



HARVARD UNDERGRADUATE EDUCATION
IN THE
Life Sciences

*Faculty Handbook for
Mentoring Undergraduates in Life Sciences Research*



© 2010 President and Fellows of Harvard College.

All rights reserved.

No part of this publication may be reproduced in any way without the express written permission of the Harvard University Faculty of Arts and Sciences Office of Life Sciences Education.

Office of Life Science Education
Harvard University
Faculty of Arts and Sciences
16 Divinity Avenue
Cambridge, MA 02138

Phone: (617) 274-3575

www.lifescience.fas.harvard.edu

Faculty Handbook for Mentoring Undergraduates in Life Sciences Research

Ann Georgi¹ and Tom Torello^{1,2}

**Life Sciences Education Office
Harvard University
2010**

1. Life Sciences Education Office

2. Department of Molecular and Cellular Biology

Preface

Dear colleagues,

For those of you who have not been keeping count, we are now in the fifth year of an ongoing transformation of how undergraduates engage the life sciences at Harvard. We began this revision with the goal of better aligning our curriculum with modern, interdisciplinary science while giving our students experiences that reflect the process of science. Today we have common foundational courses in the life sciences as well as a cluster of nine concentrations supported by a dedicated advising structure that knits them together as a community of science. I am happy to report that our undergraduate community in the life sciences is now almost a thousand strong.

The transformation process is far from over, and from the very beginning another goal has been to foster undergraduate research. If we are to give our students a genuine sense of what science is all about, there is no better way than to provide them with opportunities to directly engage in inquiry-based research. Over the past several years every department in the life sciences has launched new courses either focused on research or that include significant research components. Likewise, we have encouraged our students to seek research opportunities in faculty labs and have increased the funds available to support these students in the summer. There are now a record number of students working in your labs, a fact that further underscores why undergraduate science at a research institution like Harvard is especially worthwhile.

As we seek to sustain and indeed continue to grow the number of students doing research, we must also develop new ways to support the faculty that so generously work with our undergraduates. This handbook is an important step in providing you with information designed to help you mentor your undergraduate researcher. It brings together information and advice on the most common issues related to undergraduate life sciences research at Harvard. The issues addressed in this Handbook for Faculty include the various ways students obtain credit for research, reasonable expectations for a research project, and information about funding sources that are available for undergraduate research. In addition the handbook provides advice on how to resolve problems that may arise with your student in the lab. This handbook is just the first step in developing new resources that support faculty in working with undergraduate researchers, and we look forward to feedback from all of you. We think of this handbook as a living document, the growth of which will depend on the sharing of the experiences and expertise that resides with you, the faculty.

In closing, I must recognize the tireless enthusiasm and effort of the handbook's primary authors, Ann Georgi and Tom Torello. They are on the

frontlines of working with students in the process of finding research opportunities and have generously shared their combined wisdom. Likewise, we are grateful to the other life sciences advisers, head tutors, and several offices of Harvard College (Tamara Brenner, Associate Director of Life Sciences Education in the Life Sciences Education Office; Meg Brooks Swift, Director of Student Employment and Undergraduate Research Programs for the Student Employment Office; and Greg Llacer, Director of the Office of Undergraduate Research Initiatives, and Director of the Harvard College Program for Research in Science and Engineering) who all gave invaluable feedback on early drafts of this handbook. This truly has been a community effort and one that we hope will in turn pay dividends by helping all of us provide better research and mentoring experiences for our students.

Sincerely,

A handwritten signature in black ink, appearing to read 'R. Lue', with a stylized, cursive script.

Robert A. Lue
Director of Life Sciences Education, Division of Science
Professor of the Practice of Molecular and Cellular Biology

August 30, 2010

Faculty Handbook for Mentoring Undergraduates in Life Sciences Research



Contents:

1. Why take an undergraduate into your research group?.....	1
2. What is your responsibility to undergraduates working in your lab?.....	3
Mentoring	
Setting Expectations for the Student in the lab	
Undergraduate Research Projects	
Funding for Undergraduate Research	
Laboratory Support	
When Problems Arise	
3. What should the lab expect from the student researcher?.....	11
4. Research for academic credit.....	12

Appendices

A. Undergraduate Research Fellowships.....	13
B. Departmental Requirements for Independent Research for Credit.....	15
Chemical and Physical Biology	
Human Developmental and Regenerative Biology	
Human Evolutionary Biology	
Molecular and Cellular Biology	
Neurobiology	
Organismic and Evolutionary Biology	
Psychology	
C. Resources for faculty.....	27
a. Life Sciences Education Office	
b. Mentoring program – workshops	
c. Concentration Advisors and Head Tutors	
d. Student Employment Office	
e. Office of Career Services	
f. House Resident Deans	
D. Information for Hosting Student Researchers in the Field.....	28
References and Additional Readings on Mentoring Undergraduates.....	29

Why take an undergraduate into your research group?

Inquiry-based research is a fundamental component of the educational mission of Harvard College. Participating in basic research helps students learn how to frame appropriate scientific questions, design experiments to answer these questions and analyze and evaluate the data. Indeed, many students choose to come to Harvard because of the opportunities to do research, and most life sciences concentrators are eager to participate in research in various ways.^{1,2} Some students who arrive at Harvard with an interest in studying life sciences are planning to go on to medical school; few have considered research as a viable career option. Exposure to research in the laboratory or the field is a revelation to them and opens their minds to new goals and career paths.³ Harvard College has a pedagogical responsibility to provide training for the next generation of scientists.

Even students who do not plan to pursue a career in research benefit from the experience of working in a laboratory. Research is the practice of science and an integral part of science education. Experience with an independent research project, either in the laboratory or in the field, provides students with a hands-on experience to engage the concepts and principles of science. Learning to design experiments that may answer a specific scientific question can change the way students think about the concepts of science. Preparing a talk about their work for the lab group or undergraduate symposium teaches them how to analyze and organize data and give a cogent presentation.^{4,5}

Providing research opportunities for these bright and highly motivated students also has significant benefits for the host laboratory. Some of these enthusiastic young researchers will succeed beyond expectations and many will make valid and useful contributions to the lab's research goals. Additionally, the

¹ Light, Richard J., *Making the Most of College: Students Speak Their Minds*, 2001. Harvard University Press, 2001, pp 70-71.

² Yanamadala, Vijay, 2007. *Undergraduate Science Experience at Harvard College: Findings from 40 In-Depth Interviews with Students of Varied Interests and Abilities in the Sciences*. Independent research paper supervised by Richard Light, Walter H. Gale Professor of Education, Harvard University, pp. 10-11.

³ *Ibid.* p. 20.

⁴ Lopatto D. 2004. Survey of Undergraduate Research Experiences (SURE): first findings. *Cell Biol Educ.* 3(4): 270-7.

⁵ Handelsman, J., D. Ebert-May, R. Beichner, P. Bruns, A. Chang, R. DeHaan, J. Gentile, S. Lauffer, J. Stewart, S. Tilghman, and W.B. Wood. 2007. "Scientific Teaching." *Science.* 304: 521-522.

graduate students and postdoctoral fellows who work directly with the undergraduates in the laboratory will benefit from a valuable teaching and mentoring experience.⁶

The aim of this manual is to provide the host labs with information that may answer questions about the roles and responsibilities of faculty who host undergraduates in their labs.

⁶ Handelsman, Jo, Teaching Scientists to Teach, Howard Hughes Medical Institute Bulletin, June 2003.

What is your responsibility to undergraduates working in your lab?

Mentoring

Good mentoring is crucial to encouraging undergraduates in a research environment. Indeed, students report that good mentoring is a significant factor in determining their happiness and success in the lab.^{1,7} Even if you are not working directly with the student in the lab, it is important that either you or a senior member of the lab be actively involved with the mentoring process, ensuring that the student receives good mentoring and research training. Most labs assign a senior member of the research group (usually a post-doc or graduate student) to incoming students to direct their research training and the development of their project. This is a crucial but very time-consuming role and the lab mentor should be aware of the time commitment before taking on a student. Before the student begins working in the lab, it makes sense for the mentor and student to establish a mutually agreed-upon schedule. This ensures that the mentor will be available when the student is in the lab to oversee their work, answer questions, teach necessary techniques, discuss results, and help plan next the experiments. Having a good lab mentor at the beginning of a student's research career can have an enormous impact on a student's decision on whether to continue doing research after college or to take a different career path.

Once the student has begun work in the lab, it is a good idea for you to meet regularly with them to assess their progress. For labs that host several undergraduates at the same time, it may be easier to schedule one weekly meeting with all of them to discuss their projects, results, future experiments and any problems that they may be having. Your direct interaction with the student sends a strong message about their value to the lab.

Other responsibilities that you and the student's lab mentor are expected to undertake include writing letters of recommendation for funding support and fellowships, advising students on the preparation and writing of their fellowship proposals, research papers, and thesis; and contributing to assigning grades for independent research courses (see Appendix B for details about departmental requirements for independent research courses and theses).

Many post-docs and graduate students will not have had any experience or training in mentoring undergraduates. Some may not have had an undergraduate research experience themselves and therefore will have little idea of what their role should be. The Life Sciences Education Office offers mentoring workshops

7 Ann Georgi and Tom Torello, personal communication from students

and lunchtime discussions throughout the year to provide support and basic training for lab mentors. [Information for mentors](#) is also available on the Life Sciences web page.

Setting Expectations for Students in the Lab

Because many students will not have had previous laboratory experience, it may be helpful for you to meet jointly with the student and their mentor to set out the ground rules before the student begins working in the lab. You might want to discuss such topics as: How many hours per week should the student work during term time? During the summer (if relevant)? How will the project topic be decided? How often will you meet with the student? And, although it may seem premature, what is the lab's policy on presenting research results at group meeting or paper authorship? Students tend to get their information from each other and may not always realize that policies differ from lab to lab. Therefore, it is important to set out your lab's policies and procedures directly to the student to avoid misunderstandings or unrealistic expectations.

The student may have useful input to this conversation related to their course schedule, extracurricular activities, and how much time they will be able to devote to the lab. For instance, if the student is taking two lab intensive courses in the fall semester, they may realistically only be able to work in the lab a few hours per week for that term. For this reason, we recommend that you try to be somewhat flexible about the number of hours/week that you expect a student to work, especially with freshmen and sophomores whose course loads tend to be very laboratory intensive. In the long run, it is less costly and time consuming to scale back your ideal expectations than to set unreasonable conditions for the student and have them fail. We recommend that freshmen and sophomores who are volunteering in the lab during term time, i.e. not receiving pay or credit for their work, spend no more than 6 to 10 hours/week working in the lab. However, if their course load is lighter in another term, they may be able to work more hours/week. For students who are doing lab work for credit either in a supervised laboratory course or for a senior thesis, it is reasonable to expect them to be in the lab a minimum of 15 to 20 hours/week for the term. At the beginning of the semester, students and mentors may find it helpful to discuss setting up a fairly regular schedule for coming to the lab. Obviously, it is extremely helpful for the lab mentor to know ahead of time when they should set aside time from their own experiments to work with the student. Having a regular schedule also encourages the student to keep track of how much time they are spending in the lab, which can help them avoid either becoming over committed or showing up at times when their mentor is unavailable to work with them.

There are many opportunities for Harvard students to do research abroad. Nearly all of these are summer programs geared to upperclassmen, primarily sophomores, because they require that the student have had some advanced

course work and/or research experience; however, a few of these programs are open also to freshmen. Students also can find their own labs abroad for the summer and apply for fellowships to cover their costs through the Office of Career Services or the Office for International Programs (see Funding for Undergraduate Research below). Although you may have concerns about a student taking the summer away from the lab, students who participate in such experiences abroad benefit in several ways; they may gain some independence and maturity, broaden their perspectives, learn about approaches to research in other cultures and may even return with new technologies for the lab. We therefore urge faculty to be as flexible as possible and support the student's decision to take advantage of these opportunities. It may be advantageous for you to assist the student in identifying some labs abroad whose work is related to what the student is learning in your lab or you may want to suggest colleagues whose labs are likely to provide a good research and mentoring environment for the student. Rising seniors who are doing thesis work are strongly encouraged to remain in their Harvard labs for the summer.

Undergraduate Research Projects

Another key to success for undergraduate researchers in the lab (or the field) is the nature of the project. Listed below are some guidelines for creating a good undergraduate project. These guidelines are not intended to be rigid; obviously, the projects should be designed not only to take into consideration any special technical requirements and skills that the lab uses but also reflect the lab's research focus.

Characteristics of a good undergraduate research project:

1. Initially, it might make sense to have the student's project be part of the post-doc or graduate student mentor's research – or be in an area in which the mentor has some experience or background – to help ensure that the mentor is qualified to teach the scientific material and techniques.
2. While students may initially gain technical expertise by assisting with experiments on the mentor's long-term research project, the expectation is that eventually the student will pursue an independent project or work independently on some aspect of the mentor's larger project. The student researcher should not be viewed merely as a research assistant for the post-doc or graduate student mentor. This is especially important for students aiming to write a thesis, but also applies to students working in the lab over the summer or for academic credit during the term. An exception to this guideline is if the lab views the undergraduate position as a paid lab assistant position and has posted a job description that clearly states that the student will *not* be working on an independent project. Students sometimes find this distinction fuzzy; therefore it is crucial that the position be described as clearly as possible in the posted job description.

For some students who do may want to do an independent research project or who do not plan to do a senior thesis, a less independent lab project is more appropriate. Students considering a career in medicine who do not want to work in a lab for credit may seek a more clinically based research experience.

3. The project should be relatively “low-risk”; that is, the student should be able to get a result or make a contribution - however small - to the overall project in a relatively short time (over the summer, for example). Students who are doing independent research for credit or a senior thesis will be able to spend many more hours per week in the laboratory during the academic year and therefore will be expected to work on more ambitious projects. A student may begin work on a thesis project part time as early as their sophomore year although most begin thesis work in their junior year.

4. Ideally the project should utilize techniques, equipment and reagents that are already working in the lab. In some cases exceptionally talented and ambitious students will be capable of developing new techniques and undertaking more sophisticated projects; but this ought be carefully evaluated *only* after the student has worked in the lab for some time. Other students may lack confidence and be discouraged by expectations that are set too high.

5. For freshmen and sophomores who are just getting started in the lab, it is very important to consider the number of hours per week that they will be able to work during the term. Many of these students will be taking very lab intensive courses and have limited time to engage in independent lab work. We recommend that these students plan to work no more than 6 to 10 hours/week during the term; therefore projects that have logical stopping points that can extend for days or even weeks during exam and vacation times are best. For these students, starting with a small project that might lead to a larger thesis project may be most appropriate.

6. Students are expected to do some background reading about the project to gain some understanding of the science behind the research question. Again the goal is to encourage them, with the guidance of their lab mentor, to achieve some level of research independence, to learn how to think about experimental design and to take some ownership of the project.

7. Finally, students are encouraged to present their research results in their lab group meetings and participate in undergraduate research symposia or poster sessions offered by the Harvard College Undergraduate Research Association (HCURA). Some of the summer fellowships require that their fellows participate in an end of program poster session or symposium. This is a good opportunity for students to learn how to design a poster or to present their research in a brief talk.

Funding for Undergraduate Research

Funding is available to provide a wage/stipend for undergraduates working in labs. Normally the host lab is responsible for covering the costs of reagents and materials for the student's project. There is little support from the College to supplement a lab's expenses for student projects.

Term time funding through Harvard:

Limited term time funding is available for students who have high financial need or who are on financial aid. Freshmen and sophomores who are just getting started in the lab are encouraged to volunteer their time while they are being trained. Juniors and seniors are more likely to work for academic credit either through a supervised research or senior thesis course. Students who have high financial need or who are on financial aid may opt to receive a stipend rather than academic credit. It is important to note that during the term students may not receive funding and academic credit for research work simultaneously.

Four primary sources of funding are available to students during the academic year:

1. Faculty may pay the student a full or part stipend (\$9.00 to \$12.00/hour is the rate for most of the funding programs) directly from lab funds.
2. The lab may apply to the [Faculty Aide Program \(FAP\)](#) through the Student Employment Office.
3. The student may be eligible for the [Federal Work Study Program \(FWSP\)](#).
4. Students may apply to the [Harvard College Research Program \(HCRP\)](#).

Summer Research Funding through Harvard:

A reasonable guideline for summer compensation rates is that students who do not live locally and are not participating in one of the summer residential research fellowship programs will need about \$3500 for housing and living expenses for 10 weeks in Cambridge. Students who do have local housing for the summer generally will need around \$1500 to \$2500 for living expenses depending on their meal plan. In some cases, students on financial aid may need more financial support because these suggested stipends, which assume full time work for 10 weeks, are unlikely to cover the student's financial aid summer earnings contribution. The goal is to provide enough financial support for students working in the lab over the summer so that they will not need to find an outside job to meet living expenses and financial aid obligations.

Below is a list of some of the major sources of support for students who are doing research at Harvard over the summer. Note that with the exception of HCRP, the fellowships assume a "full time" commitment to the lab of at least 40 hours/week for ten weeks during the summer. Students must use the [Common](#)

[Application for Research and Travel \(CARAT\)](#) - which is available electronically from the websites of all participating funding agencies - to apply for the Harvard summer fellowships. This form is an effective bookkeeping tool that allows the funding programs to track each student's fellowship applications.

With the exception of PRISE and some of the smaller fellowships designed to supplement HCRP, students *may not accept* financial awards from more than one fellowship at a time. For example a student may not simultaneously accept funding from both Herchel Smith and HCRP, however a student may accept funding from Herchel Smith and participate in the PRISE program. The purpose of this restriction is to avoid situations whereby a few students receive multiple fellowships while others receive little or no funding. In some cases a student who has been accepted for two fellowships may accept the financial award from one and participate in some of the non-financial aspects of the other fellowship program. For example, a student who is accepted for both Herchel Smith and The Harvard Initiative for Global Health SURF fellowships may receive their funding from Herchel Smith and still participate in the lectures and social activities of the HIGH program. However, the student may not receive financial support from both programs at the same time. More detailed information about each fellowship can be found in Appendix A.

1. [PRISE](#) is a summer residential program for Harvard undergraduates who are doing science research.
2. The [Harvard College Research Program \(HCRP\)](#) is administered through the Student Employment Office and provides funding for undergraduates engaged in research with a Harvard faculty member in any field. HCRP does not require a full time commitment, but the student must submit a budget that describes their work time.
3. The [Herchel Smith Fellowship](#) is administered by the Office of Career Services and provides funding for students doing summer research either at Harvard or elsewhere.

A complete list of Summer Research Fellowships for Harvard undergraduates is on the Life Sciences website.

Outside Sources of Funding for Undergraduate Researchers:

1. NIH Grants - Under the stimulus bill, the government has announced funding to support undergraduates doing research in labs that are funded by NIH grants.
2. [NSF Research Experiences for Undergraduates \(REU\) Program](#) - The NSF REU program encourages undergraduate research by providing financial support to students working in any of the areas of research funded by the National Science Foundation. Undergraduate student participants must be citizens or permanent residents of the United States or its possessions.

Laboratory Support

The host lab is responsible for providing adequate lab safety training for the student including the safe handling and disposal of hazardous material and radioactive reagents (if applicable) and the safe operation of laboratory equipment. Students should be familiar with all federal and Harvard University safety guidelines for work in the lab. It is also important to explain to the student any guidelines or rules that are specific for your lab. Taking the time to teach a student the required safety rules, proper lab procedures regulations and good lab citizenship at the beginning of their research career will likely help prevent problems in the future.

The NIH and NSF now require that every member of a research project funded by their agencies be trained in the rules and guidelines for academic integrity. Harvard will be offering training that will fulfill this requirement. Students in your lab should be strongly encouraged to participate in this training.

When Problems Arise

What happens when despite the best efforts of the student's mentor - and maybe the student - the project does not progress satisfactorily? This situation is not unusual and there are a couple of options for response, but it is important to step in fairly early on and assess the situation. This is another reason for meeting regularly with the student and their mentor.

The problem could be inherent in the project; for instance, the techniques are not working or are too sophisticated for this student. In this case, the solution might be to redesign the project or help the student develop a new one that is at a more appropriate level. However, if the problem is the result of the student's poor technique or a lack of attention to detail, it is important to discuss this with the student as soon as possible. By providing feedback and suggestions for improvement early on, you may avoid having the situation escalate to a more serious level.

Students who perform sloppy work or are careless with experiments ought to be given a second chance. Perhaps they need retraining, perhaps they have felt rushed in the lab because of pressing academic issues (exam time), or maybe they just don't get it. If there is no improvement and the problem persists, you are not obligated to allow the student to continue in your lab. Before discussing termination with the student, you may choose to alert the student's Resident Dean (see contact information in Appendix C) and Concentration Advisor because they may know of extenuating circumstances that could be temporary and might affect your decision. If you do decide to terminate the student, giving the RD and Concentration Advisor a heads-up will help them provide support for the student going forward.

Sometimes problems arise because of communication difficulties between the student and the lab mentor. Often meeting with the two of them can resolve the problem, but sometimes cultural, linguistic or personal barriers are just too high. In this case, assigning the student to a new mentor within the lab group may solve the problem. If, however, you have the sense that the student may bear some or most of the responsibility for the lack of communication; for instance by demonstrating a lack of respect for the mentor's time by showing up unannounced and expecting help or by refusing to abide by the lab rules despite repeated warnings, you may feel that it would be better for the student to start over in another lab.

What happens when a student has been working on a project with a mentor who is leaving to take a new position at another institution? By thinking about this early on, you may be able to avoid this situation - for example, when matching students and mentors, you might want to consider not only their research interests but also the timing of their stay in the lab. If the unavoidable happens, however, you may be able to plan for a smooth transition. For example, the solution can be quite simple if there is someone else in the lab with the expertise to continue mentoring the student on the project or if the student is just getting started and is not heavily invested in the project. The real problems arise when the student's work is quite far along and no one else in the lab is qualified to oversee the continuation of that project, or if the mentor is taking the project when they leave. This situation rarely arises, but it can have serious ramifications for the student when it does. In a few cases students have had to abandon their thesis senior year because they were unable to continue the project unaided. In this situation, you may want to encourage the student to contact their Concentration Advisor for advice.

What should the lab expect from the student researcher?

It is important from the beginning for students to recognize that their training will require a significant time commitment from their lab mentor and that they should demonstrate respect for this commitment by arranging to be in the lab according to a schedule agreed on in advance with the mentor. Especially when just starting out in the lab, students should avoid planning to work in the lab on nights and weekends when no one else is there to supervise them. In cases where students cannot avoid being in lab at night or on weekends, it is their responsibility to ensure that another lab member will be working in the lab at the same time. Until they are fully trained and able to work independently, students should not work in the laboratory unsupervised.

As mentioned above, students and their mentors are expected to meet with you regularly. The students should approach these meetings in a professional manner and be prepared to discuss matters pertaining to their lab work, including progress on their research, their schedule in the lab, and upcoming deadlines for proposals or written assignments.

Students are often required to write about their work for fellowship applications, final papers for research courses, and, of course, their senior theses. The interactions between students and mentors while preparing a written text can be among the most in-depth and rewarding of their research experience. However, frequently students do not engage with their faculty advisors or lab mentors early enough in the writing process to reap the benefits of this interaction. It may be helpful to encourage your student to submit drafts well in advance of the due date so that there is adequate time for you to provide feedback.

It is reasonable to expect the undergraduates who come into your lab to be "good lab citizens" and follow the tenets laid out in your first meeting. If a situation arises in which it becomes apparent that a student has treated others in the lab with disrespect, failed to clean up at the end of an experiment, used up the last of a lab stock reagent without replenishing it or ordering more, etc., you may want to have a follow-up conversation with the student to reemphasize good lab practices and lab citizenship. It is often much better to address these issues as a positive teaching moment when they first arise rather than allowing the situation to continue and perhaps deteriorate to a point where the lab is adversely impacted and a more difficult conversation becomes necessary.

Above all, it is important for the students who come to your lab to approach their projects with genuine interest and intellectual curiosity. Regardless of the limited time that freshmen and sophomores are able to devote to their lab work, all students should convey true intellectual engagement with their projects and the lab's research goals rather than give the impression that they are there just to fill a degree requirement or as a pre-requisite for a post-graduate program.

Students may sometimes elect to change labs. Often this decision is based on a change in the student's scientific interests; for example they have finally decided on a concentration that is unrelated to their work in the lab. However, there also may be other reasons for leaving a lab. The student may be frustrated with the pace of progress on their project or have personal reasons for leaving. Sometimes they have realized that they are just not interested in doing research. These decisions are not made impulsively; students often think about it and seek advice from their concentration advisors, house tutors or other members of the community for several weeks before taking action. Students tend to be loyal to their labs and many have a difficult time making the decision to leave. Some students find facing the conversation with their lab mentor and PI about leaving the lab extremely difficult. You can help by being patient and understanding even if you are caught completely by surprise and are disappointed in the student's decision. You may find the conversation helpful for mentoring other students in the future.

Research for Academic Credit

During junior year, students who are concentrating in the life sciences may elect to do independent research in the laboratory for credit. The course numbers and requirements differ among the departments and a more complete description of the research courses for each department can be found in Appendix B. A second year of independent research for credit may be done as a senior thesis. Although a senior thesis is not required for an honors degree in most departments, many students choose to write one.

It is important to note that students *may not* be paid for their lab work during the same semester in which they receive course credit for research. Rising seniors who are working on their thesis research over the summer may be paid for their work since there is no academic credit associated with summer research done in labs at Harvard.

APPENDICES

A. Undergraduate Research Fellowships



[Click here](#) to
view additional
funding sources.

Term Time Funding:

Faculty Aide Program (FAP): FAP will match the contributions of the faculty member up to \$1500 for the full year to provide a total of up to \$3000/year for students to work during the term and over the summer. Faculty must apply to the Student Employment Office for approval for each student they wish to sponsor through FAP. Applications for FAP are accepted on a rolling basis at the beginning of each semester and in April for the summer. While there is no specified pay rate for FAP, most comparable fellowships offer compensation in the range of \$9.00 – \$12.00/hour.

Federal Work Study Program (FWSP): FWSP is administered through the Student Employment Office. The program supports students who qualify for federal financial aid to work in approved Work Study Jobs. The standard federal contribution for on-campus jobs is 70% with the faculty employer providing the remaining 30%. The pay rate range is from \$9.25 to \$12.00 per hour. Students should check with their financial aid officer to find out if they qualify for this program.

Harvard College Research Program (HCRP): HCRP will offer limited support to students for work during the semester. Students must submit an application for HCRP funding that includes a research proposal, resume, transcript and a letter of support from their faculty mentor. The HCRP stipend is usually \$500 to \$1000/term. Because HCRP does not have enough funds to support every student who applies, faculty are strongly urged to match funding from HCRP to support their students. This will allow the SEO to fund many more students during the term. Faculty who are not able to match the HCRP grant should contact the SEO to discuss other possible arrangements for the lab contribution to the student's stipend.

Primary Sources of Summer Funding for Undergraduate Research:

PRISE: The focus of PRISE is to build a small, diverse research community within the larger sphere of undergraduate science at Harvard. PRISE fellows are expected to participate fully in the community and attend the evening programs. The PRISE 10 week program provides students with housing and two meals each weekday, a small stipend if they do not receive any other fellowships (although they are strongly encouraged to apply to other fellowship programs for stipends), great social activities, and faculty lectures in the evenings. Students who are accepted into the PRISE program may also accept fellowships from other programs to provide a stipend. The program is limited to about 125

students and is quite competitive. The application requires two essays from the applicant: one on their research proposal and one on their expectations for and contributions to living in a science community. The deadline for PRISE is mid-February.

PRISE fellows are expected to find their own research positions. When a faculty member accepts a PRISE applicant into their lab, they are asked to provide a brief statement of support affirming that the student will be working in the lab for the summer. In addition to providing this confirmation statement, you can assist the student applicant in two other ways: first, if you already know the student, a strong letter of recommendation (separate from the confirmation letter) is very important for the selection committee and second, you can review your student's research project proposal to ensure that it is clear, scientifically accurate and written in the student's own words.

However, students also may apply to PRISE before they have secured a lab position. Obviously, students who have not found a lab placement by the application deadline will not be able to write a specific project proposal; but they should submit an essay that broadly outlines their research interests. The selection committee allows some leeway in these instances as long as the essay has some scientific merit. However, the selection committee expects a more detailed research proposal from students who have already secured a position in a lab. You and the student's lab mentor can help by providing the appropriate background material, ensuring that the student understands the research question and experimental design and proofreading their draft proposal.

Harvard College Research Program (HCRP): This is the largest source of undergraduate research support and the majority of students who apply are awarded some funding. However, due to the increase in the number of students who seek funding to do research with Harvard faculty, faculty are strongly encouraged to match HCRP awards with lab funds so that the maximum number of students can be supported. The goal is to have the labs contribute \$1500 to \$2000 for a summer stipend that will be supplemented by HCRP to provide students with a total of \$3500 - \$4000 for the summer (for students who have free local housing, the figure would be in the range of \$1500 to \$2500 for the summer). Again, the most important thing that you can do to assist your student in the application process is to help them put together proposals that are scientifically accurate and well written. You will also be asked to submit a letter of support for the student. The deadline for HCRP summer awards is early April.

The Herchel Smith Fellowship: This fellowship is quite competitive and applicants are expected to provide a good understanding of the scientific background behind the proposal, a description of the experimental procedures, and an explanation of why the lab they will be working in is a good place to do

this project. The fellowships are quite generous for students working at Harvard. Herchel Smith will cover travel and living expenses for students doing research outside of Harvard including labs overseas. You may also be asked to write a recommendation letter for this fellowship. The deadline for Herchel Smith is mid February.

B. Departmental Requirements for Research for Credit

Experimental Research Courses (LS 100r, OEB 100, Chem 100)

A group of project-based experimental laboratory courses (Chemistry 100, Life Sciences 100r, and Organismic and Evolutionary Biology 100) are available to interested undergraduates. They are taught in a new lab space in the Northwest Building that is dedicated to undergraduate teaching and designed to accommodate research in a variety of fields. In these courses, students work on projects that are directly linked with ongoing faculty research in a highly collaborative and dynamic research environment. They provide an excellent introduction to research and research techniques, and many students who take them go on to work in a faculty lab and write a senior thesis.

Life Sciences 100r offers projects in the following research tracks: neurobiology, microbial sciences, cell biology, and synthetic biology. New projects, including some in other research fields, are offered every term. It is offered in both the spring and fall semesters and can be taken in any year. It is open to students from any concentration, and may be repeated with the permission of the instructor.

OEB 100 offers projects utilizing experimental evolution of microbial populations. The research will address questions that synthesize knowledge of genetics, biochemistry, systems biology, microbiology, evolution and ecology. It is offered in both the spring and fall semesters; Life Sciences 1a and 1b or permission of the instructor is required. It is open to students from any concentration.

Chem 100 engages students in independent, open-ended research problems in collaboration with a research group in the chemistry department. Prior completion of Chem 27 or 30 lab is required for enrollment in Chem 100.

Chemical and Physical Biology

Students in the CPB concentration are encouraged to begin working in a research lab as soon as they feel ready to balance research and coursework. Some students begin in the freshman year, others in the sophomore year, and most are working in a lab by the spring semester of the junior year. Those considering writing a senior thesis (which is required for honors eligibility) should be working in a lab by the spring of their junior year and ordinarily are required to spend the summer between their junior and senior years working in

their thesis lab.

All CPB concentrators are required to take at least one letter-graded research course to be eligible for the degree. Courses that fulfill this requirement include LS 100r, CPB 91r, and CPB 99:

LS 100r – See course description above

CPB 91r (Introduction to research) allows students to receive course credit for laboratory research carried out in a laboratory under faculty supervision. This is a one-semester course that ordinarily may be repeated once. It may not be taken as a fifth course. Students enrolled in CPB 91r are required to spend 15-18 hours per week in the laboratory and submit a 5-10 page final paper to the faculty sponsor at the end of the semester. For the final paper, students are required to write about their project in the context of the field as a whole, summarize their key findings, and outline “what to do next”. We encourage students to involve faculty sponsors in the preparation of the final paper so that they have a clear understanding of the faculty sponsor’s expectations: getting feedback from the faculty sponsor on drafts of the paper can help avoid a situation whereby the student submits an unsatisfactory paper. The letter grade for CPB 91r is determined by the faculty sponsor based on the final paper and the student’s performance in the lab. CPB 91r is ordinarily taken in one or both semesters of the junior year in preparation for CPB 99, though it may also be taken in the sophomore year or, for students not intending to write a thesis, in the senior year.

CPB 99 (Laboratory Research for Honors Thesis) is a full-year course required for students intending to write a senior thesis. In the summer prior to their senior year, students intending to enroll in CPB 99 are expected to work closely with their faculty sponsor and direct lab supervisor to prepare a 5-10 page thesis proposal for approval by the Board of Tutors in Biochemical Sciences. During the academic year, students typically spend the fall semester collecting data in the lab and writing the introduction to their thesis, a draft of which is due at the end of the fall semester. In the spring semester, students continue doing experiments, revise the draft of their introduction, make figures, and draft the remaining portions of the text. Feedback and mentoring from the faculty sponsor and direct supervisor is an essential part of the thesis writing process. The thesis is due shortly after spring break, and is evaluated by two reviewers, each of which recommends a letter grade to the Head Tutor. The faculty sponsor recommends one of the reviewers and the second is a member of the Board of Tutors in Biochemical Sciences. The final grade for CPB 99 is determined by the Head Tutors based on input from the reviewers and feedback from the faculty sponsor. The faculty sponsor is not required to suggest a final grade for CPB 99, however their written evaluation is helpful in assigning the final grade.

Human Developmental and Regenerative Biology

Students in the HDRB concentration are required to enroll in at least one semester of independent research. Those who seek honors eligibility in the concentration must write a thesis. Most students decide to work in a lab by the summer between sophomore and junior years. Students intending to write a thesis should be working in a lab no later than the spring semester of the junior year.

The following three courses fulfill upper-level concentration electives:

LS 100r - See course description above.

SCRB 160 (Stem Cell and Regenerative Biology - Experimental Embryology). This advanced laboratory course applies experimental approaches and surgical techniques to illustrate critical developmental events during mouse embryogenesis. Particular emphasis is placed on experiments covering the following topics: fertilization and pre-implantation embryology; reprogramming of adult somatic cells into embryonic stem cells; early organ development; and surgical manipulation of late stage mouse embryos in utero.

SCRB 165 (Directed Differentiation of Stem Cells). This practical laboratory course investigates the fundamental biology of human embryonic stem cells and their remarkable capacity to differentiate into all cells of the body. The course explores the underlying developmental pathways that guide embryonic stem cell development into differentiated cell types.

SCRB 91r (Introduction to Research). SCRB 91r is a required course for HDRB concentrators. It is a semester long research course in the lab of a SCRB faculty member or others with laboratory interests that fall within the broad field of human developmental and regenerative biology. Ordinarily, SCRB 91r cannot be taken as a fifth course. SCRB 91r may ordinarily be repeated once. SCRB 91r can fulfill both research and tutorial requirements for the HDRB concentration. Students are expected to spend roughly 15 hours per week in the laboratory. Students and faculty mentors are required to meet regularly to discuss the project and relevant primary literature in the field. Faculty and direct supervisors should provide feedback to students on their progress throughout the semester. Students are required to submit a 5-10 page paper at the end of the semester based on their project. The paper should include how their project fits into the context of the field as a whole, a summary of the data collected, and a description of the next logical steps for future study. The letter grade for SCRB 91r is determined by the PI and is based on the final paper and the student's performance in the lab. Ordinarily, SCRB 91r is taken during the junior year.

SCRB 99 (Laboratory Research for Honors Thesis). Honors candidates in HDRB are required to write a thesis. SCRB 99 is ordinarily taken both

semesters during the senior year. It may not ordinarily be taken as a fifth course. Students are required to submit a 5-10 page written proposal prior to enrolling in the fall. The proposal is generally due during the summer between junior and senior year and should be prepared with strong input from the faculty advisor and direct supervisor. The Course Head and Co-Head Tutors must approve the proposal prior to a student enrolling in SCRB 99. In the fall semester, students may still be running experiments and working on the introduction of their thesis. A draft of the introduction is due at the end of the semester. In the spring, students are finishing up experiments and completing the writing of the thesis. A final draft is due after spring break. A committee of faculty, two of whom will assign the grade, reviews the thesis. While the faculty sponsor does not assign a grade, their evaluation of the thesis will be considered in assigning the final grade.

Human Evolutionary Biology

Research in HEB may be carried out in the lab, in the field, or may be purely literature-based. Concentrators in HEB are required to receive 1 semester's worth of course credit for research, and this is normally fulfilled through the Junior Research Seminar or HEB 91r. About 20 percent of our students also pursue research through HEB 99r, taken while researching and writing the Senior Thesis.

The *Junior Research Seminar* is a small course taught by an HEB faculty member in which students learn techniques for and conduct original research. This may involve work, for example, in an endocrinology or anatomy lab, running psychology experiments, or writing an in-depth research paper. Research is closely supervised by the instructor, and may be carried out as part of a group project. Normally, students also read and discuss relevant research articles in small groups.

HEB 91r allows students to receive course credit for research carried out under the supervision of a faculty member. This research may be in the lab, in the field, or in some cases, it may involve analysis of preexisting data or literature-based research. Students find advisors for their 91r research classes in a number of ways: Many are inspired in class by a particular instructor and approach them about independent research; students may meet with one of the HEB concentration advisors to get recommendations about which faculty member(s) would be in a good match; or students may learn more about faculty research interests and opportunities via the web, by visiting professors' lab pages and reading recent publications that have come out of a particular lab.

The requirements for HEB 91r are flexible, but normally students meet weekly with their faculty supervisor, read and discuss scientific articles pertinent to their research project, and submit a research paper at the end of the course. We encourage students to get feedback from the supervisor on

preparation for and drafts of the paper. HEB 91r is a one-semester course that ordinarily may be repeated once. The letter grade for HEB 91r is determined by the faculty sponsor and based on the student's research progress over the semester, the quality of preparation for meetings, and on the final paper. Frequently, HEB 91r is taken in one or both semesters of the junior year in preparation for HEB 99 and researching/writing the senior thesis, although it may also be taken in the sophomore year or, for students not intending to write a thesis, in the senior year.

HEB 99r: Students writing a Senior Thesis must enroll in this course both semesters of the Senior Year. Students pursuing the HEB/MBB track, and students wishing to be considered for the Highest Honors recommendation must write a Thesis. Students may write a thesis regardless of their GPA; but in the case of students with very low GPA's, we may encourage them to get involved in less demanding research projects, such as an independent research project through a 91r course. Students engage in vastly different kinds of research for their theses--in the last few years, topics have ranged from the evolution of drug resistance to the malaria parasite in Ecuador, to Ultimate Frisbee players' testosterone responses to winning and losing, to sex differences in decision making, and the role of maternal folic acid in genomic imprinting of IGF2. Students may also write literature-based theses, but this option is less popular.

Students find topics and advisors for their thesis research much as they do for HEB 91r, described above. Students normally begin thinking seriously about their research in the Fall of their Junior year, and may even find an advisor at that point. Many students will carry out pilot studies or other preparation in the Spring of their Junior year as part of HEB 91r, then conduct the bulk of the research over the summer after the Junior year. Ideally, the data analysis and writing takes place in the Senior year.

Students enrolled in HEB 99 are required to attend several thesis-writer group meetings throughout the Senior Year. These meetings serve mainly to provide support and guidance to thesis writers. Thesis writers are responsible for scheduling and attending meetings with their advisors and for meeting deadlines (whether set by the student or the advisee), but some advisors may prefer to take a more proactive role. Thesis writers should be independent, self-motivated, highly disciplined and proactive. They will need to take the initiative to find a faculty advisor and a topic that intrigues them, and have the resilience to persist through setbacks. While advisors are not responsible for the students' compliance and progress, they should provide support and encouragement when possible.

Thesis advisors should work closely with students during the initial stages of planning the thesis research (Junior spring), and should check in with the student frequently as research is beginning. Advisors should provide frequent and detailed feedback to students about research and writing progress,

inform students about the desired content and format of the thesis (i.e., chapters or headings, citation format, what should be included in methods or introduction), help students plan a calendar indicating when various chapters, analyses, etc. should be completed, and be available to read and comment on work as it progresses. Advisors should meet with advisees at least every two weeks, and as the deadline approaches (the Friday before Spring break in the Senior year), meetings should become more frequent.

The Director of Undergraduate Studies (DUS) and Concentration Advisors communicate with thesis writers and advisors to ensure that the expectations outlined above are clear. When questions and concerns arise about student progress or advisor responsibilities, parties may wish to discuss these concerns with the DUS or Concentration Advisor. They will work with both parties to ensure that the advisor/advisee relationship runs as smoothly as possible and that students receive the support they need.

The thesis is graded and evaluated by a three-person committee, including the advisor and two other faculty members or research advisors. The committee is set by the Concentration Advisor. Thesis writers also participate in and grade an oral exam based on the written thesis. Thesis grading and the oral exam normally take place during reading period in the Spring of the student's senior year. [Click here](#) for more information on guidelines for the HEB senior thesis.

Molecular and Cellular Biology

Students in the MCB concentration are encouraged to begin working in a research lab as soon as they feel ready to balance research and coursework. Some students begin in the first year, others in the second year, and most are working in a lab by the spring semester of the third year. Those considering writing a senior thesis (which is ordinarily required for honors eligibility) should be working in a lab by the spring of their third year and ordinarily are required to spend the summer between their third and fourth year working in their thesis lab.

All students are required to take at least one letter-graded research course to be eligible for the degree. Courses that fulfill this requirement include LS 100r, MCB 91r, and MCB 99:

LS 100r - See course description above.

MCB 91r (Introduction to research) permits students to receive course credit for laboratory research carried out under the supervision and in the laboratory of a faculty member. It is a one-semester course that ordinarily may be repeated once, and it may not be taken as a fifth course. Students enrolled in MCB 91r are required to spend 15-18 hours per week in the laboratory and submit a 5-10 page final paper to the faculty sponsor at the

end of the semester. For the final paper, students are required to write about their project in the context of the field as a whole, summarize their key findings, and outline “what to do next”. We encourage students to involve faculty sponsors in the preparation of the final paper so that they have a clear understanding of the faculty sponsor’s expectations: getting feedback from the faculty sponsor on drafts of the paper can help avoid a situation in which the student submits an unsatisfactory paper. The letter grade for MCB 91r is determined by the faculty sponsor based on the final paper and the student’s performance in the lab. MCB 91r is ordinarily taken in one or both semesters of the third year in preparation for MCB 99, though it may also be taken in the second year or, for students not intending to write a thesis, in the fourth year.

MCB 99 (Laboratory Research for Honors Thesis) is a full-year course required for students intending to write a senior thesis. In the summer prior to their fourth year, students intending to enroll in MCB 99 are expected to work closely with their faculty sponsor and direct lab supervisor to prepare a 5-10 page thesis proposal for approval by the Board of Tutors in Biochemical Sciences. During the academic year, students typically spend the fall semester collecting data in the lab and writing the introduction to their thesis, a draft of which is due at the end of the fall semester. In the spring semester, students continue doing experiments, revise the draft of their introduction, make figures, and draft the remaining portions of the text. Feedback and mentoring from the faculty sponsor and direct supervisor is an essential part of the thesis writing process. The thesis is due shortly after spring break, and is evaluated by two reviewers, each of whom recommends a letter grade to the Head Tutor. The faculty sponsor recommends one reader and the other is a member of the Board of Tutors in Biochemical Sciences. The final grade for MCB 99 is determined by the Head Tutor based on input from the thesis reader and feedback from the faculty sponsor. The faculty sponsor is not required to suggest a final grade for MCB 99, however their written evaluation is helpful in assigning the final grade.

Neurobiology

Students in the Neurobiology concentration are encouraged to work in a research laboratory. Students are encouraged to settle on a lab during the fall of their junior year, although many students begin before junior year, and a few wait until senior year. Students who are considering writing a senior thesis should be working in a lab by the spring of their junior year, and ordinarily spend the summer between junior and senior years working in their thesis lab.

While a research course is not a degree requirement in Neurobiology, participation in these courses does affect a student’s honors eligibility. One semester of Neurobiology 98r (see below) confers eligibility for regular or high honors and completion of a Neurobiology thesis confers eligibility for highest

honors.

Neurobiology 98r (Laboratory Research) allows students to receive course credit for laboratory research carried out under the supervision and in the laboratory of a faculty member. It is a one-semester course that may be repeated once, and ordinarily it may not be taken as a fifth course. Students enrolled in Neurobiology 98r are required to spend 15 hours per week in the laboratory and submit a 5-10 page final paper to the faculty sponsor (PI) at the end of the semester. For the final paper, students are required to write about their project in the context of the field as a whole, including background, methods, results, and references sections. *However in place of their final 98r paper, students who intend to write a thesis in the following semester are required to submit a rough draft of either the Introduction or Results section of their thesis, along with a brief list of all experiments and analyses, stating which are complete.* We encourage students to involve their PIs in the preparation of the final paper so that they have a clear understanding of the PI's expectations. The letter grade for NB 98r is determined by the PI based on the student's performance in the lab and on the final paper. NB 98r is ordinarily taken in the spring of the junior year and/or during the senior year.

Neurobiology 99r (Honors Thesis Tutorial) is a one-semester course designed for students writing a senior thesis. In the spring of the junior year, students intending to write a thesis are expected to work with their PI and lab mentor/s to prepare a 2-3 page thesis proposal for approval by the Neurobiology concentration. Students should receive feedback on this proposal going into the summer before senior year, allowing them to focus on their specific senior thesis research. Ordinarily NB 99r is then taken during the student's final semester. A one-page thesis abstract is due upon registration for NB 99r. Feedback and mentoring from the lab is an essential part of the thesis writing process. The thesis itself is due around spring break, and is evaluated by a faculty thesis committee along with the Head Tutor. The grade for NB 99r (which appears on the student's transcript) is determined by the student's PI. The student also receives a Latin grade on the thesis itself, which is determined by faculty committee. This grade does not appear on the student's transcript.

Organismic and Evolutionary Biology

OEB students are not required to do research. However, to qualify for a recommendation of Highest Honors by the concentration, a senior thesis is required. Honors and High Honors recommendations can be made on the basis of within-concentration GPA alone (i.e. without a senior thesis), but a senior thesis can enhance a student's Honors standing: for example, a student with a GPA of 3.5 with no thesis will receive Honors; a student with the same GPA and a thesis deemed "praiseworthy" will receive High Honors. For full details,

consult the OEB page on the Life Sciences website. Regardless of Honors considerations, many OEB students choose to do research while at Harvard.

To pursue a thesis and/or to get academic credit for doing research (i.e. an OEB 99r), OEB students must have an OEB faculty adviser. Often, the choice of adviser is simple because the student is working in the faculty member's lab. If a student develops a project in the lab of a non-OEB professor (whether in FAS -- e.g. in an MCB lab -- or beyond FAS -- e.g. in an HMS lab or in a lab at another institution), they will still need an OEB faculty adviser. Similarly, OEB students who develop their own field-based projects, which may be entirely independent of direct institutional support, are required to have an OEB faculty adviser.

Field research is necessarily carried out over the summer. Students in the past have set up projects:

- At a faculty member's field site
- At an established research station (e.g. the Rocky Mountain Biological Lab) or field camp (e.g. Operation Wallacea)
- Independently

Various Harvard funds support summer fieldwork. See the research pages of the Life Sciences website.

Students become involved in research at varying stages in their Harvard careers. Some students switch labs. In general, a Senior Thesis involves *at least* the following:

- Junior year. Join lab, develop project. Students are typically volunteering in the lab over this period
- Junior-Senior summer. Generation of the bulk of thesis data, whether in the lab or the field
- Senior Fall. OEB 99r. Cleaning up summer's data; or, in the case of field work, analyzing summer's data
- Senior Spring. OEB 99r. Writing up thesis, which is due immediately before Spring Break.

Research Courses

OEB 91r (Supervised Reading). This course permits students to pursue a topic that is not adequately covered by OEB's course offerings. A student, or group of students, agrees with a faculty member on a reading list and course structure before the beginning of semester. In order to register for this course, students must submit a proposal (available on the Life Sciences Website under OEB forms), signed by the OEB faculty sponsor, with details of reading, syllabus, and assessment. Typically, the student and faculty

member would meet once a week to discuss the readings and/or the student's assignments. Methods of assessment are determined by the faculty member, but typically involve a term paper. Students may not simultaneously enroll in an OEB 91r and an OEB 99r with the same faculty adviser.

OEB 99r (Supervised Independent Research). This course may be repeated for credit. In order to register for this course, students must submit a proposal (available on the Life Sciences Website under OEB forms), signed by their OEB PI, describing the work they anticipate carrying out. The work must be *independent* -- i.e. the student will not qualify for an OEB 99r if they are in effect working merely as a research assistant. The expectation is ~15 hours of work/week. The course is letter graded by the student's OEB PI on the basis of a 10page paper submitted at the end of the semester. It is up to the student and the OEB PI to agree on an appropriate format for the paper. If a student is doing an OEB 99r in their final semester and is submitting a Senior Thesis, the paper requirement is waived. Students who are *not* planning on doing a Senior Thesis may take OEB 99r for credit.

LS 100r – See course description above.

Psychology

Students in any of the tracks of the Psychology concentration are encouraged to begin working in a research lab as soon as they feel ready to balance research and coursework. Some students begin in the freshman year, while most begin in the sophomore year. Students considering writing a senior thesis should be working in a lab no later than the fall of their junior year and often spend the summer between their junior and senior years working in their thesis lab. Many labs require a yearlong commitment to working in the lab due to the amount of training required. Students are encouraged to start by volunteering in the lab for a few hours a week, or even just asking permission to sit in on a few discussion groups or lab meetings to see if the lab is a good fit before making a longer commitment and working in a lab for course credit (see below).

All Psychology students in the life science Social and Cognitive Neuroscience track or MBB Cognitive Science track as well as all thesis writers in the General track are required to take one letter-graded research course to be eligible for the degree. Students in the general track who are not writing a thesis are not required to take a research course, but may count research courses toward their degree as psychology concentration electives. Across all tracks, students in the class of 2011 and later are allowed to count up to two research courses toward their psychology concentration requirements. Research courses in Psychology include:

Laboratory Methods Courses

A list of laboratory methods courses is available on the undergraduate page of the Psychology Department website (<http://www.wjh.harvard.edu/psych/ug/>).

Most faculty members list a “lab course” in the catalog. Although these courses have their own course numbers, these are not the same as taking a regular, classroom-based course with lectures, exams and papers. Instead the bulk of the work is actually working on research in the lab with a graduate student or other researcher, typically 10-12 hours per week. This component may involve analyzing data, helping to design projects, running participants and collecting data, or any of a number of things to help the lab run and the project move forward. Often labs will require student attendance at regular lab meetings, and many labs will assign readings to compliment the work going on in the lab or to understand the project’s larger context. All lab courses will require some large academic assignment, typically a research paper or presentation. These courses cannot be shopped, and there is often limited space in each lab. Students interested in one of the lab courses should be in contact with the instructor in advance to express their interest and see if they are a good fit for the lab. The letter grade for lab courses is determined by the faculty supervisor based on the assignments in the course and the student’s performance in the lab. These courses are one-semester courses that count against the lab limit of two research courses for the concentration, but can be taken for College credit multiple times.

PSY 910r (Supervised Research) requires an [application](#), and allows students to receive course credit for laboratory research in a lab where 1) the faculty member does not offer a lab methods course, 2) the research is outside of the normal scope of that faculty member’s lab methods course, or 3) the student has arranged to conduct research with a member of the [Board of Honors Tutors](#). Students should contact possible PSY 910r supervisors directly, but can direct questions about the scope of the course to the Psychology Undergraduate Office, WJH 218. Students enrolled in PSY 910r are required to spend 10-12 hours per week in the laboratory and submit a 10-page final research paper (with research references) to Psychology Undergraduate Office and the faculty supervisor at the end of the semester. The letter grade for PSY 910r is determined by the faculty supervisor based on the final paper and the student’s performance in the lab. PSY 910r is a one-semester course that counts against the lab limit of two research courses for the concentration, and can be taken for College credit up to three times.

PSY 985 (Junior Tutorial: Honors Thesis Preparation) is a course taken in the junior year, typically in spring that is designed for exploring potential thesis topics and learning how to navigate the thesis process. This is a for-credit course because it involved independent study under the supervision of a department faculty member for the specific purpose of selecting a thesis topic and producing a thesis prospectus. The course also includes required group meetings with PSY 985 students that cover the thesis process. PSY 985 requires a completed prospectus or (if you decide not to write a thesis) research paper. PSY 985 does not meet the lab methods course requirement, but it does count against the limit of two research courses permitted to count for psychology concentration requirements. PSY 985 is graded Satisfactory/

Unsatisfactory.

PSY 990/992/993 (Senior Tutorial: Honors Thesis) is a full-year course required for students intending to write a senior thesis. In the spring of junior year (usually while enrolled in PSY 985) or summer prior to their senior year, students intending to enroll in PSY 990/992/993 are expected to work closely with their faculty supervisor to prepare a thesis prospectus to present to their thesis committee for approval at the prospectus meeting. During the academic year, students typically spend the fall semester finishing data collection, writing the introduction and methods section of their thesis, and beginning data analysis. In the spring semester, students continue doing data analysis, revise the draft of their introduction and methods, make figures, and draft the remaining portions of the text. Feedback and mentoring from the faculty sponsor and direct supervisor is an essential part of the thesis writing process. The thesis is due the Thursday before spring break. Students also present their research orally to their committee at the thesis poster session in mid-April. The course is graded Satisfactory/Unsatisfactory, based on professional conduct in the laboratory and meeting all thesis-related requirements by their deadlines. The thesis grade is independent of the course grade; the thesis committee assigns a final grade to the thesis following the poster session, weighted 80% for the written thesis and 20% for the defense. PSY 990/992/993 does not meet the lab methods course, nor does count against the limit of two research courses permitted to count for psychology concentration requirements.

C. Resources for faculty

- a. Life Sciences Education Office: <http://lifescience.fas.harvard.edu>
- b. [Mentoring program – workshops](#): The Life Sciences Education Office will offer lunchtime mentoring workshops throughout the year. Topics include: setting expectations for students in the lab, elements of a good undergraduate research project, fellowship advising, writing letters of recommendation, and how to handle problems in the lab. The format is case studies and discussion. For more information contact Ann Georgi (ageorgi@fas.harvard.edu) or Tamara Brenner (tamara_brenner@harvard.edu)
- c. Life Sciences Concentration Advisors:
<http://lifescience.fas.harvard.edu>
- d. Student Employment Office (information on FAP, FWSP and HCRP):
<http://seo.harvard.edu>
- e. Office of Career Services (Fellowship information):
<http://www.ocs.fas.harvard.edu>
- f. House Resident Deans: (for advice about a student's academic situation):
 - Adams – ad-abrd@fas.harvard.edu 5-2260
 - Cabot – ca-abrd@fas.harvard.edu 5-8744
 - Currier – cu-abrd@fas.harvard.edu 5-8101
 - Dudley – dd-abrd@fas.harvard.edu 5-2256
 - Dunster – dn-abrd@fas.harvard.edu 5-2263
 - Eliot – el-abrd@fas.harvard.edu 5-2275
 - Kirkland – ki-abrd@fas.harvard.edu 5-2276
 - Leverett – le-abrd@fas.harvard.edu 5-2279
 - Lowell – lo-abrd@fas.harvard.edu 5-2283
 - Mather – ma-abrd@fas.harvard.edu 5-4829
 - Pforzheimer – pf-abrd@fas.harvard.edu 5-8176
 - Quincy – qu-abrd@fas.harvard.edu 5-2286
 - Winthrop – wi-abrd@fas.harvard.edu 5-2296
 - Freshmen – elm-rd@fas.harvard.edu 5-1577
 - Freshmen – crim-rd@fas.harvard.edu 5-1577
 - Freshmen – ivy-rd@fas.harvard.edu 5-1577

D. Information for Faculty Hosting Student Researchers in the Field

In the past, students have done field research at

1. Their PI's field site.
2. The Harvard Forest.
3. A field station with appropriate infrastructure
4. An independent site (i.e. one they themselves have established)

Inevitably, key parameters here are a student's independence, the ease of doing research at the site, and the ability of the student to communicate regularly with their PI.

* Many Harvard students are naturally confident that they can handle a tough novel situation, but inexperience can nevertheless be a real problem. Bear in mind that many students are inexperienced in areas that most field biologists take for granted, such as the rigors of a prolonged season without access to running water.

* It is difficult for an inexperienced student to appreciate the difficulty of doing science in the field. Often issues are purely logistical, such as site access given poor roads etc. However, others relate to the science itself. A student studying a species on which is difficult to collect data may quickly become demoralized. After all, it all looks so straightforward on David Attenborough shows. Projects should be designed with this in mind. It is a good idea to pick a topic for which a lack of data nevertheless constitutes useful information (e.g. a biological inventory of degraded habitat).

Students may find that direct communication with their PI is impractical. In many cases, however, it is possible to recruit an in situ colleague to act as their de facto advisor.

References and Additional Readings on Mentoring Undergraduate Researchers

References:

1. Light, Richard J., 2001, **Making the Most of College: Students Speak Their Minds**, Harvard University Press, pp. 70-71
2. Yanamadala, Vijay, 2006, **Undergraduate Science Experience at Harvard College: Findings from 40 In-Depth Interviews with Students of Varied Interests and Abilities in the Sciences**. Independent research paper supervised by Richard Light, Walter H. Gale Professor of Education, Harvard University, pp. 10-11
3. Lopatto D. 2004, **Survey of Undergraduate Research Experiences (SURE): first findings**, *Cell Biol Educ.* 3(4): 270-7.
4. Handelsman, J., D. Ebert-May, R. Beichner, P. Bruns, A. Chang, R. DeHaan, J. Gentile, S. Lauffer, J. Stewart, S. Tilghman, and W.B. Wood, 2007, **Scientific Teaching**, *Science*, 304: 521-522.
5. Handelsman, Jo, 2003, **Teaching Scientists to Teach**, Howard Hughes Medical Institute Bulletin, June 2003.

Additional Reading:

1. Merkel, Carolyn A. and Shenda M. Baker, 2002, **How to Mentor Undergraduate Researchers**, Council on Undergraduate Research. <http://www.cur.org>
2. **Adviser, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering**, 1997, National Academy Press. <http://www.nap.edu>
3. Handelsman, J, C. Pfund, S. Miller Lauffer, C. Maidl Pribbenow, 2005, [Entering Mentoring: A Seminar to Train a New Generation of Scientists](#), The Wisconsin Program for Scientific Teaching.
4. Evans, Jennifer, **Mentoring Magic**, 2008, *The Scientist*, 22:12 p70.
5. [Project Kaleidoscope \(PKAL\)](#) is one of the leading advocates in the United States for what works in building and sustaining strong undergraduate programs in the fields of science, technology, engineering and mathematics (STEM).