A Guide to

Training and Mentoring

in the

Intramural Research

Program at NIH

National Institutes of Health
Office of the Director

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Preface

NIH's mission is to improve the health of the public through support of biomedical research and the training of biomedical scientists. The NIH Intramural Program has a long tradition of training outstanding investigators who have become leaders throughout the world. Training of fellows has rested heavily on the quality of research and mentoring in individual NIH laboratories, but until recently there has been no formal guide to emphasize the training role of the NIH and encourage outstanding mentoring in our laboratories and clinics.

The following Guide grew out of my sense that research training at the NIH—and undoubtedly elsewhere—would benefit from a more explicit set of expectations for the predoctoral and postdoctoral research training experience. This sentiment, in turn, sprang from a movement by NIH fellows themselves seeking improved mentoring. This movement was complemented by a project of the National Academy of Sciences (See page 19, Directory of Useful Web Sites) and gained momentum from an editorial outlining my expectations for postdoctoral training at NIH (*The NIH Catalyst*, Volume 4, Issue 6, p. 2).

I am grateful to Joan Schwartz, Chair of the NIH Committee on Scientific Conduct and Ethics, for her leadership in organizing the effort to write this Guide, to Alan Schechter, Richard Asofsky, Christy Ludlow and Carol Thiele for their major contributions to drafting this document, and to the Committee for its hard work in bringing this Guide to fruition. I am pleased that *"A Guide to Training and Mentoring in the Intramural Research Program at NIH"* has taken its place beside the *"Guidelines for the Conduct of Research in the Intramural Research Program at NIH"* as complementary statements of our standards of training, ethics, and conduct for NIH scientists.

This Guide is now supplemented by three documents prepared and approved by the Scientific Directors in May 2002 that provide more explicit guidance: Guidelines for Mentors at the National Institutes of Health (Appendix 1), Guidelines for Trainees at the National Institutes of Health (Appendix 2), and Guidelines for Annual Progress Review of Trainees (Appendix 3).

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Introduction

Research conducted by established investigators together with scientists-in-training is part of the complex pattern of pre- and postdoctoral training that has evolved in much of science over the last 50 years. Scientists who work with trainees on research projects, and the institutions that support them, are responsible for ensuring that their fellows receive the best possible training in how to conduct research, as well as develop and achieve career goals, throughout the training period. The fulfillment of this responsibility as part of research training is known as mentoring and is the subject of this Guide. NIH, like other institutions, has pre-doctoral trainees, as well as many fellows from other countries. These trainees will have certain unique requirements that should be considered. For example, post-baccalaureate fellows may require guidance relative to choices for graduate/medical school. Most foreign fellows return to their country of origin, so their needs with respect to career planning will differ from those of fellows looking for jobs in this country. In all cases, mentoring should be adapted to the needs of each individual trainee.

This booklet outlines the broad principles on which training programs should be based, sets forth criteria for good mentoring, and complements the *Guidelines for the Conduct of Research in the Intramural Research Program at NIH*. No attempt has been made to include listings of all of the resources available to mentors and trainees at NIH since guides to these resources, such as the recently published NIH Handbook for Postdoctoral Fellows (Office of Education, Office of the Director, NIH) and the NIH Web homepage, are available elsewhere (See Page 19: Directory of Useful Web Sites). ▲

Supervisors, Mentors, and Trainees

Research training is a complex process starting with formal courses in undergraduate and graduate years, carrying through to personal interactions with faculty during early research projects, and on to continuing education at meetings and courses throughout one's career. It is the responsibility of each training institution to establish and optimize learning opportunities, but ultimately it is up to each trainee to tailor his or her own education to meet career goals.

The component of training that is designated as mentoring (after Mentor, Odysseus' family's sage counselor in Greek mythology) has received increasing attention in recent years. A mentor is a person who has achieved career success and counsels and guides another for the purpose of helping him or her achieve like success. Research supervisors should always be mentors; they have the responsibility to discuss with and advise a trainee on aspects of his or her work and professional development. The trainee may find additional mentors informally — or the training institution may designate them. They are very important in the overall experience of the trainee and may contribute to research productivity as well. Supporting these training and mentoring relationships at the NIH are the Section, the Laboratory (or Branch), the individual Institutes and Centers, and the Office of Intramural Research, in the Office of the Director, NIH.

Training in the skills of mentorship itself is important, especially for those who plan careers in research or teaching. Postdoctoral trainees should learn to train and guide others, for example, by working with more junior individuals, supervising technical staff, or training students. The characteristics considered important by a fellow in selecting a supervisor and other mentors — interest in contributing to the career development of another scientist, research accomplishments, professional networking, accessibility, and past success cultivating the professional development of fellows — are characteristics that trainees may eventually strive to emulate in their own careers.

Although this Section has emphasized the responsibilities of supervisors and others in research institutions to provide mentoring to trainees to facilitate their professional development, trainees also have responsibilities. Collaborative research frequently requires productive interactions among fellows themselves as well as recognition of their roles as part of a team effort. In addition, fellows must have a commitment to the work of the laboratory and Institute and to the achievement of their goals. They cannot be passive participants in their training; they should appropriately make known their satisfactions, dissatisfactions and needs clearly and often. ▲

Training in Scientific Investigation

A key to successful research training is identifying a first-rate research project. Supervisors should suggest projects that are scientifically innovative, important, and challenging, and which are also feasible based on the fellow's knowledge and abilities and the resources available for the work. Research projects that have high potential to open new fields of investigation or make previously unrecognized connections among fields are most desirable, but may be less feasible. The hypotheses underlying all projects should be explicitly and clearly formulated. Fellows should also understand both the potential significance and the possible limitations of their work. In the beginning, supervisors should monitor the work closely to ensure that fellows learn and use appropriate methods, keep good records, and examine, analyze, and interpret data frequently and appropriately. In all cases, training should allow the fellow to take on an increasingly independent role in identifying research problems, formulating hypotheses, designing and conducting experiments, and presenting results to other scientists. At the outset, the major research goals of trainees and their supervisors should be congruent. As the fellow matures and prepares to define a scientific niche, a good mentor knows when to step back and allow more independence. The trainee should review the relevant scientific literature at the inception of the project and stay abreast of new results as the work progresses. Fellows should know or learn how to explore and evaluate the published information in their field, using the latest electronic search techniques for scientific literature and databases such as those produced by the National Library of Medicine and various private organizations. Trainees should take advantage of opportunities to read critically and discuss published papers related to their work, both one-on-one with more senior staff and in group settings such as journal clubs. They should also learn to critically review pre-publication work with their supervisors: this could include reviewing articles submitted to journals for publication.

Complementing the published literature is NIH's vast menu of research seminars, including individual laboratory seminars, Interest Group meetings, NIH Director's Wednesday Afternoon and Friday lectures, and on-campus meetings of one or several days duration, including the annual NIH Research Festival. Fellows should attend seminars within, but also outside, their field of study to develop the interdisciplinary perspective which makes for the best science. Mentors should recommend seminars that are likely to be valuable and encourage trainees to attend. Participation in regional and national meetings is important for postdoctoral fellows as their work progresses. In contrast, most post-baccalaureate fellows spend only one year at NIH and may not have advanced a project sufficiently for presentation at a meeting. Formal courses, such as those offered by the Foundation for Advanced Education in the Sciences at NIH, will broaden the perspectives and skills of scientists throughout their careers. In addition, more specialized courses, such as those offered by the Center for Information Technology, the National Library of Medicine and the NIH Library, as well as by government and non-government organizations and research institutions may provide more technical resources important for conducting research. ▲

Training in Communication

Communication skills are essential to a successful research scientist. A project is not complete until the results have been reported to the scientific community, especially in written form. Thus, fellows must be trained in the art of communicating the results and conclusions of their research, orally and in writing. Skill in oral presentations can be enhanced by giving fellows the chance to rehearse before a small group and by training in the preparation and use of visual aids such as graphic and text slides. Each trainee should have the opportunity to present his or her work in group or laboratory seminars, one or more times each year. Informal local presentations at early and preliminary stages of projects are especially important. It is also important to learn how to tailor a presentation to a specific audience, whether it be scientific peers, prospective employers, students, or the public. Improving their use of the English language is particularly important for those fellows for whom English is not their native language and who expect to continue in careers which will require publications and seminars in English.

Completed work is presented most appropriately to larger and more diverse audiences, for example, at regional and national meetings. Presentations at meetings can contribute to the fellow's reputation, give him or her a broader view of research in the field, and permit introductions to senior colleagues and peers from other institutions. It also allows critical feedback to both the junior and senior investigator on their research project. Thus, sponsorship and funds should be provided for postdoctoral trainees to travel to conferences to make poster or oral presentations.

Peer-reviewed publication of full research articles — including detailed descriptions of the purpose of the research, methods used, important results, interpretations, and relevant literature citations — is the definitive step in bringing a research project to fruition. Such articles form the backbone of scientific knowledge, and their authorship is critical in the developing careers of junior investigators. Journals differ in their target audiences, range of research coverage, and "impact factor" or citation rate. Fellows should become familiar with these differences by reading articles published in various journals and by consulting with senior colleagues. Authors should have other fellows and more senior investigators read and comment on drafts of manuscripts before submitting them to the selected journal. Approval of manuscripts and abstracts through publication clearance procedures by the individual Laboratories and Institutes, prior to or at the time of submission, is required. All co-authors on a paper should discuss responses to the journal's reviews and editorial judgments before resubmitting it. Joint preparation of review articles can be an important means to help a trainee develop a broader perspective of the field, as well as enhance his or her professional recognition.

The names of the authors, and the order in which they are listed, convey information about the relative contributions of collaborators — this should be discussed with all participants on a project. Guidelines for authorship should be reviewed at the outset and the contributions of all individuals involved in the project should be periodically assessed. These discussions will help trainees understand the process and the complex issues involved in determining authorship. (See *Guidelines for the Conduct of Research in the Intramural Research Program at NIH* for a discussion of publication practices and authorship issues.)

Another important form of research communication is the presentation of research projects to outside review groups. For these presentations, succinct and clear statements of the significance, goals, and hypotheses to be tested in the research project are especially critical for successful communication to reviewers in the specific discipline as well as in related fields. In the intramural program, research review involves written and oral presentations by principal investigators to the individual Institute and Center Boards of Scientific Counselors. Fellows should be encouraged to participate in the preparation of these presentations. For NIH extramural programs, project review is based on written grant or contract applications. ▲

Training in Personal Interactions

Learning negotiation, persuasion, and diplomatic skills is important for a scientist. These skills are called into play in convincing others of the importance of one's ideas, in getting credit for one's contributions, and in navigating administrative channels. Obtaining these skills is a critical part of a scientist's training and is generally acquired by watching the behavior of others. Diplomacy is essential for preserving relationships that may be important for a fellow's career development, and a key step is learning how to cooperate with the very people whose help will be needed to achieve goals.

Networking is the process of forming contacts or exchanging information with individuals to advance scientific or career goals. Establishment of ties to groups of scientists with similar interests can facilitate refinement of scientific ideas, exchange of reagents, development of new collaborations, and exchange of information about job opportunities. Networking starts at the earliest stages of a career and develops continually thereafter. Research supervisors and mentors often are the first points of contact in the introduction of a trainee to scientific colleagues. Fellows should also develop good working relationships with other researchers in the laboratory. Frequently laboratories provide an opportunity for trainees to meet as a group or individually with visiting scientists to discuss research interests. Fellows should seize these networking opportunities and others that abound at NIH, including trans-Institute Interest Groups and regular journal clubs. Joining national professional societies is another good way to broaden scientific contacts.

Finally, without leaving the office it is possible to network on the Internet internetworking! Over the past decade, e-mail has made it easy for scientists to ask their colleagues questions or to request reagents. It is likely that other forms of electronic communication, such as meetings, workshops, and electronic publications, will continue to expand opportunities in the future for convenient networking and data exchange. ▲

Career Planning

Almost as soon as a fellow arrives at NIH for postdoctoral training, he or she should start to consider career pathways. Training at NIH will involve research in some type of basic, clinical or epidemiological project. The possibilities for future career paths are more diverse than ever before, including research careers, academic positions which will encompass research and/or teaching, employment in industry, and careers in science administration, science writing, or biomedical law. Many of today's research jobs involve collaborative work as part of a team rather than the independence of an academic position. Each fellow should consider these different options in terms of what type of work he or she prefers. To help fellows learn about various career options, NIH sponsors programs on professional development, including non-laboratory career pathways. Opportunities are sometimes available at NIH for senior postdoctoral fellows to spend a few months in a science policy or communications office on campus; however, this option depends on the ability and willingness of the supervisor or Institute to support this exploration of non-laboratory career areas. All supervisors should encourage fellows to participate in workshops on diverse career options, as well as others relevant to their particular career plans. Thus, every postdoctoral fellow should attend sessions on preparation of a resume or job interviewing techniques, whereas only those planning on independent academic positions will be interested in sessions on grant writing.
Supervisors should provide their own personal input, by reviewing fellows' CVs and resumes before they apply for jobs. As a fellow decides upon a career path, he or she should start the process of career networking, including identifying contacts, gathering information relative to the chosen path, and learning about the structural or administrative requirements for pursuing that particular career. These critical steps can easily be overlooked if a fellow is focused exclusively on his or her research.

Supervisors and mentors have substantial responsibilities in assisting fellows as they make career choices. Particularly useful would be yearly evaluations, providing assessments of both research progress and career plans, for each fellow. Most important is to offer a frank assessment to the fellow of his or her potential to become an independent researcher or to suggest other career possibilities. Mentors other than supervisors may play important roles at this time as independent career advisors if they know the fellow well enough to evaluate strengths and weaknesses with respect to various career choices. Other functions that mentors can perform include reviewing and critiquing a fellow's CV, notifying the fellow of job openings, and encouraging the fellow to consider diverse career options. Predoctoral fellows, for the most part, are planning on graduate or medical school and will be looking for advice on preparation of applications and choice of schools.

As an institution, NIH promotes career planning by fellows in two distinct areas. The first includes the activities that enhance a fellow's preparation for job hunting, such as the various seminars and workshops noted above. The Graduate School of the Foundation for Advanced Education in the Sciences at NIH actively recruits fellows to design and teach courses, thereby offering them the opportunity to enhance their teaching skills, and to see whether they enjoy teaching. The second area of NIH's institutional commitment is in listings of available jobs, as well as training in applying for research grants that may be necessary for jobs in academia. The NIH Office of Education maintains a list of scientific job opportunities, both within NIH and outside, on its home page on the Web, and sponsors a job fair in association with the annual NIH Research Festival. ▲

Training in Scientific Responsibility

Supervisors, mentors, and training institutions must ensure that trainees learn the legal and ethical aspects of conducting research. This educational process occurs through both formal and informal mechanisms. Distribution and discussion of the *Guidelines for the Conduct of Research in the Intramural Research Program at NIH*, as well as completion of the computer-based module on Human Subjects Research, are now required of all staff members, including trainees. All employees and trainees are also subject to the federal Standards of Conduct for Employees of the Executive Branch. Clinical investigators have to satisfy requirements of the Food and Drug Administration, the Federal Common Rule for Human Subjects Protection, Institutional Review Boards, and Privacy Act and other confidentiality requirements in getting approval for their protocols. Various regulations governing the care and use of laboratory animals, the handling and disposal of radioactive materials, chemicals or hazardous biologicals in research, as well as rules pertaining to patents and technology transfer, may also apply to individual research projects.

Supervisors should convey the relevant rules and regulations to trainees upon their arrival at NIH, ensure that they have taken all required courses, and provide guidance as trainees learn to apply these regulations and policies.

In addition, trainees must develop a sense of responsibility for the use of public resources that are made available to them. Consideration of the costs of equipment, supplies, personnel, and space should be part of the budgeting of each project. Supervisors and trainees should explicitly discuss these constraints so that fellows may begin to understand the limits, opportunities, and trade-offs that must be weighed within a finite budget.

Trainees also need to develop an understanding of the behaviors that are considered ethical and unethical within the scientific community. These standards, discussed in the *Guidelines for the Conduct of Research in the Intramural Research Program at NIH*, are perhaps the most important precepts which supervisors and mentors can convey to fellows, in part by example, during their training. Fellows should also be told about trans-NIH resources like the NIH Ombudsman/Center for Conflict Resolution, the NIH Committee on Scientific Conduct and Ethics, the Office of Equal Opportunity, the Women Scientist Advisors and other places they may go to with specific problems. ▲

Conclusion

NIH is a world-renowned institution because it has been both a major training center as well as a leader in basic, clinical, and epidemiological investigation. As the Intramural Research Program increasingly attracts trainees from very diverse backgrounds with equally diverse goals, it is important that NIH as an institution, and NIH scientists as individuals, continue to focus attention on training and mentoring responsibilities. Individual laboratories, as well as the Institutes and Centers, must continually evaluate the success of their training programs to ensure that these are as effective and current as possible. This Guide is one step in what must be a continual process of self-examination, adaptation, and improvement. Our hope is that striving to improve mentoring will keep our training programs as excellent as our science and ensure that NIH-trained scientists continue to be world leaders in biomedical research. ▲

Directory of Useful Web Sites

Scientific Directors Policy Updates For Mentors and Trainees- May 1, 2002
<http://www1.od.nih.gov/oir/sourcebook/ethic-conduct/sdpolicy-mentoring.htm>

Guidelines for Mentors at the National Institutes of Health
<http://www1.od.nih.gov/oir/sourcebook/ethic-conduct/guidelines-mentors.htm>

Guidelines for Trainees at the National Institutes of Health
<http://www1.od.nih.gov/oir/sourcebook/ethic-conduct/guidelines-trainees.htm>

Guidelines for Annual Review of Trainees
<http://www1.od.nih.gov/oir/sourcebook/ethic-conduct/guidelines-evaluation.htm>

Guidelines for the Conduct of Research in the Intramural Program at NIH
<http://www.nih.gov/news/irnews/guidelines.htm>

A Guide to the Handling of Scientific Misconduct Allegations in the Intramural Research Program at the NIH
<http://www1.od.nih.gov/oir/sourcebook/ResEthicsCases/NIH%20Misconduct2.pdf >

NIH Web Homepage
<http://www.nih.gov>

Office of Human Subjects Research Computer-Based Training
<http://helix.nih.gov:8001/ohsr/newcbt/>

NIH Handbook for Postdoctoral Fellows (Office of Education, Office of the Director, NIH)
<http://www.training.nih.gov/handbook/>

The NIH Catalyst
<http://www.nih.gov/news/irnews/catalyst/current/ddir.html>

A Short Guide to the Preparation of NIH Grant Applications
<http://deainfo.nci.nih.gov/EXTRA/EXTDOCS/gntapp.htm>

Advisor, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering, National Academy of Sciences
<http://www.nap.edu/readingroom/books/mentor/>

Appendix 1

Guidelines for Mentors at the National Institutes of Health

Mentor was the man Odysseus entrusted with the care and education of his infant son, Telemachus, as he was leaving Ithaca on what would be a 20-year absence to fight in and slowly return from the Trojan war. The role of mentor thus implies guiding the maturation and development of the person being "mentored."

The mentoring of junior scientists (students and post-doctoral fellows) is one of the most important obligations of senior scientists at the National Institutes of Health (NIH). Scientific mentoring has several important goals: teaching an approach and methodology for scientific investigation, developing a sense of what questions are technically able to be answered and have important answers, transmitting a history of ideas in a discipline including identification of major contributions and contributors, encouraging the development of the ability to evaluate critically the quality of one's own and others' research, providing an ethical framework for the conduct of research and dealing with collaborations, enhancing the development of oral and written communication skills, and facilitating entrance into the research community in the discipline. In addition, the mentor is expected to assess the progress of the junior scientist, make suggestions for improvement on a regular basis, and provide advice and counsel regarding career development decisions. Mentoring may be obtained by the fellow from others, as well.

Mentoring is a practitioner-apprentice relationship, and by its nature, requires interaction between them. According to a survey of post-doctoral fellows conducted at the NIH, a subset of fellows interact with their mentors less frequently than once a month and some reported never having had a discussion about career development. Disturbingly, women reported these conditions significantly more frequently than did men. While the nature of mentoring relationships can vary widely, the NIH Scientific Directors consider the following guidelines as the minimal requirements for effective mentoring.

1. The mentor (or a surrogate when the mentor is on travel) should be readily available to the trainee to answer questions about research and discuss results and future research directions; this availability implies responding within 24 hours to specific inquiries initiated by the trainee and meeting in person with the trainee (either alone or with other laboratory staff) at least every 2 weeks.

2. The mentor should work closely with the trainee in the preparation of oral presentations of the research and the preparation of papers and abstracts describing the work.

3. The mentor should advise the trainee about the best fora for presenting the research work and when attending meetings together, the mentor should strive to introduce the trainee to important contributors to the research field.

4. On an annual basis, the mentor should provide the trainee with an oral and written assessment of the trainee's progress, strengths, and areas requiring improvement. This meeting should include a discussion of the trainee's professional goals and the mentor's feedback on their appropriateness, the likely length of stay in the laboratory, and planning and preparation for career decisions after the NIH training. ▲

Appendix 2

Guidelines for Trainees at the National Institutes of Health

Mentoring of junior scientists (students and post-doctoral fellows) is one of the most important obligations of senior scientists at the NIH, and the professional relationship that a trainee develops with his or her mentor is one of the most important outcomes from a fellowship. The trainee and mentor must work together to develop a relationship that fosters freedom of inquiry, critical evaluations, and personal and professional integrity. Trainees must take the initiative to build a strong relationship based on mutual trust and respect. They must strive for the excellence that will merit the intensive involvement of their mentor in their future success. Trainees have certain responsibilities that will enhance their mentoring and training experiences while at the NIH. The NIH Scientific Directors consider the following guidelines as the minimal requirements for trainees to meet:

1. Trainees must have a commitment to the work of the laboratory/branch and Institute/Center and to the achievement of their research goals. They need to develop a sense of responsibility for the use of the public resources that are made available to them.

2. Trainees must recognize that much of contemporary science involves team effort and collaborative interactions that require them to conduct themselves in a mature, professional, and civil manner in all interactions with other NIH staff. Trainees must recognize that they work within a laboratory environment and be good citizens by contributing to the maintenance of shared resources and a clean and safe work area.

3. Trainees should initiate meetings with their supervisor at least every two weeks to discuss research findings and at least yearly to discuss career goals. They have a responsibility to develop their yearly training goals and career goals in these discussions and will need to tailor their education and training to meet those goals.

4. Trainees are encouraged to identify one or more mentors in addition to their immediate supervisor. Such mentors will facilitate the professional networking that is key to advancement of their career goals.

5. Trainees must be aware of the legal and ethical aspects and responsibilities that underlie their research. They need to develop an understanding of the behaviors that are considered ethical and unethical within the scientific community (see item 7). They must exercise the highest integrity in collecting, analyzing, and presenting research data.

6. Trainees should make their satisfactions, dissatisfactions, and needs known to their mentor clearly and often. They should feel comfortable about discussing concerns with their lab/branch chief, scientific director, and/or the NIH ombudsman when necessary.

7. Trainees must take the NIH Orientation and Information Program and ensure that they take the required courses described therein. Topics covered include essential items to start work; NIH history; staff rights, responsibilities and programs; staff development opportunities; research ground rules; and and quality of life issues. ▲

Appendix 3

Guidelines for Annual Review of Trainees

A periodic review of a fellow's progress in the laboratory is helpful for both the trainee and the mentor to ensure that training goals will be achieved. The following list provides topics that should be discussed in annual progress reviews with the trainee. Several annual progress evaluations used by different Institutes are provided as possible templates <http://www1.od.nih.gov/oir/sourcebook/ethic-conduct/sdpolicy-mentoring.htm>. Each Institute is encouraged to develop a written review that meets the training goals of the Laboratory or Branch within the Institute/Center.

1. Productivity
2. Effort
3. Creativity
4. Reliability
5. Cooperation/Team effort within the lab
6. Research presentations, including attendance at local/national/international meetings
7. Goals for the upcoming year
8. Long term research and career goals