

Department of Genetics PhD Program Handbook
Case Western Reserve University
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PREFACE

This Handbook provides an overview of the Genetics and Genome Sciences (GGS) Graduate Program at Case Western Reserve University. The information provided can benefit graduate students, faculty, and anyone else interested in the Genetics PhD program. This document describes the special features, requirements, and expectations of the Program. The policies described in this handbook are revised periodically by the GGS Education Committee (GGSPC), and the current handbook contains revisions that apply to incoming students for the 2019-2020 academic year and beyond. Students who matriculated prior to 2019 follow the guidelines that were in effect the year they began, except where the recent changes are designated for all students.

Students should be familiar with requirements and guidelines of the university, the School of Graduate Studies, and the Department of Genetics. Many, but not all, of these requirements are described in this document. There are several other useful documents and websites that describe the opportunities and requirements associated with graduate study at CWRU.

Policies of the School of Graduate studies, along with links to important forms and "The Graduate Student Handbook" can be found at <http://gradstudies.case.edu/index.html>

School of Medicine resources and information can be found on the Office of Graduate Education web site. <http://casemed.case.edu/gradprog/>

The Graduate Student Council (GSC) web site, <http://gsc.case.edu/>, provides additional resources and information.

Two excellent handbooks, "The Mentee Guidebook for Students" and the "The Mentor Guidebook for Faculty" published by the GSC are available for download at <http://gss.case.edu/resources.php?name=mentoring>.

Policies of the BSTP and the "BSTP Handbook" can be found at <http://www.case.edu/med/BSTP/>

The Writing Resource Center (WRC) provides supplemental, discipline-specific writing instruction to students of all levels. <http://writingcenter.case.edu/>

Resources for faculty are available at <http://www.case.edu/provost/UCITE/>

PROGRAM OVERVIEW

The goal of the GGS Graduate Program is to train the next generation in the use of genetics to study important biological and biomedical problems. We offer our students a highly interactive training environment, characterized by extensive collaboration among laboratories using a wide range of organisms, biological systems, and approaches. Students pursuing their PhD will be trained by an interdepartmental community of Geneticists with primary appointments in 12 CWRU departments and Centers, and at the Cleveland Clinic (CC). Because CWRU is a physically compact and highly interactive community, it is feasible to have a very effective inter-departmental program. Even the faculty located at CC are only a 5 min drive or 15 min walk away, enabling faculty and students to easily travel back and forth for seminars, committee meetings and research collaborations. The interdisciplinary and collaborative features of the program are especially important, as the students have easy access to other research groups

with common interests and wide ranging expertise in most, if not all, modern genetic approaches.

Our mission is to provide a sophisticated and engaging curriculum which affords trainees the opportunity to achieve excellence while preparing his/herself for a productive science-focused career. During the training period, our students can expect to:

- acquire core scientific knowledge
- develop critical thinking and analysis skills
- participate in activities to improve oral and written communication skills
- develop a creative and independent research project and
- participate in various professional development activities.

These five training objectives are integrated throughout the training program, which includes rigorous and well developed graduate courses, journal clubs, a seminar program featuring student-invited outside speakers, a seminar program featuring student research presentations, and independent research in laboratories with active, well-funded programs.

We offer our trainees research opportunities in many areas of genetics with particular emphasis on six, increasingly overlapping, areas:

- Human Genetics and Disease
- Cancer genetics
- Developmental Biology and Stem Cell
- Epigenetics
- RNA Biology
- Therapeutics

The diversity of systems and approaches employed by the faculty provides trainees with both a wide range of exciting research projects to choose from, as well as exposure to ideas and approaches beyond their own research area. It is our conviction that the next generation of outstanding geneticists will require knowledge in many areas, so that whatever their specific area of interest, they can effectively and easily draw on strategies, perspectives and precedents from research in all organisms. It is this philosophy that has guided the development of the Genetics Graduate Program.

JOINING THE GGS PHD PROGRAM

The Department of Genetics and Genome Sciences accepts students into its Ph.D. program via two pathways: the interdepartmental Biomedical Sciences Training Program (BSTP) or the Medical Scientist Training Program (MSTP).

BSTP: BSTP, <http://casemed.case.edu/bstp>, provides access to most of the biomedical science Ph.D. programs at CWRU during the first semester. Students interested in rotating in the Department of Genetics and Genome Sciences should contact Dr. Hua Lou, Chair of the GGS Education Committee.

Students who have had considerable exposure to genetic research, either in undergraduate school or the workplace, and wish to identify Genetics and Genome Sciences as their field of study, can join Genetics and Genome Sciences directly. These students should apply to BSTP by selecting "Biomedical Sciences Training Program" as their Academic Program in the "Enrollment Information" section and then select Genetics and Genome Sciences as a Priority

Program of Interest (PPI) in the Supplemental portion of the BSTP application form. Selecting the PPI option will identify the student as a BSTP applicant who seeks admission only to the Genetics and Genome Sciences PhD program.

MSTP: Genetics also accepts students enrolled in the Medical Scientist Training Program <http://mstp.cwru.edu/default.asp>. The general guidelines, course requirements and performance expectations for MSTP students are identical to the other graduate students, except that they are not required to take the fall semester Cell and Molecular Biology core course (C3MB, see below). In general, MSTP students complete their rotations and choose a lab in year 2 of medical school after completion of the USMLE step 1. Prior to choosing a PhD program, MSTP students are advised by members of the MSTP Steering Committee. The Genetics MSTP Representative is Dr. Paul Tesar. For more information please see the MSTP handbook, available for download at http://mstp.cwru.edu/Program/StudyCourse/course_of_study.asp.

GENERAL INFORMATION

The Genetics Graduate Program Committee (GGSPC): This Committee oversees graduate training. All members of the committee are available to discuss progress and provide advice on course selection. Members will also serve as the student's advocate should difficulties arise.

2019-2020 GGSPC

Hua Lou (Chair), Anne Matthews (co-Chair), Anthony Wynshaw-Boris (Department Chair), Peter Harte, Helen Salz, Paul Tesar, Fulai Jin. Support Staff: Clarice Young

The Genetics Graduate Student Council (GGSC): The GGSC coordinates various aspects of the graduate student experience, and functions as a voice for graduate student concerns. For example, representatives of the GGSC attend faculty meetings, where they are free to voice graduate student concerns and to suggest curricular and programmatic changes, The GGSC also assumes responsibility for choosing, inviting, and hosting a number of invited speakers for the Genetics Seminar Series and for coordinating student run activities such as the annual Genetics Department Retreat, DNA day activities and various social activities. The GGSC consists of four elected representatives from the GGS graduate student body.

Course Registration: The Student Information System (SIS) is the system of record for student information and the university course catalog. Students use the SIS to register for classes, view grades, view their progress towards graduation, and for other important business.

SIS is accessible at <http://www.case.edu/erp/sis>.

Students must attain a minimum of 54 credit hours to earn the PhD degree. Of those hours, 24 credit hours must be graded credits (receive letter grades) and 18 hours must be thesis research hours (GENE 701). The remaining credit hours (12) may be graded as Pass/Fail or Satisfactory/unsatisfactory. All GGS students must have the GGSPC approve their choices of courses and course registration each semester. To help facilitate this process, students are asked to list the GGSPC co-chairs (Hua Lou and Anne Matthews) as an advisor in addition to their laboratory mentor, so that course registration can be reviewed and the "Advising Hold" lifted in SIS.

Before advancement to candidacy, students are required to register for 9 credits per semester in the fall and spring semester to maintain the full-time student status. In addition to the credits for coursework, students can register for 0-9 credits of GENE 601 (Research in Genetics). In the summer, students should register for 0 credit of RSCH 750 unless they graduate in the summer semester. After advancement to candidacy, students register for less than 9 credits; however, this constitutes being a full-time student. The required 18 credits of GENE 701 should be spread out in the remaining semesters with 3-4 credits per spring or fall semester. In the semester students graduate, including summer, they must be registered for at least 1 credit of GENE 701.

Stipends, Tuition and Medical Insurance: GGS students matriculating on a full-time basis are eligible for tuition and stipend support, and medical insurance. The stipend level for the **2019-2020** academic year is \$30,000. Stipend, tuition and medical insurance are funded by the Dean's Scholarship Program, NIH training grants, NIH individual research grants or fellowships, other federal and private research grants, and department or university resources are also sources of funding. Students who choose to train with faculty members whose primary appointments are outside the Department of Genetics and Genome Sciences should note that tuition, stipend and medical insurance will be the responsibility of the training faculty member and his/her Department. A letter of support is required from the training Faculty and Chair of Department stating that tuition, stipend and medical insurance will be guaranteed for at least five years. This letter must be received by the Department of Genetics and Genome Sciences before a student begins training with the chosen Faculty member.

Note: The University requires that all students have medical insurance. No exceptions are allowed. Students with private insurance, comparable to the Student Medical Plan, may submit a waiver online in the Student Information System (SIS).

Individual Predoctoral Fellowship Support. It is highly advantageous for students to successfully compete for individual grant support from extramural sources, and the department strongly encourages such applications. The Office of Graduate Education maintains a list of graduate funding opportunities and other information about writing fellowship applications: <http://casemed.case.edu/gradprog/prodevwriting.cfm> Note that most agencies require applications early in graduate training.

SUMMARY OF PH.D. REQUIREMENTS

- Complete 3 research rotations
- Complete 24 credit hours of graded coursework with a minimum GPA of 3.0, which must include the following:

CBIO 453/455/450/456	Cell and Molecular Biology (aka C3MB) (graded)
GENE 500/504	Eukaryotic Genetics (graded)
IBMS 500	On Being a Professional Scientist (research ethics) (P/F)
GENE 511	Grant Writing Workshop (graded)
GENE 505	Genetics Journal Club (P/F)
- Pass the Research Proposal Defense
- Satisfy the Genetics Presentation Requirement
- Satisfy the Genetics Publication Requirement
- Satisfy the School of Graduate Studies Requirements for Graduation

PROGRAM DESCRIPTION

The First Year: Course work, rotations in at least three laboratories, and attendance at seminars, journal clubs and research meetings are the major activities of first year students. All

incoming students are encouraged to begin graduate training in July. By doing so, they will complete one rotation before the academic year begins. Having already adjusted to new surroundings well before courses begin generally makes for an easier first year. The choice of a thesis advisor is usually made at the end of December.

Research Rotations & Choosing a Thesis Lab

One of the most important decisions a student makes is the choice of thesis lab. To obtain experience in different laboratories, students complete a minimum of three rotations of approximately 4-6 weeks each. Entering students will be assigned a first-year advisor to guide them through this process. At least 20-25 hours per week of laboratory work is expected during the semester. During the summer and when class is not in session, students are expected to work in the lab at least 40 hours per week. To thoroughly evaluate the research environment, students should do all they can to learn about the lab's research interests and interact with all the lab staff and trainees.

At the end of each rotation a 2-3 page report describing the project and a rotation evaluation form must be submitted to Ms. Clarice Young in the Genetics Office, and to the BSTP and/or MSTP offices if appropriate. (Format and forms available for download at <http://www.case.edu/med/BSTP/>). Three written reports are required to earn a Satisfactory grade in CBIO 400 or GENE 601.

By the end of the first semester, students commit to a specific laboratory for doctoral studies. The date of this commitment is generally around December 15. Any faculty member who agrees to admit a student into his/her lab must do so only with confirmed financial support. Although the placement of one student per lab per year is preferred, two or more students can be placed in one lab in one year, if the faculty member has sufficient resources, is willing to take more than one student and after discussion with the GGSPC. Before placement is finalized, the student, the mentor, the mentor's Department Chair, and the GGSPC must approve the laboratory selection in writing.

First year required coursework

Fall: During the fall, all first-year students are required to take the "*Coordinated Curriculum in Cell and Molecular Biology*", known locally as C3MB (CBIO 453/455/450/456). Using the first half of the Alberts et al., "Molecular Biology of the Cell" textbook as a guide, these courses are designed to provide the first-year student with a broad yet rigorous survey of current knowledge and experimental approaches in modern cell and molecular biology.

Spring: During the Spring semester, students take Advanced Eukaryotic Genetics (GENE 500/504). The goal of this team-taught course is to train students in the use of genetic and genomic methods to solve important biological problems. This course meets 4 days a week, and although the topics covered change from year to year they typically span a wide range of contemporary issues in eukaryotic genetics. While some instructors may provide an overview of the topic in a lecture based format, the majority of class time will be devoted to a discussion of the primary literature. By transitioning to a discussion based format, students learn to think critically about the published literature and not rely on the interpretations and conclusions of the authors, to identify important gaps in knowledge, to frame questions that can be answered and to consider multiple approaches and perspectives in finding innovative solutions to those questions. A portion of class time is also devoted to conversations about the responsible conduct of research (RCR). These modules are meant to augment, not replace, IBMS 500 (discussed below) that is required of all graduate students. The goal of integrating RCR

instruction directly into our graduate course work is to foster discussions in a small group setting. Topics include the standards for compliance in research with humans and animals, integrity in professional scholarship and discussions concerning personal ethical decision-making.

All students are also expected to attend at the Genetics Journal Club (GENE 505). Starting from the second year, students are required to present at the Genetics Journal Club. Attending presentations is important to expose students to recent research advances and promotes the development of critical thinking skills. Preparing and delivering talks on important findings from the literature is also important for learning how to organize and present data in a format that is both engaging and informative.

All students are required to take IBMS 500, "Being a Professional Scientist". This course, which is organized by faculty in Bioethics, provides information on each of the NIH nine-points, (research misconduct, animal research, authorship, mentoring, data management, human subjects, conflict of interest, peer review, collaborative science). Students must register for IBMS 500 prior to the start of the course.

Planned Program of Study

All students must submit electronically a formal Planned Program of Study (PPOS) into the Student Information System. The SIS also includes an electronic process for PPOS approval and degree audit. Each Student submits the PPOS electronically through the SIS; then the PPOS must be reviewed and approved by Dr. Anne Matthews, and by the School of Graduate Studies. ***The Planned Program of study should be entered into the system by the end of the student's first year.*** The student can revise the PPOS if courses initially entered into the PPOS change in subsequent semesters. An example is provided in the appendix.

The 2nd Year: During the second year, students begin formulating a doctoral research proposal, assemble a thesis committee, and prepare to write and defend an NIH fellowship-style thesis proposal. Students are required to participate in the Proposal Writing Workshop (GENE 511) in the fall and register for GENE 505 in the Spring. The students also present, for the first time, at both the Genetics Journal Club (GENE 505) and the Monday Genetics Trainee Seminar Series.

Selection of PhD Thesis Committee

After selection of a research project, students assemble a PhD thesis committee in consultation with his/her advisor. Students should identify three or four GGS faculty members and one from a department outside of GGS. The chair of the committee, who is not the student's adviser, must be from GGS. This committee is responsible for the exam leading to advancement to candidacy and the guidance and monitoring of progress during the research years.

The first committee meeting will be held by December 15 of the second year (June 15 for MSTP students). The goal of the first meeting is to review student's progress and set an estimated time for the oral defense of the thesis proposal. The guideline and report form are in the appendix.

Second Year Required Coursework

Fall: During the fall students must take GENE 511, an introductory course in grant writing and reviewing skills. During the course of the semester, each student develops and

writes an NIH-formatted research proposal, which will ultimately form the basis of the proposal used for the research qualifying exam (see below). Together, the students write, critique and re-write their proposals. By the end of the semester, the students have gained valuable experience in formulating a proposal that not only describes a cohesive set of experiments, but also communicates why the proposed research is important and relevant. This course also features RCR discussion sections about Research Misconduct--Falsification, Fabrication and Plagiarism.

Students must also take at least one elective (graded course) of their choosing.

Spring: All students are required to attend and present at the Genetics Journal Club (GENE 505). 2nd year students must also register for 1 credit of GENE 505.

Advanced Elective Coursework

GGs PhD students need to complete their graded credit requirements by taking two or more advanced electives during their 2nd year. Course selection is kept flexible to allow for the individualization of training determined by research interests and the expertise needed for carrying out the thesis project. Suggested courses are listed on the web site, and many are cross-listed in other departments and taken by students pursuing degrees in other PhD programs, such as Molecular Biology & Microbiology, Neurosciences, Biochemistry and Biology.

1st Genetics Student Research Seminar Presentation

Development of oral presentation skills is a key part of our training program, and all students from second year and beyond, are required to present their work once a year in the Monday Genetics and Genome Sciences Trainee Research Seminar Series. These presentations are quite formal because this series is advertised throughout campus, and open to all faculty and students. After the seminar and the questions about the work are answered, faculty remain to meet with the speaker to evaluate the presentation, *not* the science. Comments focus on the quality of the slides, the clarity of the seminar and speaking style. This feature has been very well received by both faculty and students and has contributed greatly to the quality of the presentations. In addition, this seminar series has proven to be the single most important mechanism for ensuring programmatic coherence and broad communication across the many labs with interests in Genetics and Genome Sciences.

Advancement to Candidacy

Advancement to candidacy requires the composition and oral defense of a research proposal. The purpose of this written document is to evaluate the ability of the student to formulate a research problem, to state hypotheses, to propose experimental and analysis techniques to test those hypotheses. While this proposal will often represent the research ultimately pursued by the student, it is recognized that the details of the proposal and even its goals may evolve significantly over time.

While it is expected that the preparation of the written proposal will be a mentored activity with the research advisor, the oral exam will specifically test the student's understanding of a broad range of genetics and genomics concepts as well as their research capabilities. Thus, the exam will be administered by the Thesis Committee, in the absence of the research advisor. After the defense, the committee votes on the proposal and its defense; the student may pass, fail or pass conditionally. In the case of the latter, the student is typically given a few weeks to rewrite aspects of the proposal and/or remedy deficiencies in the proposal or defense; depending on the nature and extent of the deficiencies the thesis committee may re-examine the student or may simply re-read the proposal and decide to pass the student without a second defense. The proposal is typically defended by June 30 of the end of the second year (December 31 of fall

semester 2nd year for MSTP students). Moreover, all other requirements for admission to candidacy must have been completed by this time. Once the student has passed the oral defense, an “Advancement to Candidacy” form should be completed and submitted to the Graduate School office (<http://case.edu/gradstudies/current-students/forms/>). The guidelines and the evaluation form for the thesis proposal defense are in the appendix.

If a student does not perform sufficiently well in the oral defense, the student's thesis committee and GGSPC will meet and decide if the student will be asked to withdraw from the program.

The 3rd Year and Beyond: By their third year, most students will devote most of their efforts towards meeting the publication and presentation requirements. Students in the research years are also expected to fully participate in all Genetics Events, such as seminars, Journal Club and retreats, meet with their Thesis Committees every 6 months (see below) and The GGSPC every year.

Presentation Requirement

The ability to give effective oral presentations that describe research findings and engage in discussions with research peers are critical skills. Our trainees are therefore encouraged to work on their communication skills through poster and oral presentations as often as possible. While presentations at on-campus venues, including the yearly Biomedical Graduate Student Symposium (<http://filer.case.edu/org/bgss/index/Home.html>), or at regional meetings will satisfy the requirement, the ultimate objective of this requirement is for all students to have the opportunity to present their thesis research at a national or international conference. The Department will pay \$750 for travel and registration fees for any Genetics Graduate Student (or post-doctoral fellow) invited to give a platform presentation at a national or international meeting. The School of Graduate Studies also has a Graduate Student Travel Award (<http://gradstudies.case.edu/new/profdev.html>).

Publication Requirement

The goal of a PhD is to complete and publish a substantial body of original research. In the Department of Genetics and Genome Sciences this usually takes the form of two first author manuscripts. The absolute minimum expectation is that the student will have published at least one peer reviewed manuscript on which he/she is first author prior to thesis defense and have completed a larger body of work that the student's thesis committee judges to be impactful (for example, an additional first author manuscript, substantial contributions as co-author on 1 or more manuscripts).

Review of Student Progress

An important goal is for students to complete their training in less than 6 years. Although the research advisor takes primary responsibility for guiding the student's training during the research years, the student's progress is monitored by both the thesis committee and the GGSPC.

The student's thesis committee provides feedback and advice on research-related aspects of the student's training. The committee monitors each student's progress by meeting with the student every 6 months to discuss his/her research progress. The guidelines of committee meeting and meeting report are in the appendix.

Once a year, representatives of the GGSPC meet with each student to assess progress towards graduation. The student's research advisor and thesis committee chair are involved in the

discussion for students in Year 4 and beyond (Year 3 and beyond for MSTP students). Progress is assessed by academic coursework, rotation reports, annual research presentation evaluations, committee meeting evaluations, publications in print, in press, and in preparation, as well as honors and awards. In cases where a student fails to meet timelines or normal milestones, the student and his/her research advisor will be asked to formulate a plan that describes how and when milestones will be met. In cases where there are difficulties with the student's progress that cannot be resolved, an alternate resolution such as transfer to another laboratory, separation from the program may be required.

Completion of the PhD

Completion and publication of substantial original research is the key objective of graduate work. Therefore, a PhD is awarded when the student has completed a significant and original body of work and has become an expert in his/her chosen field of study. The thesis committee, which includes the student's advisor, is responsible for deciding whether the student's progress toward the degree is sufficient and gives permission to the student to start writing the dissertation.

Because the majority of our students will have published much of their work prior to completion, the dissertation often reflects that work as chapters, placed in context with a general introduction and a discussion that considers the relevance of the studies and future directions.

Before scheduling a date for the formal seminar and public defense the student must successfully defend his/her thesis to the thesis committee and submit a polished draft of the dissertation for approval. Once approved, the student can then schedule a formal seminar presentation.

Graduate Studies Requirements for Graduation

Students should follow the procedures required by the School of Graduate Studies to apply for graduation, including obtaining the necessary forms to be signed following the final thesis defense. The final dissertation document is submitted electronically to the School of Graduate Studies. Special attention should be paid to copy right issues (obtaining permission from publishers to use published materials as well as the embargo option). More detailed information about the dissertation requirements and the paperwork associated with graduation can be found in the Graduate Student Handbook (<http://gradstudies.case.edu/index.html>).

CAREER DEVELOPMENT ACTIVITIES

Graduate students are expected to initiate and participate in a variety of activities having to do with professional growth. Activities that add to the overall training environment include structured programs to facilitate meeting and networking with established investigators from other institutions, professional skills and career opportunity workshops, and opportunities to teach at CWRU and at other institutions.

Journal Clubs and Seminars: Journal Clubs and Seminars offer an opportunity to learn about broad areas of Genetics, and form an important part of graduate training. At a minimum, all students are expected to attend the Genetics Seminar Series, the Monday Student Research Seminar Series and the Genetics Journal Club. Students are strongly encouraged to actively participate by asking questions at all seminars.

Meeting Outside Speakers for Lunch: Students are encouraged to meet with visiting speakers at lunch following seminar. This is a good opportunity to practice talking about science in a concise, interesting way. Further, it offers a means to get to know the speaker, his/her institution and to discuss scientific strategies or collaborations. To meet with a speaker for lunch, contact Claire Young. A student should expect to meet with at least 4 speakers a year.

GGSC-sponsored Outside Speakers: The Genetics Graduate students can sponsor up to four speakers a year. The invitation and hosting of these outside speakers is arranged by consensus through the GGSC. Students create the schedule for the speaker, arrange lunch and dinner with students and postdocs and introduce the speaker at the seminar.

Teaching Opportunities: Although there is no teaching requirement associated with any of the training programs in the School of Medicine, Journal Club/research seminar presentations do allow the student to acquire the communication skills relevant to teaching. Students desiring additional teaching experience are encouraged to TA undergraduate courses offered by the Department of Biology. In years past, our students have TA'ed for Genes and Evolution (BIOL 214) and Principles of Developmental Biology (362/462). Many of our students also teach in high schools on "National-DNA Day". The program, organized by the GGSC includes a short lecture, a lab in which students isolate DNA from frozen strawberries and time for an extensive question and answer period.

Continuing RCR Education: Advanced students, postdocs and faculty are encouraged to participate in monthly workshops, presented by the Office of Research Compliance, on critical issues in the practice of science, including authorship, compliance with IRB/IACUC, conflict of interest and technology transfer. <http://casemed.case.edu/gradprog/research.cfm>.

Professional Skills and Career Opportunity Workshops: Students can learn about different career possibilities available to PhD's and obtain career-development advice through colloquia organized by the students themselves through the Biomedical Graduate Student Organization (BGSO; <http://casemed.case.edu/gradprog/bgso.cfm>) and through the Office of Graduate Education, <http://casemed.case.edu/gradprog/gradprodev.cfm>. Topics have focused on networking, selecting a post-doctoral mentor, employment opportunities in biotechnology, forensic science, patent law and scientific publishing, securing a teaching position, navigating two-career job negotiations and balancing career and family obligations.

Applying for PostDocs: What is a PostDoc? A postdoctoral position is a temporary, non-tenured training position taken before a tenure-track assistant professor position. Postdoc appointments last several years and are a prerequisite for tenure-track positions at research universities and most liberal arts colleges. Some regional colleges do not require postdocs and students can apply for these jobs straight out of graduate school. Postdoc job posting can be found on <http://www.postdocjobs.com>. Additional information about obtaining positions at teaching-intensive institutions can be found at <http://casemed.case.edu/gradprog/prodevteaching.cfm>.

Application for postdoctoral training is made directly to a specific faculty member. Although postdoc positions may be posted in discipline-specific publications or websites, or on the website of an individual researcher, most postdoc positions are not advertised. Application for a postdoc can be done informally at a meeting or via an e-mail inquiry. An e-mail inquiry should clearly articulate your interest in a postdoctoral position, a description of your graduate work, your future career goals, what you hope to accomplish during your postdoctoral training and why that particular lab is the best environment to achieve those goals. PDF files of a formal CV

and research publications should be attached. If a position is available, reference letters will be requested and an interview scheduled. The interview consists of a research seminar and time spent with the potential mentor and members of the research group. The interview process is an important opportunity to ask questions and learn about the dynamics of the research group, department, and community. Many excellent articles about postdoc applications can be found at: <http://www.nature.com/naturejobs/science/articles>.