

MIT-WHOI Joint Program
In
Physical Oceanography

The Guide To Procedures

Prepared by
The Joint Committee For Physical Oceanography
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1. About This Guide

The goal of the MIT—WHOI Joint Program in Physical Oceanography is to prepare students to carry out independent and creative research in Physical Oceanography and to demonstrate this ability by writing and defending a PhD dissertation. This Guide describes some of the roles and responsibilities of the students and the staff who make up the Program. It also discusses the procedures that are used to monitor the academic progress of students through the Program. This Guide was prepared by the Joint Committee for Physical Oceanography (JCPO), which has the responsibility to oversee and administer all academic aspects of the Program.

Students enter this Program from diverse academic and social backgrounds. Moreover, scientific research is a highly individualistic endeavor whose progress cannot be preordained or tightly scheduled. Consequently, the procedures and schedules described in this Guide can be altered on a case-by-case basis by making a written petition to JCPO.

For a much wider description of professional and academic policy, students and staff are referred to the MIT Graduate Policies and Procedures (<http://web.mit.edu/gso/gpp/index.html>), which applies in full to this Program. Staff members also have obligations described in the MIT Rules and Regulations for Faculty (<http://web.mit.edu/faculty/rules/index.html>). Students should consult the Joint Program Handbook (http://web.mit.edu/mit-who/ww/academics/current/pdf/jp_current_studhandbook.pdf), which describes the administrative structure of the Program and many of the services available to students.

2. Roles and Responsibilities

2.1 Students

From the outset we want to emphasize that the primary responsibility for progress through this Program resides with the student. Consequently students need to be fully aware of the nominal progression through the Program, described in Section 3 of this Guide. Students should also be aware of the resources available to help them, described in the remainder of this section.

Advice and suggestions from the student's advisor and thesis committee are almost always required at certain key stages, e.g., selecting courses and developing a viable thesis problem. The latter, especially, requires judgment about the status of a research area and the availability of resources. If at any time a student feels that he or she is not being given appropriate

guidance or support, then he/she is urged to take corrective steps. The first step is to consult with the principal advisor. However, the student may prefer to discuss the situation with the thesis committee, JCPO, the Education Coordinator, the Physical Oceanography Department Chair at WHOI, the Department Head of Earth, Atmospheric and Planetary Sciences at MIT, the Joint Program Director at MIT, or the Deans, all of whom have a professional commitment to insure that the Program functions in a fair and efficient way.

These advisory and supervisory committees can function well only when they are kept fully informed of a student's status. There are formal mechanisms for such reporting described below. However, these may not be appropriate or sufficiently timely for every circumstance. It is therefore the students' responsibility to keep their advisor and JCPO informed of significant events or circumstances that may affect their academic progress. Written notification is preferred.

2.2 Advisors

Each entering student is assigned two advisors, one from MIT and one from WHOI. One of these is the "principal advisor," with whom the student will begin his/her research work. The importance of a strong working relationship between the student and the principal advisor cannot be overemphasized. The principal advisor will be the student's closest scientific contact and must have an active interest in helping and advising. The advisor's advocacy at the time of the general exam can be very important.

The initial assignment of advisors is made by JCPO before students arrive for their first term. Assignment is based upon indications of scientific interests in the admissions application and, to some degree, upon availability of financial support.

It is natural that students' scientific interests will change as they learn more about the field of Physical Oceanography. The initial principal advisor may then not be the most suitable and each student should seek out the best advisor for his/her thesis research, subject to personnel and financial considerations. A change of principal advisor for this reason is common. Students can best choose a new advisor when they have made an effort to discover what research opportunities are available within the Program. The student must notify JCPO in writing of the proposed change of principal advisor and receive JCPO's approval.

2.3 Advisory Committee (Thesis Committee)

The Advisory Committee is intended to serve as a resource for the student in planning courses and research. Prior to submission of a student's thesis proposal, in consultation with the advisor(s), he/she needs to form a five or more person Advisory Committee at least two months prior to the thesis proposal defense. The principal advisor serves as chair of this committee, which must have MIT and WHOI representation (two from each institution are strongly encouraged) and include at least one current member of JCPO. JCPO must be notified, in writing, of the composition of the proposed Advisory Committee; JCPO may recommend changes and must approve the final composition. It may be appropriate and indeed desirable to change the membership of this committee as the research develops; approval of the advisor and JCPO is also required for such changes. The Committee, together with the principal advisor, should be the student's primary resource for information and advice; close contact with the members of the Committee is important and two formal meetings per year with the Committee are required.

2.4 Joint Committee for Physical Oceanography

The Joint Committee for Physical Oceanography (JCPO), composed of members of the faculty at MIT and the staff at WHOI, oversees the graduate educational program in Physical Oceanography. It is responsible for development of the curriculum and course scheduling, overseeing student admissions and the initial assignment of advisors, setting examination policy, reviewing student progress, and maintaining acceptable academic standards for doctoral theses. Upon recommendation of the advisor and the student's Advisory Committee, JCPO approves continued registration in the program and accepts the final Ph.D. Thesis. In addition, it serves as the first level grievance board for student concerns.

The Education Coordinator of the Physical Oceanography Department at WHOI is a member of JCPO. His/her responsibilities include liaison with the Academic Programs Office for allocation of financial support to students and other educational activities at WHOI. Advisor(s) and students should feel free to discuss problems with the Education Coordinator or any other member of JCPO. At MIT, the Department of Earth, Atmospheric and Planetary Sciences and the Institute as a whole have Committees on Graduate Students who can respond to concerns.

JCPO can best serve the educational needs of the students if fully informed of their status. Thus it requests notification of changes that may effect a student's academic status and has the final authority for approving them. A written note to JCPO will best assure careful consideration and a clear response to students' concerns.

2.5 The WHOI Dean of Graduate Studies and the MIT Dean for Graduate Education

The Deans set the overall policy of the Graduate Program. They generally do not have a direct role in the day-to-day academic operation of the Joint Program. They are, however, very experienced educators and administrators who have a keen interest in the welfare of the students and of the Program overall. They are available to students and staff for personal consultation, and are essentially the last stop in the chain of academic governance at both Institutions. The rare problem, which cannot be resolved by JCPO, will be referred to the Deans.

The WHOI Academic Programs Office, which is run by the WHOI Dean of Graduate Studies, and the Joint Program Administrator's Office at MIT administer services to Joint Program students (registration, admissions, housing, payroll, etc.; see the Information to Incoming Students). They also maintain official records. The Earth, Atmospheric, and Planetary Sciences Department Office can also provide help with student services.

3. The Academic Program

The completion of a PhD requires four to five years of sustained effort (Appendix A). For most students the first two years are devoted mainly to course work, though with some important opportunity for research. The remaining years in the program are devoted mainly to dissertation research and writing.

Extension beyond the fifth year requires a petition by the student and principal advisor to JCPO. To be approved, this petition must provide supporting evidence that good progress is being made toward the completion of the thesis.

3.1 Financial Support

Students are eligible for fellowships, scholarships and research assistantships for the first five years. Extension of aid into the sixth year requires a petition as described above. Registration may be permitted beyond the sixth full year, but the student should not expect financial support. Guidelines for the obligations and benefits for students supported by Research and Teaching Assistantships (e.g., vacation policy,...) can be found in the MIT Graduate Education Manual.

3.2 Curriculum in Physical Oceanography

Students are expected to take about 16 courses during their first two years in the Joint Program. This number is a recommendation and not a requirement – there are no formal physical oceanography course requirements in the Joint Program. Courses should be selected in a way that is consistent with a student's preparation, and with their research interests. Each student's general exam (see Section 3.4 below) will be tailored to reflect their individual course of study.

1. A Core Curriculum for Physical Oceanography. Four courses have been designed to be a core curriculum for Physical Oceanography and are highly recommended for all Physical Oceanography students, with the possible exception for students who have already completed similar courses. Students with interdisciplinary interests may design (in consultation with their advisor) an alternative core sequence to meet their needs. These four core courses are intended to provide the minimum, essential foundation in dynamics needed by all students pursuing research in physical oceanography. They can be completed within the first year:

In the first (Fall) semester;

12.800, Fluid Dynamics of the Atmosphere and Ocean

12.808, Introduction to Observational Physical Oceanography

In the second (Spring) semester;

12.801, Steady Circulation of the Ocean and Atmosphere

12.802, Wave Motions in the Ocean and Atmosphere

2. Applied Mathematics. An understanding of the methods of applied mathematics is essential for nearly all research topics. The choice of applied mathematics course is dictated by the student's preparation and interests and made in consultation with the advisor. Suitable graduate level applied mathematics courses for the first semester include 18.305, Advanced Analytical Methods in Science and Engineering, 18.085, Mathematical Methods for Engineers I, and 18.075, Advanced Calculus for Engineers. An additional graduate level applied mathematics course is recommended also during the second semester (e.g., 18.306 or 18.086).
3. Electives Courses. The core curriculum in Physical Oceanography has been kept to a minimum in order to allow each student the time to define a program of elective courses that are tailored to their research interest. To help prepare for research on these diverse topics, Joint Program students may choose elective courses from the offerings of any MIT or WHOI department and cross-registration is available with Harvard and Boston University. The list of possible elective is thus very extensive and the following is no more than a sample menu. As an example, a student pursuing thesis research on a

problem in Paleoceanography would find a number of relevant course offerings listed below under the focus of “Oceans and Climate”. If an important aspect of their research was numerical ocean circulation modeling, then some courses listed under the focus “Dynamical Oceanography” would also be highly relevant. Students are expected to define their own, personal paths through an elective course program, with advice from their major advisor and other academic staff members.

Focus: Dynamical oceanography

- 12.755 Hydraulic Phenomena in Geophysical Fluid Flows
- 12.803 Quasi-Balanced Circulations of the Oceans and Atmospheres
- 12.804 Large Scale Flow Dynamics Laboratory
- 12.812 General Circulation of the Earth's Atmosphere
- 12.820 Turbulence in Geophysical Systems
- 12.822 Nonlinear Waves and Vortices
- 12.866 Theory of the General Circulation of the Ocean
- 12.970 Stability Theory for Oceanic and Atmospheric Flows
- 18.306 Advanced Partial Differential Equations with Applications

Focus: Oceans and climate; paleoclimate

- 12.707 Pre-Pleistocene Paleoceanography and Paleoclimatology
- 12.708 Special Topics in Paleoclimatology
- 12.812 General Circulation of the Earth's Atmosphere
- 12.840 Past and Present Climate
- 12.841 Climate Dynamics
- 12.842 Climate Physics and Chemistry
- 12.864 Inference from Data and Models

Focus: Air-sea interaction

- 12.806 Atmospheric Physics
- 12.810 Dynamics of the Atmosphere
- 12.811 Tropical Meteorology
- 12.812 General Circulation of the Earth's Atmosphere
- 12.818 Introduction to Atmospheric Data and Synoptic Meteorology
- 12.820 Turbulence in Geophysical Systems
- 12.870 Air-Sea Interaction Boundary Layers

Focus: Observational oceanography and data interpretation

- 12.865 Ocean Data and Ocean Models
- 12.803 Quasi-Balanced Circulations of the Oceans and Atmospheres
- 12.804 Large Scale Flow Dynamics Laboratory
- 12.805 Laboratory in Physical Oceanography
- 12.818 Introduction to Atmospheric Data and Synoptic Meteorology
- 12.864 Inference from Data and Models

Focus: Coastal oceanography and near-shore processes

- 1.61 Fluid Transport Processes
- 1.63 Fluid Dynamics of the Environment
- 1.67 Sediment Transport and Coastal Processes
- 1.691 Surface Wave Dynamics
- 12.755 Hydraulic Phenomenon in Geophysical Fluid Flows

12.820 Turbulence in Geophysical Systems
12.862 Coastal Physical Oceanography

Focus: Physical-biological and physical-biogeochemical interactions

7.47 Biological Oceanography
12.742 Marine Chemistry
7.440 Introduction to Mathematical Ecology
7.430 Topics in Quantitative Marine Science: Ocean Biological/Physical Interaction
12.xxx Modeling the Biology and Physics of the Ocean
12.803 Quasi-balanced Circulations in Atmospheres and Oceans
12.804 Large-scale Flow Dynamics Laboratory
12.747 Modeling, Data Analysis, and Numerical Techniques for Geochemistry
12.864 Inference from Data and Models
7.431 Topics in Marine Ecology
7.436 Topics in Phytoplankton Biology
7.434 Topics in Zooplankton Biology
7.435 Topics in Benthic Biology
12.746 Marine Organic Geochemistry
12.862 Coastal Physical Oceanography
12.870 Air-Sea Interaction: Boundary Layers

3.3 Pre-generals Research Project

Students are strongly encouraged to start research as soon as possible to build expertise in identifying a field of interest, developing a firm understanding of the state of knowledge within the field, and singling out possible research/thesis topics. In the semester before the general exam, normally the spring semester of the second year, students are strongly encouraged to take a reading course with their principal advisor. This course should help prepare the students for the brief research presentation required as part of the oral portion of the general exam (see below) and for later development of a formal thesis proposal.

3.4 General Exam in Physical Oceanography

The general exam qualifies the student for Ph.D. research in the Joint Program. The first portion consists of written and oral examinations, usually taken after two years in the program. If these are satisfactory, the student must then prepare and defend a thesis proposal within four months. The purpose of the exam is to test:

- 1. the student's grasp of material covered in the core curriculum and other courses. The exam emphasizes not only understanding of the basic ideas and concepts presented in the courses but also the ability to draw together and synthesize material from different courses, readings, seminars, etc. For all students the general exam will recognize the individualized aspects of their course of study.
- 2. the student's ability to approach a new problem in ways appropriate for an independent scientist. This ability is certainly difficult to test but is central to the notion that passing the general exams qualifies one to prepare the Ph.D. dissertation.

The written and oral exams will usually be given in early June each year. They are administered by a General Exam Committee (GEC), comprised of the principal advisors of the students taking the exam that year plus possible additional members appointed by JCPO. Two JCPO members, one from MIT and one from WHOI, will chair the GEC and be responsible for the logistics.

Application to take the General Exam should be made to the EAPS Department Office at MIT or the WHOI Academic Programs Office one month prior to the exam. (*see Appendix B for Application Form*)

3.4.1 Written Exam

The written exam consists of two four-hour examinations administered on successive days; one open and one closed book. The questions are solicited from the entire faculty. The GEC will gather and select the questions to be included and will ensure that individualized courses of study are respected and that grading standards are maintained. Graded answers will be returned and students are encouraged to discuss them with their advisors and Advisory Committee or other members of the GEC prior to the oral. Before the orals, the GEC will meet to assess the written exams.

3.4.2 Oral Exam

The oral exam is administered between five and ten days after the written examinations, to allow the Committee and the student to review the performance on the written part. The oral exam gives the students an opportunity to describe their research, to clarify questions raised by the written exam, and to further demonstrate their ability to organize and utilize scientific concepts and information. At the beginning of the oral exam, students will make a short presentation, lasting approximately 20 minutes, describing research which they have carried out. This portion of the exam is an opportunity to demonstrate the ability to master an area of interest, to show progress on a reasonable research problem, and to argue for its relevance and tractability. (If the student has encountered difficulties such as intractability or negative results, it should still be possible to tell an interesting story.) If in doubt about the content of the presentation, the student should consult with the advisor(s). After the presentation, the examining committee will ask questions pertinent to the research and may also ask questions concerning the written exam, the course work, and other areas.

The GEC will be in charge of the oral exams, but may delegate responsibility to a smaller group or choose to invite participation from other faculty members who may share a special scientific interest with the student and who can aid in formulating an appropriate oral exam. Students will be informed of the membership of the GEC. (Other faculty members may attend the orals, subject to the approval of the GEC chairpersons, but they are expected to inform the student of their interest in attending.)

The GEC will recommend to JCPO whether or not this portion of the general exam has been passed. If the student has passed, he/she then proceeds to the final part of the exam, which involves preparing a thesis proposal. In some instances, however, the GEC may recommend that the student prepare a Master's thesis before continuing to the thesis proposal stage. If the decision is that the student has not passed the oral or written exam, the GEC normally recommends that the student (1) immediately withdraw, (2) prepare a Master's thesis and then withdraw, or (3) prepare a M.S. and retake all or part of the general exam. Although it is possible to take the exam a second time, the student must withdraw if the exam is failed again.

3.4.3 Thesis Proposal

The purpose of the thesis proposal is to demonstrate the ability to formulate a tractable, interesting research problem. The proposal is a written document (typically 10-15 pages) which should outline

1. the scope of the problem
2. its significance
3. previous work done by others
4. the methods of research to be used

Preliminary results can be presented mainly to indicate the direction the work will take, but are not a necessary component of a successful proposal. The proposal is not in itself expected to be a completed piece of research. Given the nature of research, thesis work may evolve away from the path originally outlined in the thesis proposal; guidance in this evolving process is one of the roles of the advisor and the Advisory Committee. It may occur that after acceptance of the proposal, the student wishes to change thesis problems (and perhaps advisor) completely. This can be done with approval of the Advisory Committee and JCPO; it will generally involve defending a new thesis proposal.

The thesis proposal document is normally to be submitted to the Advisory Committee within about four months after the successful completion of the written and oral exams, or in the cases described below, within about four months after the acceptance of a required Master's thesis. A modest extension of the preparation period may be approved by JCPO in cases when the proposal topic is sufficiently different than the pre-generals research. Two weeks after submission, the thesis proposal is to be defended before the Advisory Committee, supplemented as necessary to have representation from the General Exam Committee. An essential first step is for the student to review the proposal with his or her advisor before submission. Students are also urged to solicit the response of individual committee members to the proposal before the thesis proposal oral presentation.

Upon acceptance of the thesis proposal by the Advisory Committee, a student has completed the general exam and can continue on to prepare a Ph.D. thesis. The chairman of the Advisory Committee will advise JCPO in writing. A copy of the accepted thesis proposal should be submitted to the WHOI Academic Programs Office for the student's file.

3.5 Ph.D. Progress

Progress towards a PhD may suffer short interruptions and periods of slow progress. However, prolonged delays (a month) are a cause for concern. The timely recognition of a research dead end, and the selection of a new research direction are best done in consultation between the student, the principal advisor and the Advisory Committee. It is important that students maintain close, informal contact with their Advisory Committee and, of course, with their principal advisor to avoid excessive delays.

Students are expected to arrange meetings with their Advisory Committee at least twice a year in order to review progress and discuss plans. JCPO will request written progress reports from each student and his/her advisor annually. It is the principal advisor's responsibility to give an objective and candid assessment of the student's performance at fairly frequent intervals. The

student and advisor should discuss the annual progress report in detail, especially when problems are identified. It is the principal advisor's responsibility to insure that these written evaluations are transmitted to JCPO, which will use them to evaluate the student's progress toward a degree. These reports will be filed with the MIT Joint Program Office and WHOI Academic Programs Office.

3.6 Ph.D. Thesis

In general, a thesis consists of four parts:

- 1. an introductory chapter with a historical review and setting of the problem,
- 2. chapters developing the original contribution toward the solution of the problem,
- 3. a final section summarizing the work and its significance,
- 4. a bibliography.

A student may incorporate as part of (2) manuscripts that have been prepared for publication, submitted for publication, or already published, if most of the work is his/her own original contribution. Inclusion in a thesis of multiple-authored sections places a burden on the student to establish his/her own contribution; the student should notify the Thesis Committee and the Chairman of the Thesis Defense in writing of his/her intent to incorporate such material at least one month before submission of a thesis. This letter is to be accompanied by categorical statements from all the other authors detailing the student's contribution to the paper.

3.7 Thesis Defense

The thesis defense provides an open forum for presentation of the results of the research and final decision on the acceptability of the work. It is essential that an adequate period of time be available for review of the thesis between the time the dissertation is submitted to the thesis committee and the date of the defense. Therefore, the oral defense of the doctoral dissertation can be held not sooner than three weeks after the submission of the defendable thesis draft. Every effort should be made to submit the thesis at least one week prior to the defendable draft submission deadline. Submission entails giving copies to the Committee members and the Department Office at MIT and the Academic Programs Office at WHOI and arranging for announcements of the thesis defense to be posted at both institutions. In order to be on a particular semester's degree list, the student must also meet the thesis submission deadline dates given in the Joint Program Academic Calendar; keep these deadlines in mind.

Each Thesis Defense consists of two parts:

- 1. A public seminar in which either the whole thesis or some significant and coherent subsection is presented. A seminar of normal length (i.e., 50 minutes) is expected. The seminar should precede the defense by at least two months. It should be given at the institution at which the student is not resident. Arrangements may be made to broadcast the talk to the institution of residency. Students are encouraged to make this early in the process since comments from people attending the seminar can be helpful in the final drafting of the dissertation.
- 2. A formal defense, chaired by someone not a member of the Advisory Committee; this person is selected by the student in consultation with the advisor and committee, subject to JCPO approval. The defense is a public presentation of the thesis, including a period

for detailed questions. At this time, the student is presenting the work to the scientific public and must be ready to explain and defend it. Private discussions with the Advisory Committee and other faculty focused on the written document may follow.

The responsibility to accept the thesis rests with the Advisory Committee. They may recommend that the thesis be accepted as it is or they may accept it subject to minor revisions that the Thesis Defense Chairman must relay in writing to the student. In exceptional circumstances, the Committee may request further work before the thesis can be accepted. In such cases, another defense may be required. The Thesis Defense Chairman will notify JCPO and the student in writing of the decision of the Advisory Committee.

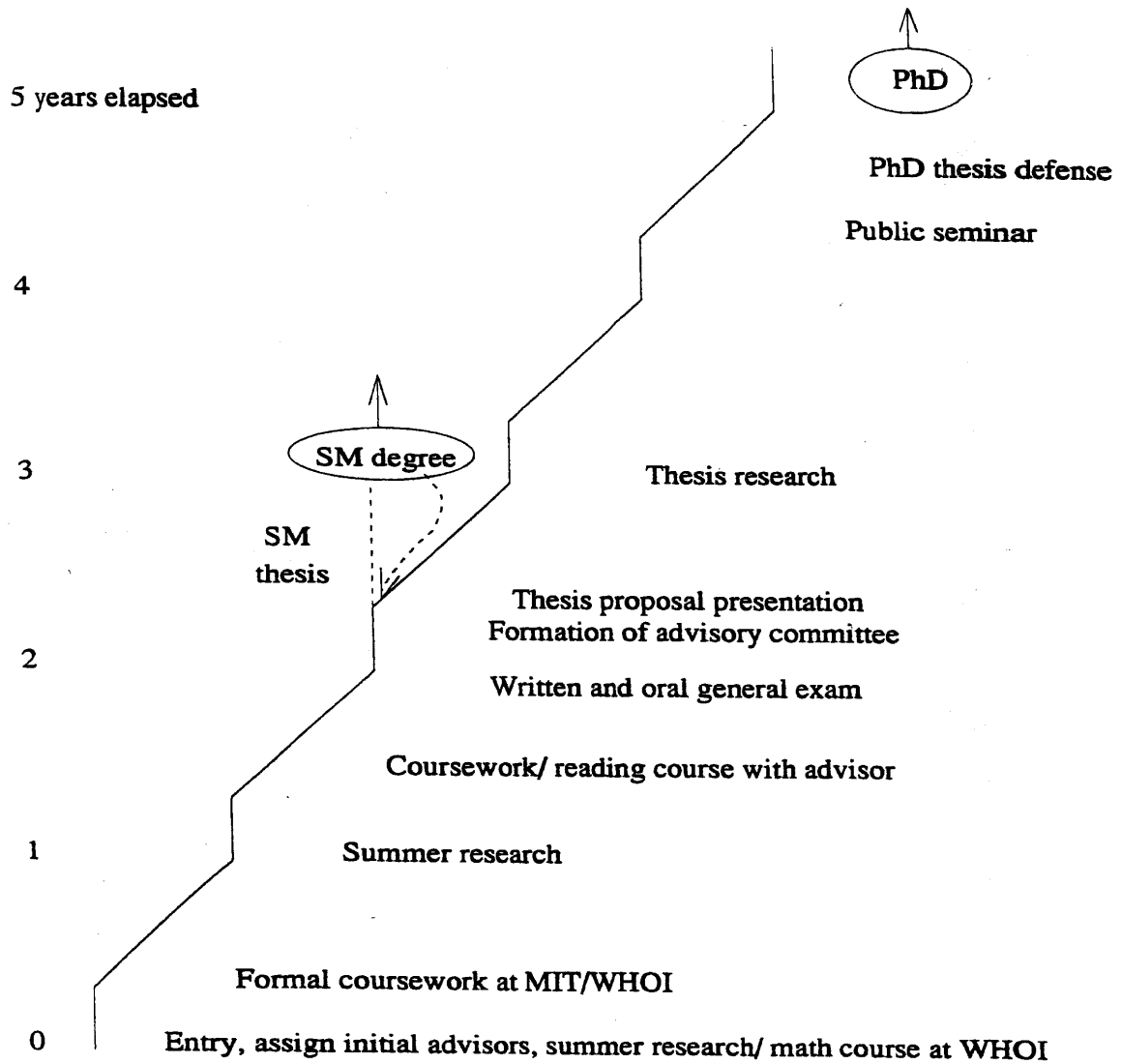
3.8 Master's Thesis in Physical Oceanography

The Master's thesis is an opportunity for a student to demonstrate the capacity to master a particular subject area in Physical Oceanography and to make a useful contribution to the field. Generally speaking, the degree of independence and originality is not as demanding for the S.M. as for the Ph.D. and there is no requirement that the research problem reach the same stage of resolution as in the Ph.D. It is expected that the student will complete the S.M. within a year from beginning the research.

There are a number of reasons why writing a Master's thesis may be chosen or required. A student may find the S.M. thesis an advisable intermediate step along the way to a Ph.D.: it gives an opportunity to develop and demonstrate research skills more fully. The GEC may recommend that a student who has failed the general exam complete a Master's Thesis and not continue to the Ph.D. For some students, even though they have passed the written and oral exam, the GEC may decide that further experience in research is needed and recommend that the student write a Master's thesis before preparing a thesis proposal. The Master's thesis would then normally be completed by the end of the third year in the program.

Acceptance of the S.M. thesis for the Master's degree requires the principal advisor's signature. If the S.M. thesis was required as part of the general exam or before submitting a thesis proposal, it must be defended successfully in an oral presentation to a committee composed of the then standing GEC plus the principal advisor and possibly one or more members of the faculty. This committee will then recommend whether or not the student continue to the thesis proposal stage.

Timeline to Degree



MIT/WHOI Joint Program in Oceanography
Application Form for General Examination in Physical Oceanography

Name: _____ Today's Date: _____

When did you enter the Joint Program? _____ (month/year)

Have you taken any part of the General Examination before? _____

Please provide the following information:

Undergraduate major: _____ Degree: _____ Date: _____

Institution: _____

Graduate major: _____ Degree: _____ Date: _____

Institution: _____

Is there some general subfield of physical oceanography in which you have special expertise?

What have been your primary sources of financial support while enrolled in the Joint Program?

General Exam Application Form – page 2

List all the graduate courses you have taken, giving dates, names of institutions, instructors, and grades achieved. Use reverse side if necessary.

Subject Title	Subject #	Institution	Instructor	Date	Grade

Signature of Applicant: _____ **Date:** _____

I recommend that the applicant be placed on the list of candidates for the General Examination to be held in the Fall Term _____, Spring Term _____, 20__.

Who is your principal advisor? _____

Signature of Academic Advisor at MIT: _____

Signature of Academic Advisor at WHOI: _____

If you are unable to obtain your advisor's signature, please explain why.