

JCCO Handbook

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1: General Information

Welcome to the Joint Program in Chemical Oceanography. In the following pages you will find information that we hope will ease your progress during your graduate years in Cambridge and Woods Hole. Although our program is flexible, we expect most students to follow a pattern somewhat like this:

1-1: Summer after Admission

New students have the option of spending the first summer in residence at Woods Hole working on a summer project with a member of the Scientific Staff (the WHOI faculty). We expect you to use this summer to acquaint yourself with WHOI, the staff, your fellow students, and the education program. You are encouraged to meet the staff and to familiarize yourself with their research interests. Many of the staff, students, and employees of the Institution will become your colleagues in the years ahead. We urge you to take time to get to know the Institution and its many resources. You are also encouraged to attend the many seminars and talks given regularly in the Woods Hole scientific community. Each summer, special seminar series are given by senior students and staff to introduce you to the many different avenues of oceanographic research. Talks are also given daily at the Marine Biological Laboratory, the U.S. Geological Survey, and the NOAA National Marine Fisheries Laboratory.

The Education Coordinator appoints an Academic Advising Committee for each first year class. This committee, consisting of two members from WHOI and two from MIT (one from Earth, Atmospheric, and Planetary Sciences and one from Civil and Environmental Engineering), will advise you about courses as well as other education-related matters. The committee follows the first-year class through their general exam, which occurs in June of the second year. Since one committee works with each class for the pre-generals period, we hope that the committee and its students will get to know each other well and that the students will receive consistent advice throughout this period. Other staff and students, both at MIT and at WHOI, are also valuable sources of information about the graduate program. The Education Coordinator, working with the Student Representative, will appoint senior students to serve as official student contacts for pre-generals students. In addition, since you will typically be working on a research project, your research advisor can be a good resource for information about the Joint Program. Information about how to succeed in the Joint Program comes to you from several directions. The Education Coordinator can help to sort out conflicting advice. The advising structure for pre-generals students is summarized on the attached flowchart.

JCCO
Oversees the Joint Program in Chemical
Oceanography

*Academic Advising
Committee*
* helps with class choices
* preparation for General
Exam
* division of effort between
class, laboratory, and
independent study

Education Coordinator
* Overall responsibility for
advising
* Appoints Academic Advising
committee
* Resolves questions about
conflicting advice
* Ombudsperson; can help
resolve conflicts between
students and advisors

Research Advisor(s)
* Oversee work on
specific research
projects

*1st & 2nd year
student*

Senior Student
* advice from the
point of view of
someone who has just
been through it

1-2: First Year

Emphasis in the first year is generally placed on course work (see section 2). All MC&G students are required to take the Introduction to Marine Chemistry course (12.742). They are required to take the Student Seminar (12.759) during each of their first two years. Each student is expected to be involved in an independent research project (see "Graduate Student Research and Teaching Responsibilities" later). In some cases, research projects begun in the summer will continue throughout the academic year. In others, factors such as financial support, research interests, and place of residence (Cambridge or Woods Hole) may lead to a change in your research. The time available for you to conduct research will fluctuate over the semester. The Joint Program is designed to be flexible, however if you are funded by a grant or contract, you may have obligations set by the funding source. Therefore, it is important that you meet with your research advisor early in the academic year to work out a plan of research. The first two years of your graduate education are an excellent time to expose yourself to different subdisciplines of chemical oceanography. We encourage you to take advantage of the program's flexibility and consider independent projects in more than one laboratory.

Depending on academic and research demands in the first year, you have a choice of residence, Cambridge or Woods Hole. A bus is provided from MIT to attend classes at WHOI (Tuesday, Thursday) and mini-vans may be available from WHOI to MIT (Monday, Wednesday, Friday) (depending upon the number of riders each term). In addition, you will be reimbursed at the current bus ticket rates for the use of your private vehicle and/or public transportation.

1-3: Summer (end of year 1)

Summer is spent doing preliminary research on likely thesis topics or sampling the research of a different laboratory. Independent projects and perhaps cruise participation may be undertaken as the opportunity arises. Participation in a cruise at an early stage in your studies can be useful to you in choosing a research topic as well as in getting some "hands-on" oceanographic experience. The best way to get on a cruise is by word-of-mouth. Ask staff members and the WHOI Education Coordinators about opportunities.

1-4: Second Year

You should begin a research project in the laboratory of your likely thesis supervisor. You will continue to take courses. By March of your second year, your Academic advisory committee will administer a preliminary examination to help you prepare for the General Exam at the end of the spring term. No grade is given on the preliminary exam. You and your Academic Advisory Committee will decide on the format of the exam; its main purpose is to identify subjects that might need further study and attention before the General Exam.

1-5: General Examination

The purpose of the General Exam is to determine whether you are ready to begin your Ph.D. thesis research. The preparation for this exam gives you the opportunity to integrate studies completed during your first two years. You can learn the material that you will need to

know to pass the exam through course work, tutorial, or self-teaching. Courses are available at WHOI and MIT, as well as through cross-registration at Harvard University and the Boston University Marine Program. A list of courses frequently taken by Chemical Oceanography students in the past appears in section 2. Tutorials can be arranged with individual members of the Staff for help in specific areas.

The General Exam has three parts. (1) In March of the second year, the student is to hand in a research paper, which is available for all JCCO faculty to read (An abstract of this paper should be submitted to the Education Coordinator by December of the second year). The General Exam Chair will convene a meeting of JCCO faculty at which the papers are discussed. Each student will then either be given a Pass on the paper or will be asked to revise it in specified areas and resubmit. The student's performance on the paper will be considered by the General Exam committee following the completion of the written and oral parts of the exam, when the committee evaluates the student's performance on the entire exam. (2) There is a four-hour, closed book written exam consisting of 4-8 questions covering topics in marine geochemistry and general oceanography. (3) Finally, there is a one-hour oral exam, following TWO weeks after the completion of the closed book exam, during which you may be asked to elaborate on some of your answers from the written portion of the exam and respond to some new questions on your general oceanographic knowledge. Each portion of the exam is designed to test skills that are essential for the successful completion of a Ph.D. in chemical oceanography. The closed book portion of the exam tests your command of fundamental principles in chemical oceanography. The research paper allows the staff to evaluate your abilities to carry out research, critically read recently published articles, integrate them with your data and general knowledge of chemical oceanography, and synthesize your ideas and conclusions.

The research paper will be written on work that has been carried out during some part of the student's first 1.5 years in the Joint Program. The paper may be written on a topic of the student's choosing. To ensure that it is distinct from the thesis proposal, it must be written in the form of a published paper, including an overview of the research presented, results of the research effort, and discussion of the contribution that the results make to the research area. The paper should be no more than 12 pages in length (12-point font, single-spaced, including figures, but excluding references). In order to ensure that they are on track to complete a paper by the deadline, students are required to submit a brief description of the proposed paper topic in December of their second year. JCCO, in consultation with the research supervisor, may then approve the proposed topic or request some change in emphasis of the paper. It is recognized that much pre-thesis research is exploratory in nature and takes place over a short time period. For these reasons, it is not expected that the research papers will be manuscripts ready for submission to a journal for publication; rather, they are to be research papers of high quality that show an ability to conduct research and present the results coherently. It is expected that the research paper will present the results of a collaborative effort by the student and the scientist in whose lab the research took place. However, it is important that the paper represent the work of the student. For that reason, the advisor's input into the final product is to be limited in the following way. The student will prepare a draft of the paper, which will be given to the advisor for review. Upon receiving the advisor's comments on the first draft, the student will complete the paper on his or her own.

The closed book written and oral portions of the exam take place in June and July of your second year. The Education Coordinator will set a specific date, following the guidelines set out in Appendix II. It is expected that all second year students will take the exam at that time. If you believe the exam may conflict with other commitments (cruises, etc.) contact the education coordinator as soon as possible. The exam is administered by a special committee with members from both institutions. The committee chair solicits questions from the staff and compiles a draft of the exam. The full committee checks the exam, and then meets to draft the final exam. The exam is administered to all students of the class simultaneously; students residing in Cambridge may take the exam at MIT, while students residing in Woods Hole may take the exam at WHOI. The research paper and closed book portions of the exam are graded by the exam committee and by members of the staff who have contributed questions. The committee then meets with the education coordinator and JCCO chair to evaluate student performance and discuss areas to be covered during the oral exam.

The oral exam is held at WHOI and is open to all interested staff. In the oral exam you will probably be asked to clarify some of your answers on the written exams and participate in follow up discussions on related topics. You may also be asked questions related to your research paper. Possible outcomes of these portions of the exam are: 1) an unqualified pass, 2) a pass with certain conditions requiring further study, 3) a fail with the recommendation that all or part of the exam be repeated, and 4) a fail. After the oral portion of the exam, the General Exam and JCCO chairs will meet with you to discuss the decision of the exam committee.

The general exam also includes development of a likely thesis topic and the oral and written presentation of a thesis proposal. The thesis proposal, due two weeks before your scheduled proposal defense, should be a description of your research problem that includes an abstract, an introduction to the problem, a summary of hypotheses and objectives, and a detailed plan of research. A copy of your proposal should be given to the WHOI Academic Programs Office. The total length of the proposal, excluding figures and bibliography, should not exceed 15 pages, double-spaced. The proposal is reviewed by members of the staff with appropriate expertise. During the oral presentation of the proposal, you should provide a brief introduction, outline your major hypotheses, and discuss your proposed research including any preliminary results you may have. You are allowed 30 minutes for your talk. Your presentation will be followed by 30 minutes of questions from the staff on your proposed research. The thesis proposal defense must be completed by October of your third year. While the defense often follows the written portion of the exam, you may defend your proposal at any time in your second year. The thesis proposal defense should be chaired by a member of the staff of MIT or WHOI (who is not the student's advisor). This person is chosen by the WHOI Chemistry Education Coordinator in consultation with the student.

All students are expected to complete the general exam by the end of their second Academic year. If you believe that you are insufficiently prepared, you may petition JCCO for an extension at least six weeks before the start of the exam. Your petition should include the reasons for your request and an estimate of the time you feel you will need to prepare for the exam.

1-6: Third Year

The third year is devoted to thesis research. After your general exam you will need to formally identify a thesis supervisor or co-supervisors and, in consultation with your supervisor(s), assemble a thesis advisory committee of 4-5 scientists. The committee members should meet with you on a regular basis throughout your research (every 6-12 months, or more frequently if needed). Upon conclusion and submission of your written thesis, the committee will examine you and vote upon its approval. The committee must include at least one member from MIT and WHOI. Scientists from other institutions should also be considered. Once you have formed your committee, you must write the JCCO chair for approval. If your committee includes members from outside WHOI and MIT, JCCO will ask you to describe your expected interaction with these members, and will require that your advisor, the prospective committee member, or the Education Office set aside funds to travel to MIT or WHOI for the thesis defense. You will need approval of the Director of the Joint Program at MIT and the WHOI Associate Dean to cover travel expenses for travel to the thesis defense. We encourage you to form your thesis committee as soon as possible after your thesis proposal defense, and we expect that a committee will be in place no later than December of your third year.

1-7: Fourth Year

You should have made substantial progress on your thesis research by the end of your fourth year; this progress should be made evident through publications and oral or poster presentations at MIT, WHOI, or national/international meetings. It is important to maintain close contact with all members of your thesis committee through annual or biannual meetings. Written drafts of some sections of your thesis, such as the Introduction or Methods sections, should be in progress.

1-8: Fifth Year

Your graduate career will conclude with the final draft of your thesis, which needs approval by all members of your Thesis Committee. Your thesis defense must occur before the end (August 31st) of your fifth year.

1-9: Extensions beyond the fifth year

If you have not defended your thesis by September of your sixth year, extensions to your student status must be approved by JCCO. The request for an extension should be communicated by letter to the JCCO chair. The request should include the length of time needed to complete your thesis, the reasons for the delay in completion and how these have been addressed, and a detailed work plan and time table of major tasks to be completed during the extension. In addition, the request should be supported by a separate letter from your thesis supervisor. An extension will be granted only if: 1) there have been good reasons for not finishing in five years, 2) there is evidence of good progress, and 3) your advisor supports the extension. If you require an extension, your request must be received by JCCO by May 31 of your fifth year, or at least 6 weeks before the end of any previous extensions. Upon review of the request, JCCO will decide to 1) grant the extension as requested, 2) modify the length of the extension, 3) grant an extension in which tuition only is provided, 4) grant an extension with neither tuition nor stipend

provided, 5) deny the extension. Typically, JCCO will grant less financial assistance as successive or poorly justified requests are received. Extensions beyond the sixth year should not be anticipated. The final decision on extensions and financial assistance beyond the fifth year will be made for students whose thesis supervisor is at MIT by the Joint Program Director at MIT and the appropriate MIT Department Heads; and, for student whose thesis supervisor is at WHOI, by the Dean of Graduate Studies at WHOI and the appropriate WHOI Department Chair.

The schedule described above is an example only. Some students move more quickly or more slowly at different stages. We try to remain as flexible as possible to provide you with the best educational experience. Staff members participating in the program meet periodically to discuss student progress, and your advisory or thesis committee should meet with you regularly.

If you have any questions about your progress, be sure to ask.

Requirement	<u>How?</u>	<u>When?</u>	<u>Who is responsible?</u>
<u>Pre-General Exam</u>			
1. Broad knowledge of oceanography	Introductory courses, tutorials, reading	First 2 yrs.	Student
2. Detailed knowledge of field - chemistry and chemical oceanography	Basic core courses in chemistry & chemical oceanography, reading	First 2 yrs.	Academic Advisory Committee (AAC)/ student
3. How to do research	1-3 different laboratory projects with different supervisors	First year	AAC/student
4. Knowledge in depth in thesis area	Laboratory project, special courses as required, familiarity with literature	Second year	AAC/student
5. Progress report	Meeting with advisors	At least every 3 months informally	AAC/student
6. Preliminary Exam	Open and/or closed book questions	After 1.5 years in program	AAC
<u>General Exam</u>			
1. Research Paper	1. Abstract & paper to Ed.Coordinator	18-24 months after start in program	Chemistry Education Coordinator and Exam Committee
2. Written exam to test pre-general work	2. Closed book questions		
3. Oral exam of pre-general work			
4. Written thesis proposal	4. Copies to Department, Academic Programs Office, Ed. Coordinator, Exam Committee	3 weeks prior to oral exam	Student
5. Oral proposal defense to test knowledge and ability to set up an experiment and to do research	5. Thesis proposal defense	No later than Sept. of third year	Exam Committee
<u>Post-General Exam</u>			
1. Oral progress report on research	(a) Semi-annual meetings with Thesis Committee (b) Oral presentations in Chemistry Seminar series	1-2 times each year	Student/Thesis Committee
2. Continued education	Special courses, tutorials, etc.	As required	Thesis Committee
3. Ph.D. exam (Thesis Defense)	Follow JCCO format	When ready: 2-3 years after General Exam	Thesis Committee/student

2: Seminars/Subjects

I. Required

12.742 Marine Chemistry - Francois/Reddy, WHOI

12.759 Seminar in Marine Chemistry - WHOI staff

II. Strongly Recommended Courses

1.76 Aquatic Chemistry - Voelker, MIT

12.743 Geochemistry of Marine Sediments – McCorkle/Martin, WHOI

12.744 Marine Isotope Chemistry – Peucker-Ehrenbrink, Kurz, Charette, WHOI

12.746 Marine Organic Geochemistry – Repeta / Eglinton, WHOI

12.747 Modeling, Data Analysis, and Numerical Techniques - Glover, Jenkins, Doney, WHOI

III. Electives and Specific Interest Courses

1.75 Limnology and Wetland Ecology - Hemond, MIT

1.83 Environmental Organic Chemistry - Gschwend, MIT

1.761 Aquatic Kinetics - Voelker, MIT

7.47 Biological Oceanography – Pineda, Sosik, WHOI

12.479 Trace Element Geochemistry - Frey, MIT

12.711 Marine Geology and Geophysics I

12.712 Marine Geology and Geophysics II

12.740 Quaternary Paleoceanography - Boyle, MIT

12.808 Introduction to Observational Physical Oceanography – Joyce, WHOI

IV. Some of the Available Courses of Interest to Chemistry Students:

CHEMISTRY and CLIMATE

12.843 Climate Physics and Chemistry - Wunsch, Emanuel, Boyle, Raymo - MIT

12.806, 12.807 Atmospheric Chemistry and Physics I and II, Molina, Prinn - MIT

BIOLOGY

B-118 Biological Oceanography - McCarthy, Harvard

7.47 Biological Oceanography - WHOI staff

MBL courses in Marine and Microbial Ecology

1.89 Environmental Microbiology – Polz, MIT

PHYSICAL OCEANOGRAPHY

12.800 Fluid Dynamics of the Atmosphere and Ocean - Hansen, MIT

12.801 Steady Circulation of the Ocean - Pedlosky, WHOI

GEOLOGY

1.67 Sediment Transport and Coastal Processes - Madsen, MIT

12.480 Advanced Igneous Petrology - Grove, MIT

12.751 Student Seminar in Marine Geology/Geophysics - WHOI staff

MODELING

1.77 Water Quality Control - Adams, MIT

10.33 Analytical Treatment of Chemical Engineering Processes

10.331 Nonlinear Analysis in Chemical Engineering - Brown, MIT

10.34 Numerical Methods Applied to Chemical Engineering - Brown, MIT

10.341 Finite Element Methods for Problems in Transport Phenomena - Brown, MIT

12.747 Modeling, Data Analysis, and Numerical Techniques – Jenkins, Glover, Doney,
WHOI

12.750, 12.751 Geosystems I and II, MIT

12.823 Ocean Modeling, Marshall, MIT

12.841 Climate Modeling, Stone, MIT

It is difficult to keep this list current as schedules and personnel change rapidly. You should become intimately acquainted with the MIT Course Bulletin (issued in August) and the WHOI Course Schedule (issued in January and August). The students are typically the best source of information on course quality and usefulness.

There are sometimes opportunities for advanced graduate students to obtain teaching experience by serving as Teaching Assistants. There are also Teaching Assistant opportunities to assist in laboratory sections of courses. If you have an interest in this, you should discuss it with the course instructors.

3: Thesis

After passing the General Exam you will begin to work on a research topic under the supervision of your Thesis Committee. Preparation of the doctoral dissertation is carried out in close association with one or two staff members you have chosen as Thesis Supervisor(s). Soon after passing the General Exam, you must also select at least two additional staff members (including at least one staff member from each institution) to help guide your research and dissertation work. It is recommended, when appropriate, to have one additional member from outside the Joint Program. Your Thesis Committee must be approved by JCCO before the end of the calendar year in which you complete your general examination. The names of the members of your Thesis Committee should then be submitted to the WHOI Academic Programs Office and the MIT Joint Program Office.

Thesis Format

In general a thesis consists of four parts:

1. A historical review and setting of the problem;
2. Chapters developing the original contribution toward the solution of the problem;
3. A final summary of the work and its significance;
4. A bibliography.

You are encouraged to incorporate, as part of 2 above, published papers or manuscripts that have been prepared for publication, if they contain some part or all of your original contribution. If the published paper has been copyrighted, a variance of the copyright must be presented to MIT with the thesis.

In the use of multiple-authored sections, you must establish your own contribution by letter to the Joint Committee on Chemical Oceanography and the members of your Thesis Committee at least one month before submission of the thesis. This letter is to be accompanied by categorical statements from all the other authors detailing your contribution to the paper. No doctoral thesis that contains multiple-authored sections will be accepted for final approval without explicit written permission from JCCO.

MIT and WHOI have very specific requirements for preparation and submission of the thesis. These are detailed on the Web at:

<http://libraries.mit.edu/archives/thesis-specs/>.

Thesis submission deadline dates are given in the Joint Program Academic Calendar (included in your registration packets), and students are advised to keep these deadlines in mind. Missing a thesis submission deadline could mean that you would be obliged to register and pay tuition for the next term. Approximately 30 days after the deadline date, faculty committees meet at MIT to approve candidates for advanced degrees. At that time, if your corrected thesis is not at MIT you will not be recommended for a degree. If this happens you will have to be placed on the degree list for the following semester and will be charged minimum tuition for that semester.

4: Thesis Defense

It is critical that the WHOI Academic Programs Office and the MIT Joint Program Office know the time and place of the defense at least two weeks in advance of your thesis defense.

The thesis defense should be chaired by a member of the staff of MIT or WHOI who is not a member of the Thesis Committee. This person is chosen by the Chair of the JCCO in consultation with the student and the thesis supervisor(s).

The oral defense of the doctoral dissertation, which is scheduled by the student and the Chair of the defense, should be held at least three weeks after the submission of the completed thesis, in order to allow adequate time for staff members to review the thesis. A three-week period to review a doctoral dissertation is considered a minimum period. Unless major revisions are required, the thesis must be submitted to the MIT and WHOI Academic Programs Offices no

later than two (2) weeks after the defense. If major revisions are required, the student's Thesis Committee, through the Chair of the defense, will make a recommendation to the Disciplinary Joint Committee Chair for the deadline by which the final revised thesis must be submitted. The Chair of the Disciplinary Joint Committee has the responsibility to seek advice as rapidly as practicable from the Disciplinary Joint Committee and then set a deadline, communicate that deadline to the student, the thesis committee and the Joint Program Director at MIT and Dean at WHOI. Failure to meet the deadline can result in denial of further stipend and tuition support by either the Director of the Joint Program at MIT in consultation with the Department Head at MIT or by the Dean at WHOI in consultation with the Department Chair at WHOI. All other MIT policies and Joint Program policies with respect to continued registration also apply.

Each thesis defense will consist of three parts:

1. A public seminar (approximately 30 to 50 minutes) to present the principal findings of the thesis;
2. A brief (15-20 minutes at most) public question and answer period following the seminar, to be presided over by the Chair of the Thesis Defense;
3. A private defense of the thesis before all interested members of the faculty and staff plus invited guests, to be presided over by the Chair of the Thesis Defense.

It is intended that the public presentation offer students an occasion for displaying their accomplishments as represented by the dissertation, and that it will be well attended by Staff, other students, employees, and any guests the student wishes to invite.

Corrections or changes designated at your thesis defense must be made in the original and in all official copies submitted to the Academic Programs Office and your MIT department.

For specific information on details of thesis requirements, contact the WHOI Academic Programs Office or the MIT Joint Program Office. The WHOI Academic Programs Office has a pamphlet, "WHOI Specifications for Thesis Preparation", available in the Academic Programs Office. They have tried to incorporate MIT requirements in their document, but you should also check the MIT specifications at:

<http://libraries.mit.edu/archives/thesis-specs/>.

5: Who's Who

The Joint Program is the responsibility of two different institutions with different primary purposes, administrative structures and operating formats.

Massachusetts Institute of Technology is an independent, coeducation, privately endowed university, and it is recognized worldwide for contributions to education and research in engineering and the sciences, and at the intersection of science, technology, policy and management. MIT brings to the MIT/WHOI Joint Program partnership the full range of educational opportunities and resources of a preeminent research university. Many programs of study and research focus on environmental processes on local, regional and global scales. The environment is now a major MIT-wide priority, and extensive intellectual and financial resources are devoted to it. The world's oceans are a key element of our environment and an important

focus of research and teaching in several MIT departments. These studies encompass both the oceans and their interactions with other natural systems and with society.

Woods Hole Oceanographic Institution is a private, independent, not-for profit corporation dedicated to research and higher education at the frontiers of ocean science. WHOI brings to the MIT/WHOI Joint Program partnership a broad ranging group of scholars and technical staff, with strong interest and involvement in all major aspects of research and higher education focused on understanding the oceans, and the interactions of the oceans with the planetary habitat. In addition, WHOI scientists and engineers have pioneered unparalleled access to the sea through expertise in sea-going operations and the development and deployment of technologies for collecting and interpreting data for oceanic processes and interactions between the oceans, the land and the atmosphere.

The Joint Program brings these two organizations together in a common cause, to provide the education and research program in the ocean sciences of the highest quality. By necessity there are a number of people and groups with responsibility for the successful operation of the program and we have listed them below. You will notice that there is considerable overlap in personnel and responsibility between several of the groups mentioned. We hope that this provides the checks and balances necessary to produce a Joint Program that is reasonably consistent from year to year and from discipline to discipline.

Dean, WHOI - The Vice President for Academic Programs and Dean at WHOI, John Farrington, has responsibility for all educational programs offered by WHOI. He is a member of the Directorate, the policy making body of the Woods Hole Oceanographic Institution, and has full responsibility for the administration, financial welfare, and ultimate success of WHOI's role in the Joint Program.

Director of the Joint Program, MIT - Designated by the Provost and Chancellor at MIT, Paola Rizzoli is the Director of the Joint Program at MIT. She has overall administrative responsibility for the Program at MIT and serves as an advocate for the Program before the MIT administration. She is, in many ways, the counterpart of the Dean at WHOI.

Associate Dean, WHOI - Judy McDowell as Associate Dean is primarily responsible for Joint Program activities at WHOI.

WHOI Academic Programs Office - The Academic Programs Office (Clark 223) is the center for administrative support for education activities at WHOI. It serves as the office for admissions, student affairs, student accounts, registrar, and whatever else you may need. The people that will help you, in addition to the Deans mentioned above, are:

Marsha Gomes (x2225), Associate Registrar (with primary responsibilities for the Joint Program)

Christine Charette (x2848), Executive Assistant to the Dean (financial responsibilities for Joint Program students)

Julia Westwater (x3379), Registrar

Stacey Brudno Drange (x2389), WHOI Housing Coordinator

MIT Joint Program Office - The MIT Joint Program Office, under the direction of Ronni Schwartz (617-253-7544), provides program-wide administrative focus for the six MIT

departments involved in the Joint Program and coordinates with the WHOI Academic Programs Office. Ronni Schwartz is the Administrator of the Joint Program at MIT and is always available to students for consultation on problems or questions regarding the Joint Program. Other administrative support (e.g. graduate appointments, office assignments) is handled by the Department Administrators. (Vicki McKenna in EAPS; Cynthia Stewart in CEE).

Department Chairs/Heads, WHOI and MIT - Department Chairs/Heads have overall responsibility for the education activities of their departments. Their authority is vested in the individuals that they, in consultation with the Dean at WHOI and the Joint Program Director at MIT, appoint to the Joint Committee on Chemical Oceanography and as the WHOI Chemistry Education Coordinator. Ken Buesseler is Chair, Department of Marine Chemistry and Geochemistry, at WHOI; Maria Zuber is Head, Department of Earth, Atmospheric, and Planetary Sciences at MIT; and Patrick Jaillet is Head, Department of Civil and Environmental Engineering at MIT.

Joint Program Advisory Committee - This committee consists of the Department Chairs at WHOI and Department Heads of Joint Program active departments at MIT. The committee advises the Director of the Joint Program at MIT and the Vice President for Academic Programs/Dean at WHOI and provides overall advice for the Joint Program.

Joint Committee on Chemical Oceanography - JCCO oversees the Joint Program in Chemical Oceanography and is responsible for your progress from admission to signing off on your thesis. JCCO keeps an eye on exam procedures, admissions, course offerings and quality, and produces this handbook. Current members are Phil Gschwend (Chair), Meg Tivey, Ed Boyle, Scott Doney and Tim Eglinton, in addition to the WHOI Education Coordinator, currently Meg Tivey.

Joint Program Committee - The JPC is co-chaired by the WHOI Dean and the Joint Program Director at MIT and includes the Chairs of the Joint Committees in each discipline (JCCO, JCBO, JCPO, JCMG&G, JCAOSE) plus the Associate Dean (WHOI). They are responsible for education policy, admissions, and allocation of program resources across the Joint Program.

WHOI Educational Council - The Educational Council (about 15 people) meets regularly to advise the Dean at WHOI on educational policy. Members represent each department and the student body. The Council serves as the Executive Committee to the Educational Assembly.

WHOI Educational Assembly - The Assembly reports to the WHOI Director and Trustees and consists of the WHOI Scientific Staff, selected Technical Staff, and Student Representatives from each discipline. Serving as a faculty body, it meets several times a year to debate and recommend educational policy at WHOI. The Assembly is chaired by the WHOI Vice President for Academic Programs and Dean.

WHOI Marine Chemistry and Geochemistry Education Coordinator (J. Seward Johnson Chair)– Meg Tivey, the present Coordinator, represents the Department of Marine Chemistry & Geochemistry at WHOI Educational Council meetings and also assigns Academic Advisory Committees and Exam Committee members in consultation with the Chairman of JCCO. She will also set the general schedule of your exams and Thesis Defense in consultation with you and your Advisory or Thesis Committee. The Education Coordinator can also act as an intermediary/ombudsman for students if necessary.

Academic Advisory Committee - Each incoming class is assigned an academic advisory committee consisting of four people: two from the MC&G department at WHOI, one each from

the EAPS and CEE departments at MIT. During the two years leading up to your general exam, this committee will help you decide what courses to take and will try to guide your exploration of potential research topics. Your committee will also help you find advisors for lab projects during your first years in the Joint Program. You are encouraged to seek out your advisors and talk to them. Remember that you are free to talk to all of the staff about questions or problems you might have. If you feel it necessary to change the members of your advisory committee, it is possible to do so with the approval of the Education Coordinator and Chair of JCCO.

Exam Committees – The members of your Academic Advisory Committee are responsible for administering the Preliminary exam. The General Exam Committee is appointed by the WHOI Education Coordinator (see Section 1-2). You must identify a probable Thesis Supervisor before your General Exam. The Chair of your Exam Committee cannot be your probable Thesis Supervisor.

Thesis Committee - The Thesis Committee is selected by you and your Thesis Supervisor(s) immediately after your General Exam, and must be approved by JCCO. This committee is responsible for advising you on your thesis research and monitoring your thesis progress. You should meet with your Thesis Committee twice a year to keep them up to date on your progress.

Appendix I.

Graduate Student Research and Teaching Responsibilities

The goal of the Joint Program in Chemical Oceanography is to educate scientists; therefore research experience in laboratories is an integral part of the education of pre-generals students. Depending on the source of support for the student, this experience is attained slightly differently:

- (1) For students supported as Research Assistants: The principal duty of a Research Assistant is to contribute, under supervision, to a program of departmental or interdepartmental research. The appointment is made with the understanding that the required services will be such as to contribute to the professional training of the graduate student. Through project work, the assistant gains increased facility in organizing work, in applying new experimental techniques or analytical tools to real problems, in technical writing, and in oral presentation, which will be of inestimable value, even though a career in research may not be anticipated. Research Assistants are expected to devote at least 50 hours per week on average to academic activities (including the time devoted to classes and their research assistantships). This requirement is normally met by registering for approximately 36 units of regular subjects, which may include "Special Problems" research projects, and by devoting 20 hours to RA duties. The latter may include additional units of regular subjects. The appropriate subjects are determined by consultation between the student and the student's research and academic advisors, and must have their approval.
- (2) For students supported as Teaching Assistants: The principal duty of a Teaching Assistant is to contribute, under supervision, to a program of classroom education. The appointment is made with the understanding that the required services will be such as to contribute to the professional training of the graduate student. Interacting with students in the classroom, grading their problem sets and exams, and discussing subject matter during office hours, the assistant gains increased facility in organizing work, in oral presentation and communication, and motivational skills which will be of inestimable value, even though a career in teaching may not be anticipated. A Teaching Assistant is expected to devote at least 50 hours per week on average to academic activities (including time devoted to their classes and teaching assistantships). This time includes 20 hours per week of Teaching Assistant duties. Normally a TA should be registered for about 36 units of subjects, which may include "Special Problems" research projects.

For both RAs and TAs, the temporal distribution of work may be highly non-uniform; the requirement is that the appropriate average level of effort during the term be achieved. Also, both TAs and RAs are allowed normal MIT/WHOI holidays and can take a 2 week paid vacation at a time arranged with the approval of their research supervisor.

- (3) Fellowship and traineeship holders are similarly expected to devote at least 50 hours per week on average to academic obligations including a research project approved by their academic advisors. The subject unit requirements are the same as for those holding TAs or RAs.
- (4) If you accept a graduate assistantship (whether supported by research, teaching, or fellowship funds), you should understand that you are expected to exhibit a professional attitude toward your work, and to take seriously your responsibility for the conduct of the Program's research and/or teaching functions. Each semester your performance is

evaluated by the faculty. Poor performance may result in a warning or in termination of your assistantship. In addition to satisfactory performance of your assigned duties, your academic performance and progress are considered in the award/continuation of your graduate assistantship, traineeship or WHOI or MIT granted fellowship. National and international fellowships have their individual requirements for continuation.

Appendix II

General Exam Procedures

The WHOI Education Coordinator (in consultation with the JCCO Chair) will convene Written and Oral Exam Committees (with at least two members each from WHOI and MIT) by April 15. In the event of work at sea or other reasons why the coordinator cannot complete these matters by that date, the responsibility falls upon the JCCO Chair. The Education Coordinator is responsible for announcing the exam dates and for scheduling the rooms. The Written Committee Chair is responsible for gathering together questions from within and outside the Written Committee and for creating the final draft of the exam. The Oral Committee Chair is responsible for moderating the oral exam and communicating the results to the student.

Timing and announcement of written exam: The (~4 hours) closed book written general examination is usually taken on the second Tuesday after MIT commencement. If special circumstances warrant it, the Education Coordinator may, in consultation with the Written Exam Committee and the students taking the exam, schedule the exam for a different date.

Timing and announcement of the oral exam: The (~1 hour) oral exam will normally be taken on the Thursday or Friday that is 2 weeks after completion of the written exam. Students should not make travel plans that interfere with their availability on either of these days, because the exams will be conducted on only one or both days depending on how many students are to take them (which will not be known until the written exams are evaluated). Students are free to depart once their oral has been held and they have been informed of its outcome. Deviation from these dates will normally not occur; unavoidable changes will be announced by May 1 if they are to occur. Student requests to deviate from these procedures will be granted only upon written permission from JCCO.

Evaluation of written exam and communication with students on their performance: The Written Exam Chair is responsible for distributing copies of the exam answer to (1) the respective students (for their preparation for the orals) and (2) the Written Exam Committee and other involved individuals. The Written Exam Chair is also responsible for ensuring that the individual written exams are evaluated within 2 weeks of completion of the written exam, and that the results of these evaluations are available to the exam committee. Prior to that point, students should not inquire as to their performance on the written exam. Upon consultation with the Written Exam Committee, and no less than 5 days before the oral exam, the Written Exam Chair should prepare a brief summary, which can be passed to each student, concerning his or her performance on the written portion. This summary goes to the students and to their pre-thesis advisors. Because the oral exam is to some extent a continuation of the written exam process, in which students have the opportunity to recover from blunders which they have recognized themselves or to show that they knew more than their answer indicated, the information given to the students at this point should be of a general nature only, and not so specific as to give away the expected answers. It is important that the Exam Committee ensures that the information provided to the students is consistent and uniform. No other discussion of the student's performance on the exam is allowed.

For example, students should be told when they have made a major error on a particular question, but should not be told what the error is beyond a one-phrase or one-sentence statement (e.g., "you made a mistake in your derivation of the advection-diffusion equation"). If a question

was answered without error but was incomplete or otherwise weak, the student should be advised to study the subject and be prepared for detailed questioning on the oral (e.g. "your answer to the dissolved organic carbon question was OK as far as it went but left out an important recent result"), but should not be told the specifics to be covered. If there is a range of opinion on how well the students have done on a particular question, they should be told of that difference of opinion and should be given a general sense of where the difference of opinion occurred (e.g., "some people liked your answer to the carbonate chemistry question, but one of the evaluators felt that you had not explained the significance to the fossil fuel problem"). Evaluators should not forget that words of praise are allowed as long as it is clear whether they reflect their own opinion (e.g., "I thought that your answer to the gas exchange question was excellent") or are representative of all of the evaluators (e.g., "everybody thought that you had the best answer to the AOU/new production question").

Evaluation of oral exam and communication with students on their performance: Students will be informed orally that they have passed or failed the combined written and oral exams on the same day that the oral is held. A written follow-up will provide more explicit information on conditions and recommendations that may be attached.

Appendix III

Master of Science Degree

Although there is no formal program resulting in an M.S. Degree in Chemical Oceanography, the decision that a student should terminate his/her studies in the Joint Program with an M.S. degree can be made for a variety of reasons (e.g. a student's personal reasons for not proceeding to a Ph.D.; unsatisfactory performance in formal classes, or in the General Examination, etc.). The point at which this decision is made will depend on each specific case; however, students should typically plan to complete the requirements for a Master's degree within a year of the decision.

The requirements for a Master's Degree are as follows:

- 1) Completion of at least 66 units worth of formal subjects (exclusive of thesis units; 44 units at a graduate level, and 34 units in a given field). It is expected that, in most cases, much of this course work will have been completed prior to the decision that a student will terminate with a Master's Degree.
- 2) Completion, and oral presentation of, an acceptable Master's thesis, based on original research by the student. The Master's thesis must make an original contribution to a particular field of study.

Conduct of Master's Degree Research

As soon as the student has determined a research topic through discussion with his/her Academic Advisor(s), a Thesis Committee consisting of at least 1 member from each of the partner institutions will be formed (exceptions must be approved by JCCO). The student will take responsibility for keeping all members apprised of his/her progress. At the beginning of her/his research, the student will also submit a short abstract of the proposed thesis and the members of the Thesis Committee to JCCO for approval.

The M.S. thesis will consist of:

1. Abstract
2. Historical review and background of the problem
3. Presentation of the original research and its contribution toward solution of the problem
4. Summary
5. Bibliography

Conduct of the M.S. Thesis Presentation

A public presentation of the research represents an opportunity for the student to communicate the result of his/her research, and brings closure to the scientific process. The thesis must be submitted to the Thesis Committee at least two weeks prior to the public presentation. In consultation with the student, the Thesis Advisor will schedule the presentation,

and inform the Academic Program Office at WHOI and Joint Program Office at MIT of the date, time and location. Those offices will then advertise the presentation.

The presentation will be Chaired by the Thesis Advisor and will consist of two parts: (1) a public presentation (typically about 45 minutes long) of the results of the research, followed by a brief public question and answer period; and (2) an informal, private discussion of the research results between the student and the Thesis Committee. Other MIT faculty and WHOI Education Assembly members who have read the thesis may also participate in the private discussion, but do not participate in the Thesis Committee's deliberations on the acceptability of the thesis.

Following the private discussion, the student will retire from the room and the Thesis Committee will determine the acceptability of the thesis and recommend any changes. Once any recommended changes/ revisions have been completed, the student's Thesis Advisor will sign the thesis signifying its acceptance.

Appendix IV

Responsibilities of Chairs of Thesis Proposal Defense and Thesis Defense

The Chair of the Thesis Proposal Defense presides over the question and answer period following the thesis proposal defense seminar. Following the defense of the thesis proposal, the Chair of the defense should send a memo to the Chair of JCCO reviewing what happened at the thesis proposal defense, including who was present, any concerns raised, and a summary of comments made and suggestions that were given.

The Chair of the Thesis Defense presides over the brief public question and answer period following the thesis defense seminar, and then presides over the private defense of the thesis before all interested members of the faculty and staff plus invited guests. Following the thesis defense, the Chair of the defense should send a memo to the Chair of JCCO (with a copy sent to each member of the thesis committee and to the student) with the following information:

- The date and time of defense and whether the Ph.D. was successfully defended.
- Who was present (committee members and others who stayed for questioning)
- An explanation if any committee members were NOT present (and if so, how did/will that committee member provide input).
- Any comments made about the thesis and defense presentation (e.g., glowing remarks, concerns, etc.).
- The anticipated time that it should take the student to complete revisions. If no time is stated, it will be assumed that the revisions will be made 2 weeks after the defense date. If more time is needed, the committee needs to decide on a time limit (e.g., 4 weeks from date of defense) and provide a brief justification of why more than 2 weeks is needed.
- Finally, either as a postscript to the memo or within memo, general recommendations or specific comments that the student needs to consider in revising the thesis should be listed (usually done by chapter).