Mentoring: Summary report of a working group from the

DISCCRS I Symposium, 2003

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The Dissertations Initiative for the Advancement of Climate Change Science, DISCCRS 2003 Symposium, held March 10-15, 2003 at the Copamarina Resort, Puerto Rico, brought together 40 recent PhD recipients engaged in issues related to the study of climate change and its impacts; see http://aslo.org/phd.html for program information. One of the goals of the symposium was to foster discussion of issues of particular interest to this group of new professionals. Working Groups were proposed by the symposium participants before and during the symposium. More than 30 topics were identified. Participants were asked to select their top four choices. The list of topics for discussion at the symposium was then reduced to those which four or more participants identified as a priority. The topic of mentoring was one such topic.

The participants in this particular Working Group numbered between 20-30. Some of the participants were already in significant mentoring roles in their capacity as university faculty or project leaders. Two mentors (Jerry Mahlman (NCAR), and Ronald Mitchell (University of Oregon)) assigned to the symposium were also present, as well as Susan Weiler (Whitman College), organizer of the symposium.

This topic was motivated by the sharp transition faced by all of the participants from student to professional - from being advised to advising students. The primary purpose of this working group was to motivate participants to start thinking about the issues faced as mentors and recognizing the various options to deal with them. Particular focus was placed on specific issues common to this group, namely their relative youth and interdisciplinary science interests.

The working group identified three focus areas of mentoring directly relevant to the group:
- How to mentor graduate students
- How to mentor undergraduate students
- How to be a project leader

For half of the time allocated, we broke up into three groups, each charged with one of the three focus areas. The groups then converged to discuss common issues.

1. How to mentor graduate students

We polled the participants on the 'good' and 'bad' qualities of their mentors in order to find out how they are effective and not effective. Those in boldface were mentioned several times.

'Good'
Demanding high standards
Open to ideas and perspectives; invites resistance
Teaches the 'game of science'
Freedom (to pursue topics)
Treats me as a collaborator
Checks in on student progress
Involved but not directing; asks good questions
Creates opportunities (e.g. intros at conferences)
Tangible concern for person
Enthuses about the science
Financial support
Career support
Generous with time and effort
Encourages participation
Brings people/team together
Involvement with grants; grant writing experience

'Bad'
Playing favorites
Micro-manages (several participants expressed this)
Rigid style
Too busy
Slow or no feedback
Doesn't adapt to different student personalities
No funding support
Insensitive to differences/diversity/gender
Excessive nonconstructive criticism
Not paying attention
Disorganized
Stealing ideas/proposals

We then discussed several issues raised by the moderator and participants:
How friendly can one be with the student?
Potential conflict of interest
The 'coach' model appears to work well - buddy and supporter, brings out the best in the student
Some amount of friendship is good
Each student is different - requires different strategies

Code of Conduct

Set the rules & expectations early (e.g. when you will be in; what you expect from them for their research)
Acknowledge their input in research and grant proposals

Approach for 'New' student as opposed to a 'mature' student
More time
More nurturing
Research - perhaps give them projects to work on; an advantage if you have constraints because of proposal funding. Alternatively, suggest several projects. The advantage of this is that they can learn techniques. *(note: this was not a universal opinion - others felt that they should be expected to come up with their own project)*
Get them to think about ideas (though not necessarily to act on them!)
Give them grant writing or fellowship application experience

Other issues

Ethical question: do we avoid taking on 'intensive' students?
Are there any special considerations for older students?
Use postdocs and older students as help for mentoring younger students
How do you recognize when a student is 'ready' to graduate?
How do you fail a student? One suggestion: as early and as quickly as possible. However, it is often not easy to objectively assess competency, so a comprehensive exam is a useful tool that all students should take relatively early in their graduate careers. Also, this should be done with compassion, and helpful suggestions on alternatives or where to find career help should be offered.
Engage committee members early - especially as it is an interdisciplinary subject

2. How to mentor undergraduate students

The central issues discussed turned out to be the role of the mentor in undergraduate research, and the role of the mentor in academic advising.

<u>Research mentoring - either volunteer or paid positions</u>

Issues

How to make sure students have fun in volunteer positions
How much to push / what to expect students to do
How much supervision or training
Respect for the student (esp. older students)
Maintaining the respect of the students; in particular, how friendly can a mentor be while still playing the role of supervisor?
Role of a supervisor

Quality of work
What to do when the research requires a lot of background that the student does not have

Possible solutions

Develop a timeline early on, set contract of what amount of work they should do (make a contract together)
Weekly or biweekly meetings to talk about progress
Involve students in decision-making, ask students to evaluate themselves and set deadlines, get them to take responsibility/ownership
Hold students to deadlines and contracts, even if you feel like you are being mean. But work with the student to find solutions
Be a role model (as a scientist)

Academic advising

Issues

Knowing graduation requirements/course information
Language and cultural issues
Students with families
Role of a supervisor.
What to do when student is not fulfilling his/her potential
Quality of work
Student with personal problems

Possible solutions

Refer students to counselors
Be a role model

Career counseling

Issues

How do you tell a student that he/she is not suitable for graduate school?

Possible solutions

Be honest
Tell the students what your letter of recommendation will say
Give honest assessment of student record vs. what is necessary to succeed in graduate school

3. How to be a project leader

A central issue discussed turned out to be: how do you fulfill this role given that you are a young PhD put in a role of leadership where the team may consist of older and more experienced people and/or people with diverse backgrounds?

Issues

Responsibility without power ('credibility' issues: young, female, new PhD)
Team members may include senior people
How to motivate people without self-motivation?
Switching between roles. Lack of clarity in roles may lead to confusion and 'power struggles'
Ego
Interdisciplinary issues - team members do not have awareness of where others are coming from or what they are doing
(Crisis of) confidence. Why me? Can I do it?
Balance of confidence and respect is a fine line.

Possible solutions

Get support from the boss - a clear statement of support and confidence from him/her
Each person in the team needs to be sensitive to the role they play in the team - leader, subordinate, colleague
Practice negotiation skills
Communicate effectively with different types
Choose teams to compliment skills - the structure is key
Get a buy-in is very important - gives you power
Keep the big-picture view
Brainstorm one-on-one in advance. Gives sense of ownership, especially with difficult people
Process is very important. Make an agenda that recognizes all parts. Offer 'space' for all - agreed at beginning - keep all involved - ground rules
Respect is key - have respect for all participants
Make it clear that **you** are responsible, but also that you want to work together.
Don't take things personally - find a sense of humor - smile - recognize 'gladiator' dimension - anticipate and prepare
Find support within the organization, and within the self
Try to be useful rather than combative - remember all people have needs.
Recognize that colleagues can also be competitors, and the roles can switch very easily. For example - seeking promotion. Understand the politics around you, and accept that it is different from the personal life.
Manage your own emotions. Know thyself, take deep breaths, count to 10

4. Common issues

The participants from the various subgroups converged to discuss common issues amongst the subgroups. The major issues turned out to be these:

Advising interdisciplinary students

Competence issues: there is an increased burden on the student to master various topics. One solution is to learn by doing.
Ownership: who is the 'real' advisor? Who gets credit for mentoring
Support student to find interdisciplinary advisors
Create opportunities - especially important in an interdisciplinary environment
How to deal with 'flaky' committee members - they don't show up to meetings, etc.

How to you give critical feedback?

The issues facing the project manager is different from that faced by mentors of students, because of the difference in the power structure.
Supervisors and advisors of weak students tend to duck this issue. However, efforts to censure the supervisor/advisor often fails, because the administration may often block any actions, and the bureaucracy does not want to deal with this either.
Mentors should find peers that would give them honest advice - someone to 'bust their chops'
Mentors should plan contingencies (plan A, B, C) ahead of time to ensure that they will not get into trouble.
If the student is stuck on a problem, it is the advisor's responsibility to (initiate?) interact with the student.

Common student issues

Mental illness
Emotional problems
Doesn't want to finish
Cultural differences (e.g. can't say no to mentor's bad advice)
Class and resource differences (e.g. student may be single mother with small children)

A possible solution is to work with the student in recognizing these handicaps - once they are recognized, then something can be done.

Issues pertaining to undergraduates

1. How does one evaluate them? (in particular, beware of setting the same standards as that for graduate students). Possible solutions:

· get advice from faculty

· get a sufficient sample size to compare against

2. How do deal with students that ***really*** break the rules? Possible solutions:

· Lay down the law in the beginning

· Make the rules explicit

· Be a jerk upfront, but be nice at the end

· Allow students to experience their own behavior

3. International student issues?

· Misunderstanding the rules - so need to be even more explicit

· Inappropriate deference to advisor - it is a barrier to teaching

· Don't back off on standards whist being sensitive to differences

4. Is a strong honor code a solution? (e.g. College of William and Mary has a strict honor code, and it seems to work - see appendix 2). Teachers working within such a system needs to respect the system - so for example, do not be present to look over students during an exam. Also, use web tools to spot plagiarism

5. Acknowledgements

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6. References

A mentoring study done at UC Davis, presenting the graduate student viewpoint on mentoring: http://gradstudies.ucdavis.edu/dean/mentoring.htm

A mentoring how-to from the University of Michigan Horace H. Rackham School of Graduate Studies:
http://www.rackham.umich.edu/StudentInfo/Publications/FacultyMentoring/contents.html

A suggested book on ethics of academia: "Academic duty" by Donald Kennedy
http://www.hup.harvard.edu/catalog/KENACA.html

7. Appendix I

This contains a summary of the first two web documents listed in section 6.

From a grad student perspective (from Office of Grad studies, UC Davis)

Proven benefit to students: productivity; academic success; career success. Students identify:

Dissertation guidance: honest evaluation of research; clear guidelines for finishing degree; encouragement to pursue new ideas (satisfaction level 56%)
Financial and other support: support for research; help with grant applications; directs me to funding sources (satisfaction level ~70%)
Interpersonal interaction: respects my opinions; does not abuse power; treats me as a colleague (satisfaction 68%)
Career help: writes me letters of recommendation; encourages me to attend meetings; (satisfaction <50%). Complaints - is willing to discuss career options; makes me aware of job opportunities; teaches me how to network

Factors affecting mentoring:

Student gender: female students less satisfied than males on interpersonal interaction, career help, and financial support. Female students meet less often with major prof.
Gender of major prof: Student with male prof "provides clear guidance" as more important; students w/ female prof rank "encourages me to pursue own ideas". Students w/ female profs "is considerate of personal problems". Students w/ male prof "encourages me to go to meetings". Students w/ male prof " helps me secure adequate space for research". Students w/ female profs "more satisfied w/ mentoring role of prof".
Years in program: advanced students less satisfied with "checks on progress; provides clear guidelines". Early students rank "facilitates co-operation w/ other faculty members". Advanced students less satisfied with career help and financial support advice.
International students: rank "clear guidance", "considerate of personal problems", "concern for financial situation" as more important than domestic students.

From a faculty guide handbook (from U Michigan school of grad studies)

Engage students in ongoing conversations ('hello'; office hrs; coffee)
Demystify grad school (clarify rules & expectations)
Provide constructive and supportive feedback ('honest advice given gently')
Provide encouragement and support (encourage ideas; okay to make mistakes; share negative experience; go to meetings etc.)
Help foster networks (introductions, potluck dinners)
Look out for student's interests ("you want them to succeed"; promote student work)
Treat students w/ respect (personalized time; remember student conversations)
Provide a personal touch

When you first meet with a student, think about: what are their goals? What are students strengths and weaknesses? What is their work style?

Clarifying expectations: Goals (long and short term); Meetings (how often can you meet w/ them?); Feedback (tell them how often and how prompt you may give them feedback); drafts (what state should it be in before you want to see it?); publishing and presenting; intellectual property; reference letters (how much advance notice)

General advice to give to grad students: be proactive; find multiple mentors; have realistic expectations of your mentors; don't be invisible; take yourself seriously; be responsible; show commitment to the profession; receive criticism in a professional manner; let mentors know you are following their advice

How departments can encourage mentoring: assign first year temporary advisor; faculty-grad student lunch program; peer mentoring program; research mentors; teaching mentors; creating community; professional socialization; develop a mentor policy; rewarding mentors

Mentoring within a diverse community: need for role models; questioning the canons (don't dismiss ideas based on bias); feeling of isolation; burden of being underrepresented; seeking work/life balance

Issues with particular groups:

Women grad students: assertiveness; competitveness; importance of positive feedback

Lesbian/gay/transgender students: homophobia; heterosexism; disclosing

Racial and ethnic minority students: stereotyping; funding

International students: culture and language in classroom; social stresses

Students w/ families: dual commitments; isolation; time constraints

Students from working-class background: access to networks; summer professional opportunities; difference in background experience; disjunction with family and friends

Students w/ disabilities: reluctance to ask for help; effort exerted just to keep up; problems from last-minute changes

Non-traditional students: devaluation of life experience; rusty skills; invisibility in classroom; isolation from fellow students; awkwardness with faculty

8. Appendix II

These are guidelines given by Dr. Paul Heideman (College of William and Mary), via Krisa Arzayus. These are her comments: "As a follow-up to John's notes on the mentoring discussions, I have attached two documents that are guidelines/expectations or codes of conduct for undergraduate and graduate student researchers. These guidelines were compiled and are used by Dr. Paul Heideman at the College of William and Mary. As you read them, you may think they come across as very harsh or even decide that he is, in his words, "a fascist control freak". I remember having similar thoughts when I first read these over. But please note that Paul is really a super guy, very nice and very reasonable and has only the best interests of his students in mind. I believe that all of his students have agreed with that assessment, too, and have appreciated the guidelines. Every time I re-read these guidelines, I am more convinced that they are critical for the optimal professional development of the student. They simply give prospective student researchers in his lab a sense of what they can expect as members of his lab gaining the training they need to become a professional scientist and he makes sure they read them and accept them (or a negotiated version of them) before signing on."

Thanks to Dr. Heideman for allowing these to be included in the report.

Undergraduate Research Student Expectations

I've written this description of my expectations of students because I want to make sure that both of us understand what we expect of each other when you do research with me in my laboratory. One of the major reasons I'm here is my enjoyment in teaching people how to do science by doing real research projects with them, and in helping them develop a realistic and professional approach to scientific research. This document provides a professional framework upon which we will interact, me as mentor and you as aspiring scientist.

What you should get out of this experience is an understanding of how good, rigorous science is conducted, instruction in developing your technical writing skills, and the chance to help write a published paper on which you are a coauthor. All of these should be realistic possibilities for you, as I do not normally accept research students working on projects that I do not believe could be publishable. You will need to be realistic with me regarding your skills, goals, and time. It generally takes undergraduates a minimum of one year of working in the laboratory with me to do enough research to become a coauthor on a paper, and most students have needed two years in the laboratory. Historically, about one in three of the undergraduates I've worked with has

become a coauthor on a published paper. My experience is that the keys to a student becoming a coauthor with me on a paper turn out to be individual levels of time available, ambition, motivation, and sheer dogged perseverance in the face of set-backs and bad luck.

Your Time

The time commitment to research tends to be one of the most important issues for students and mentors. I assume that a **minimum** study-week for a student is 45 hours. Each credit hour of research will require a **minimum** of 3-4 hours each week (unless we negotiate something different before you sign up for the course). If you take on a project that requires more time, then you are implicitly agreeing to spend the additional time. Don't attempt a particular research project if you know that you don't have the time to do it. Circumstances that legitimately modify this commitment include illness or, in the short term, personal emergencies. Time lost for these reasons will be made up later, unless we agree that this is not necessary or would create serious hardship.

I haven't usually needed to monitor student time and commitment to a project closely. If you are working on schedule and meeting commitments and deadlines, I will be satisfied with your progress. Failure to meet time commitments and deadlines is reasonably common for students; it isn't good, but it isn't a disaster. If it happens, we should meet to find a solution. If we can't find a way for you to stay motivated and to progress on your project, after significant time and effort devoted to finding ways to keep you progressing, then I will ask you to leave my laboratory; if you don't like your project, are scared of it, or aren't working because you're too busy following other interests, then I can't train you and you can't learn.

My Time

You have a right to 1 hour a week of my time (and depending upon the project, you may get much more); it will be your responsibility to make sure that you get the time you need. Be careful to use the time well. You can and should use me as a source of advice on careers as well as your project. You may interrupt me at my desk, but please be aware that every interruption, no matter how minor, costs me at least 5 minutes, and often more, while I refocus on my task, so you should think about whether a particular question merits an interruption or whether you might be able to wait until another, better, time with a series of questions. You can call me at home for important questions, but should find me in the lab/office for questions that can wait. If I find that you are interrupting more than I feel is appropriate, you can have confidence that I'll tell you and suggest ways to decide when you should interrupt me.

Ideas (Intellectual Property)

I consider ideas that come out of my laboratory to be my intellectual property unless we have agreed differently. This means that you cannot take an idea with you to follow up for work elsewhere without consulting me. Similarly, you may not offer intellectual property or materials developed in my lab to other scientists without my consent. People have imperfect memories, so

if you regard an idea as yours, make sure that you have it in writing, in detail, in a form that we both agree correctly describes your contribution, and do this early! This has never become an issue for me, but it occasionally happens that two parties disagree on their relative contributions to an idea, and the relative importance of coming up with the basic idea *vs* the development of that idea into a viable project.

You will be an author on a published paper if you have provided a substantial portion of the intellectual and physical work involved, and have completed your portion of the project satisfactorily. This involves participation in both the writing and the research work involved. You will not be a coauthor if you fail to complete your project, complete it unsatisfactorily, or don't write it up. All of these things happen fairly frequently, and often for very good reasons. I won't necessarily be upset with you in these cases, but they could keep you from being a coauthor on a paper.

I believe that all authors of a paper ought to have contributed substantially to it intellectually and ought to be able to defend it in front of a scientific audience in that field. First authorship requires that you put in the majority of the intellectual effort **and completed the project, including the writing**! If I or another student played the major role in conducting the experiments, analysis, and/or writing the manuscript, or if someone else had to come in to clean up and finish a project that you couldn't, I or they probably will be the first author of the manuscript. If you cannot finish a project under my supervision, you may forfeit your rights to be first author, regardless of how much of the work was yours (even if an important part of the intellectual contribution was yours). You might still be a coauthor, and you would certainly retain the right to be acknowledged (in the Acknowledgments section) for your contributions to the project. The rationale for this is simple. If you don't finish a project, you haven't played the leading role in it.

Animal Care

Proper care of animals and concern for animal welfare is essential in any science that uses laboratory animals. Mammals used as laboratory subjects must be treated so as to minimize discomfort, pain, and suffering to the maximum extent that is reasonable. There are good guidelines for animal care and welfare available from virtually all scientific societies, as well as from the USDA and NIH, and I will expect you to become familiar with them as required by your project.

I will take mistreatment of animals very seriously. A single instance of gross negligence or deliberate mistreatment in animal care will be sufficient grounds for me to ask a student to leave my laboratory.

The use of animals in laboratory research is an important ethical issue as well. I expect you to think about the issues and develop your own sense of appropriate uses of animals in research and society. I feel very strongly that research using animals is very important to society as a whole. However, I view this as an issue in which there is no single clear "right" answer. A legitimate goal of yours in the laboratory may be an exploration of the issue and discovery of whether you are comfortable with doing animal research (a separate issue from whether you

believe that a particular type of research is appropriate). This is a subject in which I am very interested, so I will discuss it with you at the drop of a hint.

Work Habits and Equipment

Successful research requires clean and neat work areas and clean and functional equipment. **I expect you to clean up every mess you make** (even if it wasn't really your fault), and to handle equipment carefully and competently. I will accept honest mistakes, and I expect you to tell me if you think that there is even the slightest chance that you have damaged equipment. The usual consequence for minor laboratory errors will be extra time at glassware washing or other cleanup jobs. In addition, I will probably hold you responsible for the time required to clean up or replace a part. I will not accept a pattern of negligence, carelessness, or unwillingness to share in routine laboratory maintenance tasks. Evidence of either of these as a continuing or dangerous pattern would be reason for someone to leave the laboratory.

Safety

Safety is more important than anything else in the lab. Learn and practice safe laboratory procedures and learn what to do in an emergency. Wear gloves and eye protection while handling potentially dangerous chemicals. If you don't know whether or not a particular action is dangerous, then you shouldn't do it.

Don't do anything unsafe in order to "save" an experiment. I would rather have you (or me) lose a difficult experiment than have you put yourself at risk.

Visitors to the Lab

Please check with me before bringing someone else into the laboratory for a visit, tour, etc. I have seen experiments/equipment ruined because of an innocent mistake by an unaware visitor, including things as apparently innocuous as a distracting question during a difficult procedure. In addition, some of the chemicals we handle are truly dangerous. While you are aware of proper behavior, and have implicitly agreed to accept the risks, that is not true of a typical visitor. I prefer to keep visits and tours to a minimum, but feel free to check with me if you want to show your parents or a close friend what you do in the lab.

Borrowing Policy

Don't borrow anything without permission, and, when you have permission don't remove anything from the lab (not even for Xeroxing downstairs) without leaving me a written note with your name, the title/name of the object, and the date. I should warn you that I hate not having something available when I need it!

Additional Information

There is more information in my comments specifically for graduate students, and I would encourage you to read the last few pages (**"Additional Comments and Information"**--see the

Guide to the Heideman Laboratory notebook in the lab; if you are a prospective research student, feel free to ask me to show you the notebook or request a copy).

Questions?

If you have any questions about these or other topics, and when you have questions about how well you are progressing, or if you need something explained for the nth time, **ask me**! There are no taboo subjects or questions.

Graduate Student Expectations

Most students enter a relationship with a thesis advisor without a clear idea of what they can expect, and without a clear idea of what it takes to succeed in science. I've written this document to give you a clear view of what I would expect of you as a student, with some comments on the reasons for those expectations.

My students tell me that this guide sounds harsh and inflexible, and that the reality of having me as a mentor and being in my lab is not. I haven't toned these comments down because I want prospective graduate students to think through these issues carefully and soberly. I'm hoping that you will read this and take it seriously, and then discuss with me the concerns or fears it almost certainly raises before making any decisions.

Expectations for Graduate Students

Graduate students and their mentors enter into a professional relationship. While the goals of both are, on the surface, shared and straightforward, conflicts and misunderstandings are not unusual, even when the two relate to some extent as friends as well as mentor/student.

This document is an attempt to set out very clearly my views on the rights and responsibilities of both student and faculty member in order to minimize the occasional conflicts. It also provides a format for working problems out, not necessarily to everyone's satisfaction, but in a form that is most acceptable (or least objectionable) to everyone. My goal throughout is to be both realistic and reasonable.

Reading this document should scare you a little. It should make you feel that you are considering a difficult and challenging step. It should **not** make you feel that I am unreasonable and absolutely rigid, and it should **not** make you feel taking on this challenge will be a miserable experience. It should make you be clear about your special circumstances--if you know that you want to spend 20 hours a week on something that is personally valuable to you, we need to plan around your constraints (if possible). You do not want to discover in your second year that I don't believe your time commitment can possibly let you meet your professional goal! You should expect to be challenged in graduate school, and you should expect to stretch your limits. If I let you perform at less than your best, I have done neither of us a favor.

The terms under which I take on each student are different, and the expectations differ according to your goals. Every graduate student is different, and I don't consider it either appropriate or fair to treat each graduate student identically. In other words, I won't be very concerned about whether your project or the coursework I think you need is harder than that of another student of mine or another faculty member. Instead, I will be concerned about whether your tasks are appropriate to your goals and my goals.

The areas over which conflicts are, I think, most common are over use of time, degree of progress, money, and the source of ideas. I am setting down my expectations and views here. If you disagree, make that clear, and negotiate a different set of rules for yourself. Since my memory is not perfect, **I will require any modifications to these general or specific issues to be set out in writing in a letter or memo!**

Goals

Your reasons for entering our Master's program may include such things as getting into medical school, discovering whether you like research enough (and are good enough at research) to make it part of your career, becoming employable with your master's degree, and getting into a good Ph.D. program. No matter why you entered the program, your major goal should be learning how to be a professional scientist, and my major task as a mentor is to help you learn how to be a professional scientist.

Your reasons for wanting to get a master's degree will affect how we should tailor your experience here to best meet your overall goals. The most obvious part of my task is the provision of advice and direction on your thesis project. That includes advice and direction in choosing a thesis project, doing a literature search for background information, designing experiments, analysis, and writing. I will also help you learn how to give various types of informal and formal scientific presentations, and we may choose the types of presentations you learn based on the types of presentations you will be most likely to give in your career. I will try to give you clear and specific advice on any aspect of science. My emphasis will be on teaching you how to do science rather than on how to do your specific project. In other words, you should leave my laboratory knowing exactly how to go about doing your **next** project, not knowing merely how to repeat your master's project.

I will also offer you advice on how best to meet your goals. If you need and want it, I will help you learn your personal strengths and weaknesses, and make suggestions on how to work around your weaknesses and take advantage of your strengths. No one is perfect, and becoming a perfect scientist is an unattainable goal. Part of my job is to help you learn yourself and your science well enough to be a competent scientist, with the skills and training to move on to the next phase of your career.

Most of us have a tendency to feel that how hard we work or how hard we try should be a prime measure by which we are judged. In fact, though, in science as in most of adult life, results matter. If I am a miserable teacher and mentor, it doesn't really matter to my students whether I tried hard or not; they got the same wretched performance. Thus, while I may be very sympathetic when your experiments aren't working, that won't do you much good. You need to

be aware that it matters that you plan and run your experiments as carefully as possible and as often as necessary to give you publishable results. Although I may be free with advice, suggestions, and help on your thesis, **the ultimate responsibility for completing your thesis and doing it well is yours**!

I will expect to write letters of recommendation for you (upon your request, of course). I will want to write as positive a letter as possible (and honest), and you need to help me find good things to say about you. Keep me aware of your successes, and get me to help you fix areas where you aren't successful. You can share your insecurities with me (we all have them), but get me to help you develop a professional attitude which keeps your insecurities in their proper place. You can trust me to write a professional letter of recommendation for you that discusses your skills and ability as positively (and honestly) as possible. For example, if you want me to write in a letter than you consistently do more than I expect, then you have to make the effort (and make sure that I am aware of what you do). Part of the message here is that you want to impress me as well as use me as a teacher.

Time

The time commitment to research tends to be one of the most important issues for graduate students and mentors. As long as I can see progress and accomplishments at a reasonable pace (meeting the goals you should be writing out for yourself, with a copy to me, each semester), I won't pay much attention to how you spend your time. Ultimately, results matter, and if you can get things done with a very low time commitment, that's great! Because most people struggle with the issue of research time, I've described my views here.

I expect you to regard graduate school as **at least** a full time job. Unless you take on a project with unusually heavy time commitments, I will expect you to take **some** vacation time, but I will also expect you to work during some/many/most academic year "vacations". I regard two weeks of vacation a year as reasonable, three or four weeks is probably not. I expect a typical graduate student to need to work on some, and perhaps many, weekends and evenings.

I assume that a **minimum** work-week for a graduate student is 45 hours. 8-9 credit hours of non-research credit will take up a **minimum** of 20 hours each week. Research will take up a **minimum** of 25 hours each week. We can negotiate how much working as a TA adds to a minimum work week or takes time away from the minimum research commitment. The minimum commitment of 25 hours per week is what I expect from you unless you negotiate something different. Circumstances that legitimately modify this commitment include illness or, in the short term, personal emergencies. I expect that time lost on a typical personal emergency (or short illness such as the flu) normally will be made up later.

You should not require or expect heavy supervision--I assume that you are developing your independence and maturity. You should expect me to notice when you are having problems meeting your time commitments, and you should expect a response from me. Failure to meet time commitments and deadlines is fairly common for students, and it is not good, but it is not a disaster. It does not mean you can't make it in graduate school, and it does not mean that I will recommend that you leave my laboratory. It does mean that we should meet to find a solution.

Being unable to find a solution **is** serious. If we can't find a way for you to budget time to get your projects done, after significant time and effort devoted to finding ways to keep you progressing, then I will recommend, reluctantly, that you leave my laboratory. If you aren't here, I can't train you.

To how much of my time do you have a right? At present, I'm spending minima of 30+ hours a week teaching my courses, 8 hours a week in various meetings and appointments, 2 hours a week in seminars, 3 hours a week on correspondence, 6 hours a week advising undergraduate research, and additional time on research that is just my own. I expect to accept about five-ten undergraduates and two graduate students doing work in the lab at any one time; more than that is impossible for me to handle. All of this makes my minimum work week more than 50 hours; my average is above 60 hours. (I have a personal life that I enjoy very much, and I would rather work the 35 hours or so a week that I did at the rare times when I got to set my own pace, but I can't do that and succeed at what I want to do. Nevertheless, I enjoy this job alot!)

I work with my door open, and normally you can interrupt me with questions or to discuss a problem. Appointments are sometimes more convenient, but I often prefer to deal with questions as they arise. **You should be aware that every interruption, no matter how minor, costs me at least 5 minutes, and usually more, while I refocus on my task. You should think about whether a particular question merits an interruption or whether you might be able to wait until another, better, time with a series of questions.** You can call me at home for important questions, but should find me in the lab/office for questions that can wait. If I find that you are interrupting more than I feel is appropriate, you can have confidence that I'll tell you and suggest ways to decide when you should interrupt me. You have an absolute right to a **minimum** of one hour a week of my time, and it will be your responsibility to make sure that you get that time. Be careful to use the time well. Understand also that I may give you more of my time, and possibly much more at times, especially when I judge that you need it.

Ideas (Intellectual Property)

I consider ideas that come out of my laboratory to be my intellectual property unless we have agreed differently. I have an imperfect memory, so if you regard an idea as yours, make sure that we agree and that we have that point in writing.

Papers resulting directly from your thesis work are yours, and you will probably be first author on at least one of them (most theses will probably produce a single paper). If I have had a substantial role in producing the idea, designing the experiment, **or** (not and) writing up the manuscript, I will be a coauthor (which will be the case for almost all theses). If I or another student played the major role in conducting the experiments and/or writing the manuscript, I or they will be the first author of the manuscript. In other words, if you have not put in the majority of the intellectual/physical effort, you will not be first author of resulting publications. Similarly, if you are unable or unwilling to finish your experiments or write them up for publication, I or another student may be first author on the resulting work. If you cannot finish your work, you forfeit your rights to be first author, regardless of how much of the work or intellectual

contribution was yours. The rationale for this is simple. In science, if you don't finish a project you might as well not have done it.

I will expect to see a complete, written draft of manuscripts for publication within six months of your departure. Your thesis may or may not fulfill this requirement. The maximum amount of time I consider reasonable to wait for a written draft is one year, and in some cases I may not be able to wait even six months. Why does this matter? Being able to complete analysis and writing at a reasonably rapid pace is a very important part of research, but that is only part of the issue. Most of what we work on will need to be completed rapidly in order to allow continuing work in the area or to support a particular grant proposal. Not getting things done jeopardizes projects and future grant support for the lab.

As in many other issues, discussion is crucial. Make sure that we communicate on these ideas and that areas of possible disagreement are in writing. Before you leave the laboratory you should make sure that we have agreed, hopefully in writing, on a schedule for writing the paper(s) from your thesis.

Conditions for Ending the Relationship

There are times when the best thing for students and professors to do is give up on a student/mentor relationship that isn't working. It should be rare, and it should happen only after a serious attempt has been made to solve the problems. A general list of reasons for such action include: (1) the professor cannot supply the intellectual or material resources necessary for a project, (2) the student cannot supply the personal interest, motivation, or time necessary for the project, (3) the student lacks necessary skills for the project and is unable (or unwilling) to acquire them, and (4) serious and insurmountable personality clashes.

My procedure will always be to attempt to find some solution to the problem first. Talk with me about these kinds of professional problems! I assume that all of us struggle with these kinds of issues. **I see my primary role with you not as a judge, but as someone who can help you teach yourself how to be a scientist.** Once I agree that I can help you attain your professional goals, and that your goals are compatible with work in my laboratory, my job is not to attack you for having weaknesses, but to help you find ways to minimize the negative effects of your weaknesses. However, if we can not find any solutions to a problem that I believe will make you fail to meet your goals, I will recommend that you leave my laboratory. Please be aware that I might, in rare cases, take this action even if you were only a month or less from finishing. Failure to meet commitments, without adequate cause, is something that I will take seriously.

These paragraphs should not make you nervous or paranoid. Ask me at any time, and I will give you my assessment of your performance. A good-faith effort in terms of time, responsibility, and productivity is what I require from you.

Additional Comments and Information

Professionalism

Part of what I will expect you to learn or develop with me is an attitude of "professionalism". How do I define professionalism? I view professionalism as (1) taking responsibility for one's own actions and duties, (2) reasonable respect for and tolerance of other views, (3) a willingness to make reasonable compromises to meet shared goals, (4) a pleasant demeanor (real or false), (5) a focus on getting things accomplished, and (6) an ability to escape, avoid, or ignore petty arguments, bickering, and gossip. Note that a professional relationship does not require friendship. In fact, a good professional relationship should allow you to work reasonably well even with people you personally detest, or who detest you (although we all hope it never comes to that).

A professional manner carries us through periods of disagreement and difficulty with minimal strain and stress. While a serious disagreement with a friend may make it impossible to continue any relationship with that friend, it normally shouldn't destroy a professional relationship. A professional manner should allow you to get deeply angry with me or another coworker, yet not erupt into furious denunciation and accusation. It should allow you to calmly think through a situation and discuss it with those involved as a problem to be solved. It should allow you invite and accept reasonable criticism as constructive rather than destructive (criticism normally from a mentor or supervisor, but at times from coworkers as well). As a mentor, I expect to offer honest judgments about professional abilities that I might never offer to a friend. I expect also to ignore things that I consider irrelevant from a professional standpoint, including such things as specific political or religious views.

Credit

Your project will fall somewhere on a gradient between entirely independent (your own idea, experimental design, analysis, and writing, with only supervision from me) and highly directed (my idea, design yours only in part or only with my detailed comments, my close supervision with detailed advice at all stages of the project). You may work on your own on a smaller project or as part of a larger team on a bigger project. In all cases, for academic credit I will expect your intellectual input into the project. That means you will have to understand all phases of the project very well (including the literature), and you will have some unique and valuable intellectual contribution (in the form of an experimental design, the working out of an analytical method or technique, etc.) to some portion of the project.

You may or may not receive technical help to do the physical labor of your project, either from me, another student, a friend, etc. Obviously, projects differ, both in their importance and their needs. I won't let you take on a project that I feel that you can't do, either alone or with the level of help I feel that I can offer. If the project needs additional support, I will try to recruit other students or provide other help to make it work. However, the ultimate responsibility for completing a project lies with you. It is your responsibility to understand your project well enough (that is, very well indeed) to know whether it is feasible given the resources available.

I know that no two students are identical in ambition, resources, time, or abilities. I attempt to supervise all students fairly, but I take those differences into account. You will get credit for your efforts--greater independence, more time on a given project, or particularly good designs or projects, will be reflected in letters of recommendation and, hopefully, in results. When you have questions or concerns about these issues, talk to me about them! I regard discussion of these points as part of your training.

When you discuss your project with others, either informally or as a formal presentation, you **MUST** give appropriate credit to others who shared in or did part of the work. If someone helped with physical work, data analysis, etc., you must point that out! If someone else (me, another student, etc.) did previous work, make that clear! In other words, take credit only for what you did, intellectually and physically. If the project is truly yours, you can (and often should) speak about it in the first person, but do make it clear where you had help. For parts of a project that preceded your involvement, you can't say "we"; you should assign credit to the persons who did that work.

Animal Care

Proper care of animals and concern for animal welfare is essential in any science that uses laboratory animals. Mammals used as laboratory subjects must be treated so as to minimize discomfort, pain, and suffering to the maximum extent that is reasonable. There are good guidelines for animal care and welfare available from virtually all scientific societies, as well as from the USDA and NIH, and I will expect you to become familiar with them.

I will take mistreatment of animals very seriously. Gross negligence or deliberate mistreatment in animal care will be sufficient grounds for me to ask a student to leave my laboratory.

The use of animals in laboratory research is an important ethical issue as well. I expect students to think about the issues and develop their own sense of appropriate uses of animals in research and society. I feel very strongly that research using animals is very important to society as a whole. However, I view this as an issue in which there is no single clear "right" answer. A legitimate goal of yours in the laboratory may be an exploration of the issue and discovery of whether you are comfortable with doing animal research (a separate issue from whether you believe that a particular type of research is appropriate). This is a subject that you should feel free to discuss with me.

Equipment

I don't expect you to be perfect; I expect that some students will make an occasional mistake while using equipment and cause damage to it. I do expect you to use equipment with care. I expect you to operate equipment only if you have learned how to operate it safely and without damaging it. I expect you to take notes on the operation of equipment if you need notes, and I expect you to post them near the equipment if you need to. I expect you to ask me how to operate equipment if you have forgotten, and I expect you to write down those instructions so

you won't forget again. I expect you to tell me if you think that there is even the slightest chance that you have damaged equipment.

We all want the laboratory to operate smoothly and with a minimum of breakage. To help us remember (and to reward those of us who cause the least damage), there will be penalties for misusing or damaging equipment. The usual penalty for misusing equipment will be extra time at glassware washing or other cleanup jobs. In addition, I will probably hold you responsible for the time required to clean up or replace a part.

Damage to equipment during normal use is something that I dislike but expect (though I want it to be as rare as possible), but damage due to gross negligence is not acceptable. In other words, if you break something expensive during normal use, you'll do extra glass washing, but that's all. If, however, you forgot how to operate the equipment and decided to free up a supposedly stuck part by extreme brute force, or you brought a drunken friend into the lab and they broke the same piece of equipment, I would treat it far more seriously. Truly serious damage to equipment due to gross negligence will be grounds for asking you to pay for repairs yourself and/or to stop working in my laboratory. In other words, I can understand and accept occasional carelessness or an episode of clumsiness, but truly stupid behavior I regard as a serious obstacle to success in science.

Frequent clumsiness is also serious. Though I won't blame you for being clumsy, I may, in extreme and rare cases, consider such clumsiness to be serious enough that I would recommend you choose an alternative scientific field or career. A certain level of dexterity and care are absolutely required in all of the lab sciences.

Mistakes in Experiments

Every scientist faces times when they suddenly realize either that an experiment that they deeply hoped would work has failed, or that some serious mistake they made has invalidated an experiment. The proper reaction is to calm down, accept that result, and discuss it with collaborators (and/or mentor). Those are hard things to do; it is never easy to accept an unpleasant result or a stupid mistake and report it to collaborators. In fact, these are the conditions under which most scientific fraud begins. Under the stresses usually felt at those times, it can be easy to rationalize a slight (or sometimes large) manipulation of the data to adjust for what we deeply hope is an anomaly. That is the wrong response. The correct response is to remain calm, and carefully record the data and/or circumstances underlying the mistake, **in detail**! Think through the circumstances carefully, and try to evaluate the situation honestly to yourself. Then discuss it with me as soon as possible. My experience is that often an apparent disaster is less serious than it first appears, and that part or all of the experiment is often salvageable.

Please take this issue very seriously. Falsification of data is the worst of scientific crimes. In biomedical fields, falsification of data can lead to immense wastes of time and money, and even misdiagnosis or mistreatment of patients that might result in their death. The penalties for scientific fraud are appropriately severe; I know two Ph.D.s who falsified data in single experiments, were discovered, and thereby completely ruined their scientific career.

Safety

Safety is more important than anything else in the lab. I expect you to learn and practice safe laboratory procedures. You should learn the potential dangers of working in a laboratory, and I expect you to learn what to do in an emergency. You should wear gloves and eye protection while handling chemicals (dangerous or not!). I expect you to call my attention to dangerous spills, and to help clean them up if I judge that to be safe. If you don't know whether or not a particular action is dangerous, then you shouldn't do it.

Do not do anything unsafe in order to "save" an experiment. I would rather have you (or me) lose a difficult experiment than have you put yourself at risk.

Visitors to the Lab

Please check with me before bringing someone else into the laboratory for a visit, tour, etc. I have seen experiments/equipment ruined because of an innocent mistake by an unaware visitor, including things as apparently innocuous as a distracting question during a difficult procedure. In addition, some of the chemicals we handle are truly dangerous. While you are aware of proper behavior, and have implicitly agreed to accept the risks, that is not true of a typical visitor. I prefer to keep visits and tours to a minimum, but feel free to check with me if you want to show your parents or a close friend what you do in the lab.

Borrowing Policy

Don't borrow anything without permission, and, when you have permission don't remove anything from the lab (not even for Xeroxing downstairs) without leaving me a written note with your name, the title/name of the object, and the date. If things disappear from the lab I will enforce this rigidly, and when things aren't disappearing from the lab I'll probably still enforce it rigidly. I hate not having something when I need it!