefly.

D. Research Design and Methods (not to exceed 10 pages for Sections A-D)

How the project will be carried out in the laboratory in terms of planned experiments and also an explanation of the anticipated results.

Specific Aim 1. Discussion pertaining towards the goal listed above in Section A.

Specific Aim 2. Same

Proposed timeline for the award period (this was extra, was added to show the viability of the proposed project within a three year period – which is the maximum allowed for NIH funding at the postdoctoral level) – simple line chart with expected dates for key experiments mentioned within the project.

E. Human Subjects Research

n/a for the proposed research (or a very involved section if you do have this – refer to instructions)

F. Vertebrate Animals

n/a for the proposed research (or a very involved section if you do have this – refer to instructions)

G. Literature Cited (no page limit – ACS style format but also including the title of each article)

Petroleum Research Foundation Doctoral New Investigator Proposal format for the Independent Research Proposal Requirement Format (available in electronic format at the American Chemical Society website):

DNI

THE PETROLEUM RESEARCH FUND

DOCTORAL NEW INVESTIGATOR PROPOSAL

(Please refer to statement of eligibility, terms, and conditions.)

PRIVILEGED COMMUNICATION

This proposal is intended for review exclusively by ACS PRF staff, members of the PRF Advisory Board, and outside reviewers officially asked to furnish scientific comments. It may not be transmitted to other parties, copied, or retained for future reference. Please return to the PRF office, or destroy, in accordance with instructions.

(Principal Investigator)

(Institution)

(Department)

(City)

(State)

Title of Proposed Research: _____

The ACS Petroleum Research Fund has a “zero-tolerance” policy for scientific misconduct. Scientific misconduct includes, but is not limited to, fabrication, falsification, and plagiarism. Instances of alleged or suspected scientific misconduct will be referred to a committee of the PRF Advisory Board for investigation. Upon the PRF Advisory Board’s determination of scientific misconduct, the Board may, in its discretion, take any actions it deems appropriate. Such actions may include: disqualifying proposals from consideration; disqualifying individuals or institutions from submitting future proposals; revoking grant awards; contacting appropriate Officers of the relevant institution(s), such as the Dean, and/or Department Head of the investigator(s); and other such actions that the Board feels are appropriate.

By signing below, we acknowledge that we have read and understand this scientific misconduct policy.

In addition, we confirm that, should this proposal be funded, the proposed budget will become the approved grant budget and funds will be spent according to the budget amounts and categories approved by ACS PRF. Any revisions to the approved budget require **prior approval** from a program manager.

Principal Investigator: _____

(Signature)

(Date)

Officer of the Institution
Endorsing the Proposal: _____

(Signature)

(Title)

(Date)

I. PERSONAL AND PROFESSIONAL VITA

A. Indicate all academic degrees, when and where received; previous faculty and all other professional positions; significant awards and honors; and other pertinent biographical material. A list of ***all research publications*** from the last five years must be included or attached.

B. Do you currently hold a tenured or tenure-track position? _____. If not, please explain your eligibility according to PRF criteria, and include a letter from your department chair verifying your eligibility to apply for a PRF Type DNI grant.

II. CURRENT AND PENDING RESEARCH SUPPORT

A. List any active research grants or other current financial support received for research. Give titles, amounts (*annual direct costs; if more than one PI, indicate only your share of the granted amount*), sources, time periods of awards, and *relationship to this PRF proposal*. Use separate page if necessary; indicate “none” if applicable.

B. List any other research grant applications pending. Give titles, amounts requested (*annual direct costs*), sources, and *relationship to this PRF proposal*. Use separate page if necessary; indicate “none” if applicable.

III. CAPITAL EQUIPMENT BUDGET EXPLANATION

Provide a detailed description of the proposed equipment and the need it fulfills in your research; describe any matching funds that are to be obtained. Provide a brief description of student participation in the proposed research project, and describe other sources of funding, if any, that may be used to support student stipends given the expenditure for capital equipment.

IV. SUGGESTED REVIEWERS.

Provide the names and addresses (including email) of at least eight (8) suggested reviewers who are experts in the field of the proposed research. Do not include former research mentors, students, collaborators, or colleagues at your current or former institutions. It is suggested that you include, but are not limited to, the names of experts residing in the United States. Also, please do not list names of any reviewers whom you have suggested in any proposal previously submitted to ACS PRF. Include the first name, middle initial (if any), full current mailing address with zip code, and ***email address*** of all suggested reviewers.

NOTE: This information must also be entered as part of your online application, on the proposal submission website.

V. COLLABORATIONS

If you will be collaborating with other scientists in the performance of the research described in this proposal, identify the collaborators and briefly indicate the nature of the collaboration. If any of these collaborators are current PRF grantees or applicants, discuss the relationship between this proposal and the collaborator’s PRF project.

VI. THE PROPOSED RESEARCH

The scientific text of the proposal should be attached to the preceding introductory pages. Please observe the following guidelines in preparing the proposal.

A. The first section of The Proposed Research should be an ABSTRACT of no more than 250 words. *(The abstract must also be entered as part of your online application, on the proposal submission website.)* The abstract should present the rationale of the research, its scientific objective, and an estimate of the significance to the field of research if the objective is reached.

B. The body of the narrative should expand upon the salient points presented in the abstract. In addition, it should provide a introduction of the proposal topic, a detailed description of the research plan, including tables and figures, and a survey of pertinent literature (see Part C below), and any non-scientific matters which require explanation, for example, plans for access to specialized equipment, required field studies, etc.

C. Reference citations must include the **names of all authors, complete article title, journal title, year of publication, volume number (if any), and pages of cited article:**

Siatkowski, R. E.; Dunn, D. A.; Botto, R. E. Fundamental Geophysical Properties of Materials Relevant to Petroleum Research. *Journal of Obscure Chemistry* 2006, 16, 200-215

D. The proposal should be as concise as is consistent with an adequate presentation and justification of the research idea. The PRF has set **a limit of 2,500 words, double-spaced, in 12-point type** for the scientific text of proposals for ACS PRF Type DNI grants. The word limit excludes abstract, figures, and references. **Non-conforming proposals will be returned without review.**

E. *Applicants may not attach preprints or reprints of articles to proposals. Information that has not yet been published may be included in the text of the proposal. Updates regarding pending proposals with other agencies should be forwarded to your PRF Program Manager. No additional material may be submitted while a proposal is under review.*