

Guidelines for Graduate Students in the AOS Program

The Graduate Work Committee

This is an *informal* guide and manual for graduate students in the AOS Program at Princeton University. It is meant to help the student navigate through the Program from start to finish by providing advice and guidance on practical matters, and an interpretation of some of the rules. This guide should *absolutely not* be regarded as providing an authoritative source on rules and regulations. The Graduate School is the ultimate authority on all rules and procedures, and you should consult the Graduate School website (<http://gradschool.princeton.edu/>) for that, or speak to one of the AOS staff.

1 The Director of Graduate Studies, the Graduate Work Committee, and the Advisor

While the administrative responsibility for the AOS program as a whole (including postdoctoral fellows and research staff) rests with the Director of the AOS program, the oversight of the graduate program and the welfare of the graduate students is the responsibility of the *Director of Graduate Studies* (DGS). He or she is your point of contact for all academic matters in the program. From the point of view of students the DGS is also the primary faculty contact and guide should problems arise between students and advisors. The DGS also sits on the Faculty Committee on the Graduate School, which makes graduate policy for the university as a whole. Examples of issues that have come before the committee include admissions criteria, who may supervise dissertations, new graduate courses in different departments, and maternal leave policies. The DGS signs off on the readmission of each student each year and approves the final degree list.

The DGS chairs the *Graduate Work Committee* (GWC) consisting of two or three additional members of the AOS faculty; the GWC provides oversight for the program. Three important components of this are: (i) Recruitment — the GWC reads all the applications each year to help select students and help to coordinate student visits; (ii) Assessment — the DGS and GWC run the general exam each spring and in general monitor the progress of students; (iii) Development — the GWC works with students to help develop programs that meet the needs of the student body. An important principle that guides the GWC is fairness and uniformity, helping to assure that students are treated fairly and that the expectations of students and advisors are clear and reasonable.

The *advisor* is the main academic guide that you will have over the course of your research, and it is essential that you have good relations him or her. We talk more about the role of the advisor in the sections below.

2 Pre-Generals

The progress through the Ph.D. can be divided into two parts: the pre-general period and the post-general period. The 'Generals' are a set of examinations, both written and oral and taken toward the end of your second year, and determine whether you can continue to a Ph.D. Before your generals, you are doing both course work and research; after your generals, you are primarily doing research.

2.1 Committee and Advisor

The incoming student is normally initially assigned a principal advisor by the Graduate Work Committee (GWC), in consultation with the faculty, on the basis of the research interests of the student expressed in their admissions application, or in other communication with the faculty. However, this initial appointment is not intended to be permanent and may change as the student's scientific interests evolve, particularly as the student becomes more familiar with the atmospheric and oceanic sciences. The initial principal advisor may then not be the most suitable, and each student should seek out the best advisor for his/her proposed research, subject to scientific and financial considerations. A change of advisor for this reason is not uncommon. If a student wishes to change advisor they must notify the DGS in writing or by email of the proposed change of advisor. The student should have settled on a pre-generals advisor by the end of the second semester of their first year.

A strong working relationship between the student and the advisor is very important to a successful Ph.D. The advisor will be the student's closest scientific contact, and must have an active interest in helping and advising. Both student and advisor should make an effort in ensuring regular communication between them. The student should consult the advisor regarding courses the student plans to take, and explore topics for pre-generals research with the advisor.

When the student has decided on an advisor, the advisor and student should agree upon and organize a pre-generals Advisory Committee, normally consisting of the advisor plus at least two other scientists. These are normally AOS or Geosciences faculty, but in some circumstances faculty from other departments, or GFDL scientists, may be appropriate. At least one other committee member must be an AOS faculty, and the committee must also be approved by the DGS. The committee is to provide, together with the advisor, the student's primary resource for information and advice. The composition of the committee may evolve with time as the research evolves, and the pre-general committee need not be the same as the Ph.D. thesis committee. The DGS should be informed of, and approve changes to the committee.

The main duty of the pre-generals advisory committee is to monitor the student's preparation for the General Exam, and his/her progress in course work and pre-generals research. The student is advised to meet with committee members regularly, and at least one formal committee meeting organized by the student is required per semester.

Compiled here are some general guidelines regarding committee meetings. Note, however, that different advisors have different preferences regarding committee meetings - as do students. Therefore you should discuss with your advisor their specific expectations prior to convening your first committee meeting. Anything agreed upon by you and your advisor supersedes the guidelines listed here or suggestions from other

students based on their own meetings. The only exception: you are required to notify Anna Valerio (apval@princeton.edu) of each official committee meeting, as they are documented in your file.

Committee meetings may take a variety of formats, depending on your needs and the stage of the research - from brainstorming research ideas to presenting recent results. In general, be prepared to communicate your progress and plans for the next few months and expect vigorous discussion with your committee members. You schedule the meeting and reserve a meeting room. In advance of the meeting you should discuss your proposed agenda with their advisor. Some students find it useful to also send the agenda and presentation slides to committee members beforehand - though this is not mandatory. You, the student, typically run the meeting: presenting the agenda, communicating your findings, and soliciting committee members for feedback on specific items discussed.

In terms of meeting rooms, Sayre Hall 312 is commonly used; email Anna Valerio (apval@princeton.edu) to reserve. GFDL also has several meeting rooms; email Kim Gaestel or Dale Walton (kim.gaestel@noaa.gov/dale.walton@noaa.gov) to reserve.

2.2 Courses

A student will typically take three or four courses per semester in the first year, two or three in the first semester of the second year, and usually none or one course in the second semester of the second year. A student is normally examined on about eight or nine courses. Not all students will take the same courses, and some courses may be taken in other departments, although the majority of the courses taken are usually in AOS, and some core courses are usually taken by all students. A list of all courses currently offered in AOS is given in the following section, and below we give examples of tracks or pathways that might be taken by a student. Other pathways are possible — for example, a climate dynamics track might be a combination of the first two tracks below. Note that some classes (like AOS 577 and AOS 547) are offered in alternate years, so that the semester in which they are taken may vary. *You should regard these pathways as examples only* — they are not formal tracks in any way.

Atmospheric and/or Oceanic Dynamics Pathway

Fall, Yr. 1	Spring, Yr. 1	Fall, Yr. 2	Spring, Yr. 2
AOS571 (GFD I)	AOS572 (GFD II)	AOS 576 (Atmos. Dynamics)	AOS 577 (Weather & Climate)
GEO 425 (Phys. Oce.)	AOS 547 (Thermo, and Conv.)	AOS 575 (Numer. Methods)	
AOS 527 (Atmos. Radiation)	AOS 573 (Dynam. Oceanog.)		
APC 501-503 (Math Methods)			

Atmospheric Physics and/or Chemistry Pathway

Fall, Yr. 1	Spring, Yr. 1	Fall, Yr. 2	Spring, Yr. 2
AOS 571 (GFD I)	AOS 523 (Water in Atm)	AOS 578 (Chem. Oc.)	AOS 577 (Weather & Climate)
GEO 415 (Intro Atmos. Sci)	AOS 547 (Thermo, and Conv.)	GEO 428 (Bio Oce.)	
AOS 527 (Atmos. Radiation)	AOS 537 (Atmos. Chem.)		
AOS/CEE 593 (Aerosols)			

Biogeochemistry Pathway

Fall, Yr. 1	Spring, Yr. 1	Fall, Yr. 2	Spring, Yr. 2
AOS 571 (GFD I)	GEO 428 (Bio. Ocean)	AOS 430 (Terrestrial Bios.)	GEO 567 (Geochemistry)
GEO 425 (Intro Phys. Oce)	AOS 577 (Weather and Clim.)	AOS 527 (Atmos. Radiation)	
GEO 415 (Intro. Atmos. Sci.)	AOS 537 (Atmos. Chem.)		
AOS 578 (Chem Oc.)			

2.3 AOS/GEO Courses Offered

Fall Semester

CEE/AOS 593 Aerosol Observations and Modeling
GEO 415 Introduction to Atmospheric Science
GEO 425 Introduction of Physical Oceanography
GEO 430 Climate and the Terrestrial Biosphere (taught alternate years)
AOS 522 Inverse methods: theory and applications (taught alternate years)
AOS 527 Atmospheric Radiative Transfer
AOS 571 Introduction to Geophysical Fluid Dynamics (GFD I)
AOS 575 Numerical Prediction of the Atmosphere and Ocean (taught alternate years)
AOS 576 Current Topics in Dynamic Meteorology (taught alternate years)
AOS 577 Weather and Climate Dynamics (taught alternate years)
AOS 578 Chemical Oceanography (taught alternate years)

Spring Semester

CEE/GEO/AOS 588 Boundary Layer Meteorology (taught alternate years)
GEO 423 Introduction to Atmospheric Science: Meteorology
AOS 523 Water in the Atmosphere
AOS 537 Atmospheric Chemistry (taught alternate years)
AOS 547 Atmospheric Thermodynamics and Convection (taught alternate years)
AOS 572 Atmospheric and Oceanic Wave Dynamics (GFD II)
AOS 573 Physical Oceanography (taught alternate years)
AOS 577 Weather and Climate Dynamics (taught alternate years)

For up-to-date information on the instructor of each course, and to see whether the course will be taught in the current year, please refer to the AOS webpage, or to the online university course offerings at <http://registrar.princeton.edu/course-offerings/>.

CEE 588/GEO 588/AOS 588 Boundary Layer Meteorology

Basic dynamics of the Atmospheric Boundary Layer (ABL) and how it interacts with other environmental and geophysical flows. Topics covered include: mean, turbulence, & higher order flow equations; similarity theories; surface exchanges and their impact on the stability of the atmosphere; different ABL flow regimes (convective, neutral, and stable); role of the ABL in the hydrologic cycle; the fundamentals of scalar (pollutant, water vapor, etc) transport; modeling and measurement approaches for the ABL; and the role of the ABL in large-scale atmospheric flows and how it is represented in coarse atmospheric models. Offered every other year, in the spring.

CEE/AOS 593 Aerosol Observations and Modeling

This course focuses on ground-based and satellite observations of aerosol particles and their impacts on climate through modeling studies. Course material includes satellite and ground-based measurements of aerosol particles, mathematical formulation of transport, and numerical models of aerosol distribution. It studies how aerosols impact climate change through direct and indirect effects including cloud-aerosol interactions. Offered every year, in the fall.

GEO 415 Introduction to Atmospheric Science

An introduction to atmospheric sciences. The course discusses aspects of weather and climate both from a phenomenological and analytical point of view. The course balances overview lectures (also covering topics that have high media coverage like the "Ozone Hole" and "Global Warming") with a few in-depth analyses of selected aspects. The lectures are complemented with homework based on real data, demonstrating basic data analysis techniques employed in atmospheric sciences. Offered every year, in the fall.

GEO 423 Introduction to Atmospheric Science: Meteorology

This course provides the rigorous introduction to the moving atmosphere needed to understand Earth's weather and climate. The fundamental forces of the atmosphere (pressure gradient, gravity, and Coriolis) and conservation laws (mass, momentum, energy) will be developed. Approximations relevant to Earth's large-scale circulation and regional-scale extreme events will be discussed. Important consequences of atmospheric

turbulence will also be covered. Throughout, connections between dynamical equations and atmospheric observations will be strongly emphasized. Offered every year, in the spring.

GEO 425 Introduction of Physical Oceanography

Study of the oceans as a major influence on the atmosphere and the world environment. The theoretical and observational bases of our understanding of ocean circulation and the oceans' properties. The Coriolis-dominated equations of motion, atmospheric and upper oceanic Ekman layers, the thermocline, wind-driven and thermohaline-driven circulation, oceanic tracers, waves, and tides. Offered every year, in the fall.

GEO 430 Climate and Terrestrial Biosphere

Earth's climate is inextricably intertwined with the terrestrial biosphere. In this course, we will explore the key mechanisms that link climate (e.g., cloudiness, rainfall, and temperature) with the terrestrial biosphere (e.g., ecosystem composition, structure, and functioning), and how these mechanisms are altered by humans. We will review basic aspects of climate, surface energy balances, and terrestrial plant ecology, and then investigate feedbacks and forcings arising from biophysical properties of the land surface, biogeographical properties of ecosystems, deforestation, fires, increases in atmospheric CO₂, and other factors. Offered every other year, in the fall.

AOS 522 Inverse Methods: theory and applications

Inverse problems are ubiquitous in geosciences, occurring whenever it is necessary to infer a quantity or parameter from indirect measurements. This course will treat inverse problems from both theoretical and applied perspectives. We will develop the necessary theory to pose, interpret, and solve inverse problems, focusing on topics including error characterization, linear and non-linear methods, approximations, Kalman filters, use of prior constraints, and observing system design. These concepts will be illustrated with examples from the current literature on the Earth's carbon cycle. In particular, we will focus on how measurements of carbon dioxide concentrations can be used to infer surface-to-atmosphere carbon dioxide fluxes. Offered every other year, in the fall.

AOS 523 Water in the Atmosphere

Despite the paramount importance of atmospheric water vapour for climate, our understanding of the processes that regulate its distribution and changes therein in a changing climate, remains incomplete. In this course, we will analyze observations and discuss theoretical approaches (both basic concepts and novel ideas) to the problem. Offered every year, in the spring.

AOS 527 Atmospheric Radiative Transfer

The structure and composition of terrestrial atmospheres. The fundamental aspects of electromagnetic radiation, absorption and emission by atmospheric gases, optical extinction by particles, the roles of atmospheric species in the Earth's radiative energy balance, the perturbation of climate due to natural and anthropogenic causes, and satellite observations of climate systems are also studied. Offered every year, in the fall.

AOS 537 Atmospheric Chemistry

Natural gas phase and heterogeneous chemistry in the troposphere and stratosphere, with a focus on elementary chemical kinetics; photolysis processes; oxygen, hydrogen, and nitrogen chemistry; transport of atmospheric trace species; tropospheric hydrocarbon chemistry and stratospheric halogen chemistry; stratospheric ozone destruction; local and regional air pollution, and chemistry-climate interactions are studied. Offered every other year, in the spring.

AOS 547 Atmospheric Thermodynamics and Convection

The thermodynamics of water-air systems. The course gives an overview of atmospheric energy sources and sinks. Planetary boundary layers, closure theories for atmospheric turbulence, cumulus convection, interactions between cumulus convection and large-scale atmospheric flows, cloud-convection-radiation interactions and their role in the climate system, and parameterization of boundary layers and convection in atmospheric general circulation models are also studied. Offered every other year, in the spring.

AOS 571 Introduction to Geophysical Fluid Dynamics (GFD I)

Physical principles fundamental to the theoretical, observational, and experimental study of the atmosphere and oceans; the equations of motion for rotating fluids; hydrostatic and Boussinesq approximations; circulation theorem; and conservation of potential vorticity; scale analysis, geostrophic wind, thermal wind, quasigeostrophic system; and geophysical boundary layers. Offered every year, in the fall.

AOS 572 Atmospheric and Oceanic waves dynamics (GFD II)

Observational evidence of atmospheric and oceanic waves; laboratory simulation. Surface and internal gravity waves; dispersion characteristics; kinetic energy spectrum; critical layer; forced resonance; and instabilities. Planetary waves: scale analysis; physical description of planetary wave propagation; reflections; normal modes in a closed basin. Large-scale baroclinic and barotropic instabilities, Eady and Charney models for baroclinic instability, and energy transfer. Offered most years, in the spring.

AOS 573 Dynamical Oceanography

Response of the ocean to transient and steady winds and buoyancy forcing. A hierarchy of models from simple analytical to realistic numerical models is used to study the role of the waves, convection, instabilities, and other physical processes in the circulation of the oceans. Offered every other year, in the spring.

AOS 575 Numerical Methods

Barotropic and multilevel dynamic models; coordinate systems and boundary conditions; finite difference equations and their energetics; spectral methods; water vapor and its condensation processes; orography, cumulus convection, subgrid-scale transfer, and boundary layer processes; meteorological and oceanographic data assimilation; dynamic initialization; verification and predictability; and probabilistic forecasts. Offered every other year, in the fall.

AOS 576: Special Topics in Atmospheric Dynamics

An introduction to topics of current interest in the dynamics of large-scale atmospheric flow. Possible topics include wave-mean flow interaction and nonacceleration theorems, critical levels, quasigeostrophic instabilities, topographically and thermally forced stationary waves, theories for stratospheric sudden warmings and the quasi-biennial oscillation of the equatorial stratosphere, and quasi-geostrophic turbulence. Offered every other year, in the fall.

AOS 577f Weather and Climate Dynamics

Principal features of modern climate, including dominant modes of variability. The Earth's energy and water cycles, and their role in climate change. Processes determining the principal atmospheric and ocean circulation features, and their variability on seasonal to decadal time scales. Factors that determine past and future climates, including climate feedbacks. Detection and attribution of climate change. Offered every other year, in the fall.

AOS 577 Weather and Climate Dynamics

An examination of various components of the Earth's climate system. Dynamics and physical interpretation of principal tropospheric circulation systems, including stationary and transient phenomena observed in middle and low latitudes. Reviews of phenomena of topical interest, such as El Nino, seasonal climate anomalies, and natural and anthropogenic climate changes. Offered every other year, in the spring.

AOS 578 Chemical Oceanography

The chemical composition of the oceans and the nature of the physical and chemical processes governing this composition in the past and the present. The cycles of major and minor oceanic constituents, including interactions with the biosphere, and at the ocean-atmosphere and ocean-sediment interfaces. Offered every other year, usually in the fall.

3 The General Exam

The purpose of the general exam is to establish two things: (i) Is the student capable of attacking a research problem? (ii) Has the student acquired sufficient background knowledge of the field to put their research in the proper context and to function as an independent scientist and colleague? The first part of this is largely addressed with an oral exam, the second is largely addressed by a written exam based on the coursework.

The general process really begins in earnest toward the end of the first year of coursework, at which time the student selects a general committee from the AOS faculty who are cognizant of the particular area of research. This committee is primarily responsible for consulting with the student about the research project and the student is expected to meet with the committee over the course of the second year to apprise them of progress made on the project.

The oral exam takes place during the spring semester, typically in March or April, and is usually chaired either by the student's adviser or the Director of Graduate Studies. It consists of a 45-minute presentation generally attended by the faculty only (although members of the GFDL technical staff who have specific knowledge of the project may be

asked to attend to provide the benefit of their expertise). During this presentation questions from the audience should only be asked to clarify points raised by the student. The presentation is then followed by an extensive question period in which first the advisor and committee, then the faculty as a whole, ask questions about the research. These questions may extend to questions about the broader context of the work and may examine the student in detail about the theoretical or numerical underpinnings of the work in a way that would be more detailed than would be appropriate in a public seminar. The student then withdraws, the faculty discuss the presentation, the quality of the work and the level of answers to questions and assign a preliminary grade for the oral portion.

The written exam normally takes place in May, about 4-6 weeks after the oral presentation, to allow students adequate time to prepare. The written exam is customized to each student. The DGS in consultation with the student, the student's advisor and the generals committee chooses a set of 8 or 9 courses on which the student will be examined; typically each student has taken about nine courses. A total of 12 questions is usually selected, with at least one from each course, and additional questions from courses that correspond to the student's area of specialization. The total list of questions is then reviewed by the DGS to ensure that the individual exams are roughly comparable in level of difficulty. To the extent possible, questions are overlapped between students. The exam is administered on two consecutive days, with approximately six questions appropriate to each student offered each day, of which the student must normally answer five, with about 5 hours are allowed for each test. (However, details may vary from year to year, and from student to student.)

The faculty, then meet to discuss the overall performance on the written and oral sections of the exam. The weighting between the sections is not rigid as the point of the generals is to decide whether the student has provided sufficient evidence of potential ability to function as an independent scientist. Four actions may be taken at this point. First, the student may be recommended unreservedly to continue on to a Ph.D. Second, if the student has performed well on the oral section but poorly on the written section, and if the latter reflects poor performance in the classes, the student may be asked to retake the written portion of the exam. Third, if the student has performed well in classes and the written exam but poorly on the oral and/or research portion, the student may be asked to retake the oral examination and/or to write up some results to the satisfaction of the student's committee before a passing mark can be awarded. Finally, in relatively rare cases, the faculty may decide that the student is unlikely to be able to complete a Ph.D. within the program, and recommend that the student not be re-enrolled the following year. All students who have completed course work and passed the written component of the general exam, whether or not they continue on to a PhD, qualify for the Master of Arts (M.A.) degree.

4 Toward a Ph.D

After passing the general exam, the student begins in earnest on the research for his or her Ph.D. The student should by now have settled on an advisor — which in many cases will be the pre-generals advisor -- and the student and advisor should form a committee, typically consisting of the advisor and two or three other scientists. These may be other AOS faculty members, or faculty members in other departments or even other universities,

or GFDL scientists. At least one member of the committee, in addition to the advisor, should be an AOS faculty member. Other committee members are usually Princeton faculty members at the rank of assistant professor or higher, or with GWC approval may be GFDL scientists or scientists from other institutions with rank equivalent to assistant professor. The student should normally meet with the committee once per semester. Refer to Section 2.1 for some general guidelines on committee meetings.

Each year the student needs to be re-admitted to the Program, and this is normally made on the recommendation of the advisor, and approved by the DGS, based on the student making satisfactory progress toward his/her thesis. The re-enrollment process takes place late in the spring semester. To partially satisfy these requirements, the AOS Program requires that each student write a short annual progress report, and submit it to the GWC. Such a report maybe quite short, about two pages for example, and summarizes the work completed in the past year. The report is due a few weeks before the end of spring semester. Sometimes, the fellowship or research grant that is supporting the student will also require an annual report, and in such cases, the two reports may be the same. Students will not be re-admitted without a satisfactory report. In accordance with graduate school requirements of satisfactory academic progress for re-enrollment, students must have two meetings with their committee per academic year to qualify for re-enrollment. The student is responsible for ensuring that these meetings are held.

4.1 The thesis and its requirements

To be awarded a Ph.D., a student must write a *thesis*, and *defend* this thesis in a public lecture, called the *Final Public Oral* (FPO, also known simply as the thesis defense) which is followed by questions from the audience then the faculty. The formal requirements for the printed copy of the thesis maybe found at <http://www.princeton.edu/~mudd/thesis/> and <http://www.princeton.edu/~mudd/thesis/requirements.pdf>. The thesis must be *read* by two readers (one of whom may be the advisor), and examined by three examiners (see the Graduate School web site <http://gradschool.princeton.edu/academics/policies> and the following section).

The timescales for these are as follows, working back from the FPO.

1. The FPO.
2. Two weeks prior to the FPO:
 - (a) The two readers' reports
 - (b) Advanced degree application
 - (c) Email the graduate secretary Anna Valerio (apval@princeton.edu), a PDF of your thesis
3. Four weeks prior to the reports being due, a copy of the thesis must be given to the readers, examiners, and advisor. (The readers may agree to a shorter reading period, or may request more time. In any case, the reports are due two weeks before the FPO.)

The following items are due in Seeley G. Mudd Manuscript Library **normally immediately after the successful completion of the FPO examination**, but in no case later than two weeks after the defense:

Full details of the Mudd Manuscript Library's requirements are available at <http://www.princeton.edu/~mudd/thesis/index.shtml>.

- Complete online submission of dissertation to ProQuest at www.etsdadmin.com/princeton. Candidates will upload a PDF of dissertation, chose a publishing option, register copyright (optional) and pay relevant fees*.
- Bring to Mudd Manuscript Library
- Print-out of email confirming successful submission to ProQuest *1 bound copy of dissertation*
- 1 dissertation maintenance fee of \$15, payable by check made out to “Princeton University Library” or exact cash
- 1 original and 1 copy of FPO form signed by Chair of FPO or Committee or DGS. **(Anna V. will give to candidate after defense.)**
- If you have requested an embargo, you must provide written documentation of approval from the Graduate School (email confirmation from the Associate Dean for Academic Affairs).
- **ProQuest fees (paid online): Traditional publishing is free; Open Access publishing is \$95. Copyright registration (optional) is \$55. Note: the dissertation maintenance fee of \$15 must be paid separately to the Mudd Library in cash or check.*

Due to the Office of Academic Affairs, 111 Clio Hall, immediately following Mudd Library submission

- **FINAL PUBLIC ORAL EXAMINATION REPORT** (In hard copy, signed by Chair of FPO Committee or DGS *and* Mudd librarian)
- **SURVEY OF EARNED DOCTORATES** Hard copy of the “Certificate of Completion” page of the SED (To complete the SED, go to <https://sed.norc.org/survey> .)
- **EXIT QUESTIONNAIRE** Hard copy of “Confirmation of Completion” page must be submitted. (To be completed online by candidate)

The Trustees will not award the Ph.D. degree until these documents are received. Any delay in submitting these documents may jeopardize the award of your degree

- **The End of Enrollment Form** must be completed if you are currently enrolled. The form should be submitted to the department within one week of the termination date indicated on the form. Access link for form, print and complete: <http://www.princeton.edu/gradschool/about/docs/academics/EndofEnrollment.pdf>

4.1.1 Readers and Examiners

The readers and examiners are formal University positions. In most circumstances they correspond to your previously-formed thesis committee, but need not. The readers and examiners may partially overlap, and typically one person is both reader and examiner, but two of the examiners may not have been readers. The readers read your thesis and provide a written report; the examiners question you after your FPO. The readers and examiners are chosen by you and your advisor, and must be approved by the DGS and by the Graduate Dean. Qualified readers/examiners are those who are authorized to supervise doctoral dissertations in the University (such as, regular faculty at the rank of assistant professor or higher and certain others in senior research ranks.) External readers/examiners must be of comparable standing in another university or in the non-academic research community. In particular, any non-Princeton faculty will require justification, and their CV and an explanation of why the person should be on your committee will need to be submitted to the Graduate Dean. The AOS Program requires that at least one reader and one examiner are AOS faculty members, in addition to the advisor.

4.1.2 Time Frames and Publishing

The average time to PhD in the AOS program is about 5 years. Students may be enrolled for a maximum of up to 6 years; of this the first 4 years are in regular enrollment status, during which a student is permitted to take classes for credit. The final 2 years would be in “Dissertation Completion Enrollment” status, during which the student is writing up the thesis. However, financial support is only guaranteed for up to 5 years, and we normally expect the student to complete the PhD within 5 years. PhD completion in 4 years is possible, but only for well-organized, highly focused students who make an early start on their thesis research. Financial support is only provided if the student is resident in Princeton, unless the student is in absentia for research or academic purposes.

A Ph.D. thesis is expected to contain work that is publishable in the peer-reviewed literature, and students are expected to submit at least some of their work for publication before defending. Typically, a Ph.D. thesis would contain material for at least two substantial journal articles.

4.1.3 The Defense

The defense takes the form of a seminar by the student, normally lasting 45 minutes to an hour, followed by questioning from the public, followed by questioning from the examiners. After that, the public and the candidate are excused, and the examiners, readers and AOS faculty discuss the candidate's performance, and, if the defense is successful, sign the form approving the thesis. The candidate should ensure that the committee has the appropriate forms to sign.

4.2 The STEP Program

The Program in Science, Technology and Environmental Policy (STEP, see also the web site <http://www.princeton.edu/step/>) is based in the Woodrow Wilson School of Public and International Affairs and has strong ties to the Princeton Environmental

Institute. It offers an opportunity for students in the AOS Program, and elsewhere, to take some time to study the policy implications of their work. Thus, an AOS student may take a year in the STEP program doing research on some issue that connects science and policy — the economic impacts of global warming, understanding how states might deal with pollution, and so in. Normally, a student will make contact with one of the faculty in STEP program to discuss possible projects, and will then apply for a one year PEI-STEP fellowship to work on a problem of mutual interest — see the PEI-STEP web site (<http://www.princeton.edu/pei/grads/step/>) for more details. Often, partaking in the STEP program may add to the time needed for completion of a Ph.D., but many students find it very worthwhile.

4.3 Teaching

Students are encouraged to teach — that is, to be a Teaching Assistant (TA), or, as they are called in Princeton, an Assistant in Instruction (AI) — for two semesters during their time here, and teaching for at least one semester is recommended. This normally comes after the general exam, in the third and fourth years in the Program. Most students find this to be a rewarding time, and it provides valuable experience for their future careers. Because the AOS Program does not have an undergraduate program, this teaching comes through the Geosciences Department or through PEL. You should contact the AOS staff to arrange this. If financial support is required for a fifth year, the student is normally expected to have taught for two semesters, subject to availability. You will need to plan ahead for this, as teaching is generally not feasible in the fifth year itself.

5 Financial Support

Graduate students in the AOS program are normally provided with funding for tuition and a stipend (living expenses). Funding comes from a variety of sources, including outside (external) fellowships, research grants, GFDL funds, teaching positions (AIs), and the University. In return for support, graduate students are expected to make adequate progress on research and coursework (as determined by their Advisory Committees). *First Year:* All incoming graduate students in science and engineering are awarded a fellowship from the University at the prevailing rate. Other fellowships from the graduate school may be available on a competitive basis, and students are encouraged to apply for them. Additional information on these fellowships may be found on the graduate school website: <http://gradschool.princeton.edu/financial/fellowships/competitive/> *Second Year to End of Program:* After the first year, graduate students not on external fellowships may be supported as Assistants in Research (AR) or Assistants in Instruction (AI).

1. AR: Most students in the Program are supported by Assistantships in Research (AR). A full AR appointment requires the student to spend the majority of his or her working time on research relevant to the supporting grant and, as appropriate, to carry on a program of study (e.g, taking classes). These appointments are for the period September 1 to June 30. Support for Assistants in Research in the AOS program derives either from individual faculty member external grant funds or from funding from the Cooperative Institute for Climate Science (CICS), a collaborative

research institute between the University and GFDL/NOAA (<http://web.princeton.edu/sites/cics/>). Students funded in total or in part by CICS are expected to prepare yearly progress reports on their research and to participate in any CICS science reviews when available. The prevailing rate for an AR stipend can be found on the graduate school website:

<http://gradschool.princeton.edu/financial/assistantships/research/>

2. AI: AOS students may be funded in all or in part by teaching positions held within other departments (e.g. GEO or ENV). AI funding is not guaranteed for AOS students since AI allocations will first be used to meet the funding needs of other departments. However, AOS students are encouraged to seek out AI appointments during their tenure as a graduate student since the faculty feels that teaching experience is an important aspect of graduate education. The prevailing rate for an AI stipend can be found on the graduate school website:
<http://gradschool.princeton.edu/financial/assistantships/teaching/>

External Fellowships: AOS graduate students are encouraged to apply for external funding. Such external funding enables the program to support more students and also is a mark of high achievement for the student receiving the award. A comprehensive list of external fellowships is available on the graduate school website: <http://gradschool.princeton.edu/financial/fellowships/external/>. In the recent past, AOS students have held external fellowships from the following organizations, and *we encourage students to apply for one or more of them.*

National Science Foundation

(<https://www.fastlane.nsf.gov/grfp/>):

The National Science Foundation Graduate Research Fellowship provides three years of support for graduate study leading to research-based masters or doctoral degrees and is intended for students who are at the early stages of their graduate study. Applicants must be United States citizens or nationals, or permanent resident aliens of the United States. Fellowships are intended for individuals in the early stages of their graduate study. Applicants must have completed no more than twelve months of full-time graduate study at the time of their application. Applications due early November.

NASA Earth Systems Science (NESSF) Fellowship

(<http://nspires.nasaprs.com/external/solicitations/>):

The NASA Earth and Space Science Fellowship (NESSF) solicits applications from accredited U.S. Universities on behalf of individuals pursuing Master of Science (M.Sc.) or Doctoral (Ph.D.) degrees in Earth and space sciences, or related disciplines, at respective institutions. The purpose of NESSF is to ensure continued training of a highly qualified workforce in disciplines needed to achieve NASA's scientific goals. Awards resulting from the competitive selection will be made in the form of training grants to the respective universities with the advisor serving as the principal investigator. The NESSF Program is open to all students enrolled fulltime at accredited U.S. institutions; however, U.S. citizens and permanent residents will be given preference when two or more proposals are of equal

scientific merit. Applications due early February.

DOE Computational Science graduate fellowship (<http://www.krellinst.org/csgf/>): This fellowship, for students pursuing doctoral degrees in fields of study that use high performance computing to solve complex science and engineering problems, provides \$36K annual stipend and tuition for up to 4 years, with a requirement that fellows spend 12 weeks at a DOE lab. Applications are due in January.

EPA Science to Achieve Results (STAR) Fellowship (<http://www.epa.gov/ncer/fellow/>): The U.S. Environmental Protection Agency (EPA), as part of its Science to Achieve Results (STAR) program, is offering Graduate Fellowships for masters and doctoral level students in environmental fields of study. Doctoral students may be supported for a maximum of three years, usable over a period of four years. Applicants must also be citizens of the United States or its territories or possessions, or be lawfully admitted to the United States for permanent residence (i.e., have a green card). Applications due late November.

Hertz fellowships.

(<http://www.hertzfdn.org/dx/Fellowships/>) These are highly competitive and very prestigious fellowships, with an attractive financial package. You may apply only in the first year of grad school, or as an undergraduate. Awards are based on merit, not need. You must be a United States citizen or permanent resident, and have an excellent academic record and 'display evidence of exceptional creativity.'

National Defense Science and Engineering Graduate Fellowships.

(<http://ndseg.asee.org/>). These fellowships, for US citizen only in several disciplines including oceanography and geosciences, last up to 3 years, pay all tuition and a stipend. Applicants must be in their first 2 years of graduate study.

Of course, not all fellowships are appropriate for all students, but often there will be a match to one or more fellowships.

3. Summer Support: Students in AOS are normally supported through the Program or by fellowships for summer (between June 1st and September 15th) at the prevailing rate. Summer appointments are full-time and therefore students are expected to be working full-time during this period. Travel for non-research related purposes is not normally encouraged during this time, and any vacation must not exceed graduate school guidelines (see below). Stipends will be pro-rated to account for time away or excess vacation taken during this period.

6 Travel to Meetings

The intention of the travel provision for graduate students is to provide educational experiences that will be of direct benefit to their dissertation work. We encourage students to go to meetings to present results of their research, and to become acquainted with the 'business of research'. Of course all travel is subject to the availability of funding and is

subject to the approval of the advisor. Please note:

- CICS funds may be used to fund student travel to conferences/workshops, provided the student is presenting their own research. Due to budget constraints, CICS will pay for no more than one full cost meeting per year per student (where full-cost means registration, hotel, airfare), unless there are exceptional circumstances. In such circumstances the student must request prior clearance from the Director or Associate Director of CICS.
- Adviser and student should consider carefully the meetings the student may wish to attend over a coming year, and make a choice of the single most beneficial meeting for the use of CICS travel funds. Smaller, more local meetings to which students might carpool, have informal accommodation arrangements, minimal registration, can be considered additionally, again at the discretion of the Associate Director or Director of CICS.
- Before requesting CICS funds, the student should explore all other funding sources, e.g. student travel funds provided by the academic society/conference (i.e. AMS/AGU), Princeton Graduate School (the Deans Fund for Scholarly Travel during the academic year and the APGA Summer Travel Grant for the summer: <http://gradschool.princeton.edu/financial/travel>), Geosciences travel allocations, or travel funds from their adviser's other grants. The graduate administrator will track each student's use of CICS travel funds.
- The Geosciences department provides \$1,000 for travel per student to be used over the duration of their time in Princeton. You must e-mail the Geosciences DGS a request prior to traveling.
- Graduate students are entitled to reimbursement of all reasonable expenses associated with their travel, including transportation, room, board, and registration fees. At the same time, graduate students should spend travel money as if it were their own, and seek to minimize transportation costs, hotel room costs etc. The student must retain all receipts, including meals.
- You may use the department credit card for travel-related expenses such as registration, hotel, airline tickets, rather than purchasing them yourself and waiting to be reimbursed. Please contact the graduate administrator (Anna Valerio) for use of the credit card.
- Attendance at smaller meetings and workshops relevant to a student's research is seen an opportunity for enrichment and interaction with other researchers and is highly encouraged.

7 Vacation Policy

You should regard your graduate studentship as a full-time position that extends throughout the year, including the summer months. That is, regardless of the source of

financial support, graduate students are expected to work essentially full time fulfilling their degree requirements. During a 12 month period from September 1 to August 31st, graduate students may take up to (but no more than) 4 weeks of vacation, including any days taken during university holidays and scheduled recesses (e.g. the fall and spring breaks, inter-term break). (Students should note that 4 weeks of annual vacation is the norm for university faculty too). As a consequence, if you have taken, for example, a week of vacation at winter break and a week at spring break, you would be able to take a maximum of 2 weeks in the summer. The specific periods taken as vacation must not conflict with the student's academic responsibilities, coursework, research, or teaching, and should be discussed in advance with the director of graduate studies, adviser, or dissertation committee. Vacation time may not be accumulated for later use. A student in their first two years (i.e. pre-generals) should only take vacation during normal recess periods. In particular the summer between the 1st and 2nd academic year needs to be devoted to pre-generals research. Vacations outside normal recess periods, of more than a few days, must be approved by the advisor, and if longer than a week, also by the DGS.

If the student is receiving financial support over the summer then he or she is expected to work correspondingly over that time. In particular, a student receiving the full summer support must be in residence for most of the summer (i.e. from June through August) except for a week or two of vacation in accordance with the 4 week annual limit. Summer support will be proportionally reduced if excess vacation is taken during that period, and students should inform the AOS office about their summer plans.