Dear Members of the Harvard Community,

In March 2019, we convened a faculty committee to review the life sciences PhD training environment at Harvard. The committee's charge was to review how Harvard can provide the best training environment for our life sciences PhD students, while increasing our ability to attract the most talented and diverse students.

Professors Susan Dymecki and Andrew Murray co-chaired the review and led a committee of ten senior faculty, all of them participants in Harvard Integrated Life Sciences (HILS). Over six months, committee members met frequently and held over 30 conversations with faculty, graduate students, and deans from across the 14 HILS graduate programs.

The committee report outlines five key findings with corresponding recommendations to ensure that our life sciences PhD programs have as much impact as possible, work well together, and attract a diverse pool of the most promising students. The committee concluded its review in February 2020 as the reality of the COVID-19 pandemic was coming into focus. The current context withstanding, some recommendations will be implemented in the near term, while others will be addressed in an extended timeframe.

Based on the recommendations of the faculty committee, work is already underway to restructure and amplify the HILS federation. The committee report recommends a reorganization that incorporates the best of HILS, the HMS Program in Graduate Education, and the Division of Medical Sciences. The restructuring is intended to increase interactions between programs and Schools, encourage the inter-program mobility of graduate students, and implement a common set of principles that will guide HILS activities. Since its establishment in 2004, HILS has been a great success, and it is our hope that this further step in its evolution will maintain and reinforce the strength of life sciences at the University.

Recognizing the complexities of the life sciences landscape at Harvard, we believe that this newly structured HILS will better prepare us to address the recommendations focused on diversity, inclusion, and belonging efforts and increase emphasis on mentorship and training of graduate students. We are confident that meaningful change can and will occur in these areas, and we look forward to working with the deans to implement the committee's recommendations.

Finally, we are grateful to the members of the Review Committee and the many people who advised them during the review.

Sincerely,

Alan M. Garber
Provost, Harvard University

Emma Dench
Dean of the Graduate School of Arts and Sciences, Harvard University

REPORT AND RECOMMENDATIONS OF THE LIFE SCIENCES PH.D. REVIEW COMMITTEE

HARVARD UNIVERSITY

June 2020

TABLE OF CONTENTS

Introduction: Charge, Rationale, Composition, Process, Content

The Life Sciences Ph.D. Review Committee was convened by Provost Alan Garber and Dean Emma Dench, with the support of the Deans of HMS, FAS, and the Science Division within FAS, in May of 2019.

Charge: The committee was charged with investigating the competitiveness of our Ph.D. programs, their organization, structure, and funding, and how to ensure programmatic focus on the training, well being, and future careers of our students. The formal charge is included as Appendix A.

Rationale: The rationale for a focused review of life sciences Ph.D. programs was the result of a previous external review in 2015 of the life sciences across the University, including HMS, FAS, and HSPH. Graduate education in the life sciences was a major topic of interest to the 2015 University-wide Life Sciences Review Committee. It recommended that Harvard take a closer look at the structures established for the recruitment, admission, and training of graduate students in the life sciences Ph.D. programs, recognizing their important contributions to research, education, and faculty recruitment and retention in the life sciences at Harvard.

In response to this recommendation, two reviews ensued in 2017: the Provost's Office and GSAS worked to conduct a high-level review of the Harvard Integrated Life Sciences Program, and HMS conducted a review of its Program in Graduate Education. Both reviews pointed to the need for Harvard to re-examine what factors will ensure that the University will remain attractive to the best, most talented and diverse group of graduate students in the life sciences, and allow Harvard to be competitive with its peer institutions in recruiting and training them.

Composition: The committee consisted of faculty who serve or who have served as a director of one of the Harvard Life Sciences Ph.D. Programs:

Susan Dymecki (Chair)
Professor of Genetics
Director, Ph.D. Program in Biological and Biomedical Sciences
Harvard Medical School

Andrew Murray (Chair)
Herchel Smith Professor of Molecular Genetics
Professor of Molecular and Cellular Biology
Co-Director, Systems, Synthetic and Quantitative Biology Ph.D. Program
Harvard University Faculty of Arts and Sciences

Tom Bernhardt
Professor of Microbiology
Associate Director, Ph.D. Program in Biological and Biomedical Sciences
Harvard Medical School

Victoria D'Souza
Professor of Molecular and Cellular Biology
Co-Director of the Molecules, Cells, and Organisms Ph.D. Program
Harvard University Faculty of Arts and Sciences

Michael Desai

Professor of Organismic and Evolutionary Biology
Professor of Physics
Co-Director of Organismic and Evolutionary Biology Graduate Studies
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Sean Eddy
Ellmore C. Patterson Professor of Molecular and Cellular Biology
Professor of Applied Mathematics
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Wendy Garrett
Professor of Immunology and Infectious Diseases
Associate Director of the Ph.D. Program in Immunology
Harvard T. H. Chan School of Public Health
Associate Professor of Medicine
Harvard Medical School

Dan Kahne
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Co-Director Chemical Biology Ph.D. Program
Harvard University Faculty of Arts and Sciences
Professor of Biological Chemistry and Molecular Pharmacology
Harvard Medical School

Randy King
Harry C. McKenzie Professor of Cell Biology
Harvard Medical School

Brendan Manning
Professor of Molecular Metabolism
Director of the Ph.D. Program in Biological Sciences in Public Health
Harvard T.H. Chan School of Public Health

Peter Park
Professor of Biomedical Informatics
Director of the Bioinformatics and Integrative Genomics Ph.D. Program
Harvard Medical School

Rachel Wilson
Martin Family Professor of Basic Research in the Field of Neurobiology
Harvard Medical School

We were supported by Emily Vetter and Camille Gladieux from the Provost's Office.

Process: Following the initial meeting with the provost and GSAS dean in May 2019, the Life Sciences Ph.D. Review Committee held bi-weekly meetings from August 2019 to January 2020. The committee included membership from the Faculty of Arts and Sciences (FAS), the Paulson School of Engineering and Applied Sciences, the Harvard Medical School (HMS), and the Harvard T.H. Chan School of Public Health (HSPH). Over six months, we met with key stakeholders in Harvard life sciences graduate education, including: Harvard's Provost, Deans of GSAS, FAS and HMS, the HMS Dean for Graduate Education, the FAS Dean for Science, the leaders of Harvard Integrated Life Sciences (HILS), DMS, and the HMS Program in Graduate Education, Dean for Diversity and Academic Programs, financial officers from HMS, FAS, and GSAS, graduate program directors, junior faculty, and graduate students from the 14 HILS graduate programs including student HGSU-UAW representatives.

Throughout its work, the committee was guided by two key principles. First, that graduate students are essential to the University and, in many ways, represent the core of our research mission by contributing vitality necessary for success in innovation and discovery. Second, that the opportunity for life sciences graduate students to study across programs at Harvard is essential and should not only be sustained but strengthened.

In our findings and recommendations below, we address competitiveness and admissions yields, organization and governance for the life sciences, and student-centric training and support. The recommendations that follow are designed to strengthen the connections between programs and bolster mechanisms for sharing of best practices. Many are inspired by exemplary practices already in place somewhere at Harvard.

This report was prepared when there appeared to be a reasonable possibility that Covid19 could be contained as a pandemic in a small number of countries and thus that the global financial climate might be assumed to be reasonably stable. Now, we are in the midst of a global pandemic and economic recession, placing severe financial burdens on institutions, like Harvard, which depend heavily on endowment income to support graduate students. We acknowledge that this will make it hard to implement the report's recommendations on the initially hoped-for timescale.

Report content and organization: The report begins with a description of the 14 life science Ph.D. programs at Harvard including their organization, continues with a comparison among our programs and those at our peer universities, and concludes with findings and recommendations for our graduate programs in five areas: 1) structure and administration; 2) diversity, inclusion, and belonging; 3) funding and financial structure; 4) education, mentorship, and training; and 5) celebrating and empowering our graduate students. For each area, we offer a vision, describe problems that prevent achieving the vision, and propose solutions.

Harvard Life Science Ph.D. Programs

Life science graduate education at Harvard is comprised of 14 Ph.D. programs of study across four Harvard faculties—Harvard Faculty of Arts and Sciences, Harvard T. H. Chan School of Public Health, Harvard Medical School, and Harvard School of Dental Medicine. These 14 programs make up the Harvard Integrated Life Sciences (HILS). Although the individual programs may be administered and funded by one school, the students in each of the HILS programs work in laboratories across the four schools and the Harvard hospitals. The Graduate School of Arts and Sciences, within the Faculty of Arts and Sciences, oversees the admissions and grants degrees for all Harvard Ph.D. programs.

Harvard Life Science Ph.D. Programs include:

Administered and funded by the Harvard T.H. Chan School of Public Health
Biological Sciences in Public Health (BPH)

Administered and funded by the Faculty of Arts and Sciences
Chemistry and Chemical Biology (CCB)
Molecules, Cells, and Organisms (MCO)
Organismic and Evolutionary Biology (OEB)

Administered by the Faculty of Arts and Sciences; funded by the Faculty of Arts and Sciences and the Harvard Medical School (referred to as the cross-river programs).
Biophysics
Chemical Biology
Systems, Synthetic, and Quantitative Biology (SSQBio)

Administered and funded by the Harvard Medical School
Bioinformatics and Integrative Genomics (BIG)
Biological and Biomedical Sciences (BBS)
Immunology
Neuroscience (PiN)
Speech and Hearing Bioscience and Technology (SHBT)
Virology

Administered and funded by the Harvard School of Dental Medicine
Biological Sciences in Dental Medicine (BSDM)

Comparison with Peer Ph.D. Programs

As part of the charge to our committee, we were asked to compare Harvard's life science Ph.D. programs as a whole to our competitors, including MIT, Stanford, UCSF, etc. We relied on several key sources of data for this information: data published by the Coalition for Next Generation Life Science, surveys of Harvard graduate students in the HILS Ph.D. programs conducted by Jason Heustis, HMS Director of Student Development and Training Evaluation, and information provided to our committee by the HILS program director, Grace Gill. The main points of comparison with other university life science graduate programs were admissions rate (selectivity) and yields, median time to degree, and financial support. In addition, the co-chairs of our committee conducted interviews with multiple groups of graduate students from HILS programs to hear their thoughts on how the graduate student experience could be improved at Harvard.

Findings: As was concluded in the 2018 HILS Review, Harvard's life science programs are competitive against peers in many dimensions. While there is variation from program to program, and over time within individual programs, our overall yields and admission rates are well within the range of our peer schools. Similarly, across HILS, the median time to degree is slightly less than our peers.

Previous examination by HILS, and further investigation by this committee, shows that stipends at Harvard are comparable to other schools. In some cases, a straightforward dollar comparison of stipends is misleading as some of our peers offer a higher stipend but then charge fees that are covered in Harvard's financial package for students.

In surveys of current and prospective students, most students report choosing a Ph.D. program for reasons related to their academic goals. Differences in financial aid packages were rarely the major reason.

Findings & Recommendations

Findings & Recommendations 1: Administration of Life Science Ph.D. Programs

The diversity and growth of the life sciences and the blurring of disciplinary boundaries within biology and between biology and other natural sciences creates new challenges for major research universities, especially those with affiliated medical schools: a single biology graduate program would be extremely broad and unmanageably large, whereas, individual more narrowly focused graduate programs can create barriers to interdisciplinary research, stifling students whose scientific goals are interdisciplinary.

Vision
This structural dilemma can be solved by creating a unified, efficient, and nimble governing structure that spans the life science Ph.D. programs, benefitting from economies of scale and shared intellect yet supporting field-related differences between programs. The organization should ensure equity across graduate programs while allowing the strengths of individual programs to shine and attract the strongest and most diverse student body. The structure should increase interactions across programs and schools, acknowledging that innovation often lies at interfaces between disciplines, maximize the inter-program mobility of students, and adopt a common set of principles that will guide flexible and effective administration. We envision extending this organization to the other natural sciences at Harvard, facilitating the sharing of best practices, the education and training of our students, and promoting interdisciplinary science. This structure and the interactions that it fosters will strengthen graduate education in the life sciences at Harvard.

Problems
We are not the first review committee to argue for an integrated administration of the life science Ph.D. programs across schools (FAS, HMS, HSPH, and HSDM), which each fund graduate programs. In 2004, a faculty committee charged with unifying the graduate programs in the life sciences made a similar argument in its report on the future of science and engineering at Harvard. Their recommendation led to the creation of HILS, the Harvard Integrated Life Sciences Program, which shares best practices among graduate programs and increases student mobility between graduate programs. Given its modest budget, limited staff, and lack of administrative authority, HILS has been a remarkable success. Our students perceive Harvard as having an integrated and accessible life science community. Many students are mentored by faculty who are not affiliated with the program that admitted them, and program directors meet to share best practices and discuss ways to better support our students. Yet achieving full coordination among programs remains a recurring challenge, as does competition between programs for our students.

At HMS, the Program in Graduate Education (PGE) was founded to augment HILS, help address these issues in the Longwood-based and cross-river programs, and improve the education and training of graduate students. PGE has used the HMS Curriculum Fellows Program (CFP) – a program comprised of postdoctoral fellows training in science pedagogy and augmenting curricular efforts and innovations by HMS faculty. The Division of Medical Sciences (DMS) at HMS, yet a third governing body (HILS, PGE, and DMS), administers six of the seven Longwood-based life science Ph.D. programs.

There are two other Longwood-based life science programs: the Biological Sciences in Public Health Program at the Harvard T.H. Chan School of Public Health and the Ph.D. Program in Biological Sciences in Dental Medicine at the Harvard School of Dental Medicine (HSDM).

The relationships among HILS, PGE, and DMS are complex, organizationally and politically. Of these three groups, only DMS – working with the HMS administration– has been authorized to set the size of individual graduate programs and appoint their directors. None have been authorized to discipline faculty, to mandate training for faculty who seek to mentor students, nor to promote interactions with the physical sciences and mathematics. Thus problems persist around coordination, internal competition to recruit students, meaningful interactions between programs and disciplines, accountability, accessibility, and public and internal perceptions.

Solutions

We propose a reorganization that amalgamates the best of HILS, PGE, and DMS to create a new structure keeping the HILS acronym but reinvented and empowered through the following steps:

1. The new HILS should be jointly governed by two individuals, the Dean for Graduate Education at HMS and a newly created FAS appointment of a Dean for Graduate Education in the Natural Sciences. Just as the HMS Dean for Graduate Education oversees all life science PhD and Master's degree programs at HMS, the FAS appointed Dean for Graduate Education in the Natural Sciences would be responsible for all graduate programs in the FAS Division of Science. These two deans (HILS Co-directors) should comprise a facile team that meets frequently to effectively "weave one fabric" that supports Ph.D. education in the natural sciences at Harvard across campuses. This would include meeting regularly and jointly with the GSAS, HMS, and FAS-Science Deans, who, in addition to advising would also adjudicate any differing views between the two Deans for Graduate Education. These two deans would also meet regularly and jointly with a steering committee composed of the GSAS Dean for Academic Programming and Diversity, the Administrative Director of HILS, the Associate Dean for Graduate Education at HMS, the Director of Student Development and Training Evaluation at HMS, the HSPH Dean for Education, and the directors of the fourteen life science graduate programs – ensuring program representation for HSPH, HSDM, HMS, and FAS. To help build stronger links with SEAS, we recommend that a member of the SEAS faculty serve on the HILS Steering Committee in a non-voting role.

2. The respective HILS Co-Director would administer efforts around support for training grant and individual fellowship applications and other student and programmatic responsibilities, with the HMS HILS Co-Director managing the Longwood-based programs, the FAS HILS Co-Director for the FAS-based programs, and a unified management for the cross-river programs. For scale and efficiency, student services, such as assistance with fellowship proposals, for the Ph.D. Program in Biological Sciences in Public Health, which lies outside of HMS and FAS, would be supported by HMS-HILS given the physical proximity and programmatic affinity. These services would be supported by an agreed upon per-student financial transaction from HSPH to the HILS-HMS budget. The Biological Sciences in Dental Medicine Program at HSDM, a dual DMD/PhD Program, should be integrated with the HMS MD/PhD Program given its small size and need for a broader community and comprehensive student support for dual degree training.

3. The individual life science graduate programs and their directors would report to the HILS Co-Directors. Individual, program-generated innovations would be encouraged by this structure, and, depending on their scale, would involve consultation with one or both HILS Co-Directors.

4. Overall targets for student recruitment would be set by the Deans for GSAS, HMS, HSPH, and FAS-science in coordination with the HILS Co-Directors. The HILS Co-Directors would apportion slots to the

individual Ph.D. programs under their respective purview; the Dean for HSPH would apportion BPH program slots.

5. The PGE would be incorporated as an integral part of the new HILS, as its members are a subset of the new HILS Steering Committee, and its mission is shared. Existing PGE activities would be overseen by the HILS Co-Directors and HILS Steering Committee. Curriculum Fellows would be appointed in FAS in addition to the program at HMS and be jointly managed through the existing HMS Curriculum Fellows Program (CFP) administrative structure. The FAS-based fellows would be funded by GSAS, FAS, and its departments. Meetings and events directed towards students and program directors will occur in both Cambridge and Longwood, but the overall administration of the CFP would remain based at HMS.

6. A significant portion of the HILS budget would come from central University resources and must include funding for student migrations and student emergencies (essential to recruitment, success, and well being of our students), tools and technology for students such as computers (essential to ensuring the success of all of our students, regardless of their means), and resources to support professional/career development, including support for science-related student internships in not-for-profit entities.

7. HILS must redesign its web presence to reflect this new organizational structure and to better support existing students and new applicants. The current website is difficult to navigate and poorly integrated with GSAS webpages, where students apply to Harvard Ph.D. programs. A single portal should allow one-click access to a concise introductory page for HILS and for each constituent graduate program, whose layout is unified and provides information on the program, faculty, resources and funding, course work, diversity and inclusion, and student life**.** HILS and its constituent graduate programs should each assess their own websites to create a more accessible, user-friendly, and up-to-date experience. The policy on fee waivers for applications should be clear, liberal, and avoid embarrassing those applicants in need. The policy on number of programs and times an applicant may apply to Harvard GSAS should be clearly described and set at up to two HILS life science program applications in any given year and a total of up to four applications to individual programs over up to three admission cycles. Please see further detail in Appendix B.

8. HILS should commission external reviews of each of its constituent graduate programs every five years and should be prepared to recommend the closure of programs for any of the following reasons: uncompetitive student recruitment, persistent problems in student satisfaction and retention, and financial difficulties.

9. HILS should use a three-year model for setting admissions targets, to avoid the need to continually adjust to the effects of statistical fluctuations in student yield in the preceding admission cycle. This would allow for multi-year planning, as opposed to risking under-yielding every year to meet annual budget constraints. This would also allow for phasing in of changes in slot allocation across programs as a response to a strategic plan. The practice of sharing application information between programs so that students are only admitted to a single program should stop. Our goal is to recruit the best students to Harvard and admissions targets should reflect the reality that some of our best applicants are admitted to multiple programs. The effect of multiple admissions on the yield of individual programs should be considered in evaluating their performance and in allocating slots.

10. The two Deans for Graduate Education should work to catalyze interactions and build stronger links with the physical, applied, and engineering sciences at Harvard and the statistics- and population science-based programs at HSPH, so as to support the interdisciplinary directions of contemporary bioscience and to facilitate sharing of best practices in graduate student training and mentorship.

Findings & Recommendations 2: Diversity, Inclusion, and Belonging

For much of its history, science has been overwhelmingly white and male. We recognize that every aspect of diversity benefits science and that the absence of role models, at every career stage, discourages a wide range of students from pursuing careers in science.

Vision
The University must take steps to recruit, mentor, and fully support a maximally diverse population of graduate students *and* the faculty who mentor and advise them. Faculty role models are essential to achieving this mission. By 2030, our students, and by 2040, our faculty should look much more like the US population than we do now.

Problems
We face two problems, one geographic and one of our own making. The geographic problem is the widespread belief that Boston and New England are unwelcoming as a city and a region. Our problem is Harvard's reputation, independent of that of our city, as unwelcoming and the scale of Harvard's investment of time, energy, and money to combat this perception. Our students and faculty are less diverse than several of our peer institutions. We sometimes fail to appear as a single unified community at key recruitment events. Our programs designed to welcome, include, and support a diverse student population are *ad hoc*, accomplished on a shoestring budget, and receive little publicity. Despite the tremendous efforts of highly engaged leaders and champions of diversity and inclusion at Harvard, such as Sheila Thomas, GSAS Dean for Academic Programming and Diversity, Karina Gonzalez Herrera, GSAS Assistant Director of Diversity and Minority Affairs, Joan Reede, HMS Dean for Diversity and Community Partnership, Jason Heustis, HMS Director of Student Development and Training Evaluation, and Rosalind Segal, HMS Dean for Graduate Education, we lag behind offerings of our peer competitors, like Stanford University, diminishing our ability to successfully recruit and support minority students.

Solutions
1. We should create a GSAS-wide program to support incoming students. The program would invite GSAS-admitted students who have the potential to contribute to the diversity of their specific academic fields. Identified by their home program, these pre-matriculation students would arrive two months early and receive enabling financial support, cultural and intellectual support, preparative training for the beginning of classes and research rotations, and peer and faculty mentors inside and outside their home program. The program should follow the students throughout their Ph.D. including regular advising and community-building gatherings, provide fellowship support for its initial extra summer months, and support for its students to attend scientific meetings and participate in other activities that support their careers. Ideally such a program would exist for all Harvard Ph.D. programs, with some activities designed for all students, and others specific to students in particular programs such as the HILS programs.

2. The University should make diversifying its faculty a top priority and every search should endeavor to achieve real progress toward this goal.

3. HILS and its constituent graduate programs should organize external and internal reviews to assess how the full diversity of their student bodies experience the University, HILS, their home program, and the lab or labs where they are performing their research.

4. HILS should organize, rebrand, and highlight the visibility of an office devoted to student support services, spanning diversity, inclusion, and belonging, to career and academic support services. It would link to a web presence that includes the new Harvard University Career & Professional Development Navigator (https://careernavigator.gradeducation.hms.harvard.edu/). It would equitably serve Longwood and Cambridge based programs.

Findings & Recommendations 3: Financial Support

Science is expensive. Student training involves costs around stipend, tuition, and health benefits, as well as reagents, equipment, publications, and conferences – the core activities fueling discovery. In the natural sciences, these costs are borne by two parties, the University and the faculty with whom students train. In the life sciences, the University supports student tuition, stipend, and health benefits at the beginning of graduate school and their advisor's grant funds are used in the later Ph.D. years, but when and how completely the switch is made differs between programs and institutions.

Vision
Providing more years of support from University funds would have three benefits: 1) increasing a student's intellectual independence by making their research less connected to the goals of their advisor's grants; 2) making Harvard more attractive to students; 3) making Harvard more attractive to faculty recruits, especially junior faculty whose labs are primarily populated by graduate students. All three goals are important to continuing Harvard's position as one of the world's great research universities. The demand for stellar graduate students and outstanding junior faculty far exceeds supply, making their recruitment highly competitive.

The COVID-19 pandemic and the resulting economic consequences will likely delay the timeline for this implementation, but the importance of life science research and education cannot be over emphasized both for the health of populations and for economic stability.

Problems
We identified our four strongest competitors as MIT, Stanford, UC Berkeley, and UCSF. Although our funding is competitive with the two public universities (UC Berkeley and UCSF), we are behind MIT and Stanford.

Of the fourteen HILS programs, ten have a common model: a combination of University funds, training grants, and external fellowships support students for the first two years of graduate school, and faculty grants or fellowships support them for the remainder. The two exceptions are the Ph.D. program in Chemistry, where faculty funds or fellowships must take over at the end of the first year of graduate school, and Organismic and Evolutionary Biology (OEB), where a combination of University funds, fellowships, restricted funds from endowments, and extensive teaching by students provide their support throughout graduate school.

For all our programs, our tuition fees are structured in a uniquely idiosyncratic way: tuition is $48K for the first and second year of graduate school, $12.5K for the third and fourth, and $3K for the remaining years. The full, high cost in years 1 and 2 cannot be recovered from fellowships and grants and lower costs in subsequent years is less than many fellowships and grants will reimburse.

As well as their different funding structures, our graduate programs vary in how much they require students to teach and whether or not students are paid, in addition to their stipends, when they teach. Here the variations are extreme, ranging from programs with no teaching requirement to OEB where the average student teaches for six semesters and receives no additional compensation for doing so. Because labs are increasingly populated by graduate students belonging to different graduate programs, these differences in teaching requirements and reimbursement cause friction.

Solutions

We propose that graduate programs in the natural sciences improve the extent to which they support their students. The recommendations that follow were originally crafted before the economic and social disruption caused by Covid19; while we have chosen to leave these recommendations intact here, we recognize that the economic and social costs to the University are likely to delay their implementation. Our proposal has four elements: raising philanthropic and other external funding to support graduate students, restructuring our model for graduate student funding, making teaching requirements and reimbursement more uniform, and implementation. We deal with these in turn.

Fundraising

1. After repairing the damage caused by Covid19, the University should make raising funds to support graduate education in the natural sciences its highest priority. Harvard and the relevant school deans should undertake a major fundraising campaign to raise a mixture of current-use and endowed funds so that we can support our graduate students for their first four years in graduate school. We suggest that such a campaign should appeal to potential donors with a wide range of capacities, spanning the opportunity to support individual graduate student fellowships, groups of thematically-linked fellowships (targeted to particular subject areas or students with specific backgrounds), and transformative gifts that can support students across many programs (as several of our peer institutions have successfully garnered).

2. We should study the strategies of our peer institutions who have successfully raised funds.

3. We should endeavor to better use our faculty and students in fundraising activities, capitalizing on their energy and enthusiasm for and deep knowledge of graduate education and its centrality to Harvard's research mission. Efforts by the various Development Offices across Harvard should be coordinated and strategic and include faculty and students ready to spend time and energy in fund-raising efforts.

Restructuring

We propose the following uniform plan for all the life science graduate programs:

1. Provide additional student tuition, stipend, and health insurance support for all life science graduate students. The eventual goal should be to support students for four years, thus matching the most generous of our peer institutions.

2. Apply a uniform tuition charge for all years of graduate school. This charge should reflect the average annual tuition over the first five years of graduate school under our current structure.

3. Match the size of graduate programs to the number of participating faculty. The details of the guiding formula need to be determined and applied transparently. We see three principles that should be combined to set program (student population) size: the number of active faculty in a program, the ability of programs to raise funding to support students, and performance of programs (as judged by the mentorship, productivity, and outcomes of their students). We believe that these factors should be combined as follows:

   a. There should be a minimum size, both in total number of students, and in the ratio of students:active faculty (with appropriate accounting for the fact that many faculty are members of many programs).
   b. To achieve this minimum size, programs must attempt to secure external funding in the form of training grants and individual fellowships.
   c. Programs that can raise additional funds, beyond this level, could be granted additional slots.
   d. Programs that consistently perform strongly can receive additional slots and those that persistently underperform can lose slots.

The net impact of these proposals is substantial.

1. Faculty would incur a net financial benefit. While they will pay more in tuition to support students in years G5 and G6, they would not pay for student stipend, health insurance, nor tuition in G3 and G4, resulting in a meaningful savings to faculty.

2. Natural science graduate students would be more expensive for the University. Offsetting some of this expense would be the income from increased tuition in G5 and G6, which would substantially defray the University's cost for students in G3, but additional income would be needed to support students in G4.

3. Programs that currently admit large classes but fund them for a shorter period than other programs, would likely admit fewer students under uniform policies for funding and setting the size of graduate programs. Successful, program-specific fundraising through private or federal means would be needed to maintain these programs at their current size.

4. This new model will provide an incentive to reduce time to degree, given the higher faculty costs in the G5 year and beyond.

5. The policies adapted to meet these recommendations should follow three principles: a) raising more independent financial support for our students, b) any policy enacted should not increase the overall cost to faculty beyond those they presently pay, and c) they should not create a situation where the overall costs of students to faculty declines, but faculty find it difficult to find appropriate funds from which to meet these costs (for example, an increase in costs that cannot be covered with grant dollars, thus requiring use of limited, unrestricted funds).

Teaching
Teaching is an essential part of a student's intellectual development, whether they pursue careers in academia or elsewhere. Teaching trains students in how to communicate ideas, assess the ability of others to understand them, and test their own understanding in the crucible of communicating complex concepts to a variety of individuals. It is in their approaches to teaching that the life science graduate programs diverge the most. We propose creating more uniform policies for teaching requirements and reimbursement:

1. Each individual program would require that their students undertake mentored teaching experiences, which could include acting as a teaching fellow, participating in outreach activities, and supervising undergraduate research projects. This should amount to one or two teaching experiences per student, as determined by the program.

2. Additional teaching, beyond program requirements, would require approval by program directors and should not exceed one semester in an academic year.

3. Half the income from additional teaching would be used to support a student's stipend and half would be paid directly to the student.

Implementation
There are three possible choices: 1) implementing the proposed changes for all graduate students at the same time; 2) implementing the proposed changes, in their entirety, for all students in an entering graduate class, with all more advanced students remaining under current policies, but doing so in advance of raising funds; 3) gradually implementing the changes, for example by paying for G3 but not G4 or giving increased support for only a fraction of the students, as funds permit. We reject the first option on

the grounds of cost and the reaction of changing the rules for previously admitted students, the second is financially difficult under the current circumstances, but provides maximal motivation for fund-raising, and the third is fiscally conservative but leaves us at a disadvantage with our competitors, which could last for many years.

Findings & Recommendations 4: Education, Mentorship, & Training

We recruit extraordinarily talented young scientists with large and noble ambitions: they hope to discover how life works, cure disease, invent and perfect technologies that will improve the human condition, and implement and devise policies that will solve pressing problems, from health-care disparities to climate change.

Vision
Our goal must be to train our students to become effective, rigorous, and independent scientists, develop their skills, inspire them to lead, and help them not only identify careers that fit their goals and talents but through effective mentorship help lay the foundation for an enhanced science identity, and career success, satisfaction, and commitment.

Problems
We identify several problems:

1. Graduate programs and individual mentors have traditionally expected that students will pursue academic careers and many advisors lack experience or contacts outside academia. As outlined in the National Academy of Sciences 2019 report on *The Science of Effective mentorship in STEMM*, "mentees now need a constellation of mentoring relationships with other individuals within and outside of their home department, program, or institution who can provide supplementary functions that enable mentees to progress and succeed."

2. The relationship between student and advisor is deep and both students and advisors can find it difficult to negotiate. Some faculty see students as agents to produce papers rather than individuals to be educated, mentored, and trained.

3. Access to mentorship training for faculty has been limited. Graduate program directors have lacked the forum and power to inspire faculty to see training and mentorship as a priority, making it hard to produce cultural change.

4. An additional, formidable impediment to cultural change is that skilled, inclusive mentorship goes largely unrewarded in Harvard's promotion, tenure, and performance appraisal practices.

5. Mentee training, which has been shown to be equally important to successful mentorship outcomes (National Academy of Sciences 2019 report on *The Science of Effective mentorship in STEMM),* is largely absent.

6. Some disciplines, specifically chemistry, have a national history of strongly hierarchical and demanding relationships between advisors and their students.

7. Performing a five-year Ph.D. requires very different demands from participating in part-time research as an undergraduate. As a result, every program accepts students who turn out to be ill-suited for Ph.D. research. Since leaving a program can seem like a failure, the default solution is for students to stay,

unhappily, in labs and then receive a Ph.D. that is often granted on very modest research accomplishments.

Solutions
Our individual recommendations have a common goal – to increase the emphasis on education, mentorship, and training for a wide range of careers.

As a starting framework, we recommend adopting the National Academy of Sciences (NAS) 2019 definition of mentorship, which recognizes the evolution of mentoring practices for STEMM researchers:

> *Mentorship is a professional, working alliance in which individuals work together over time to support the personal and professional growth, development, and success of the relational partners through the provision of career and psychosocial support.*

We emphasize the NAS 2019 findings that effective mentorship experiences lead to: enhanced science identity, persistence in academic decisions, higher rates of Ph.D. degree completion, better integration of women and underrepresented students into the STEMM academic community, increases in recruitment of underrepresented mentees into graduate school, and increases in productivity and likelihood of publishing their research.

Faculty mentorship optimization
1. Program directors should work towards culture change. Suggested steps include:
    a. Requiring mentor-student compacts (see Appendix C for an example) that outline expectations from, and commitments to mentees, and vice versa. Compacts should be reciprocal and aspirational, communicating a serious commitment and set of intentions for the mentoring relationship, and serve as a concrete reminder of those commitments.
    b. Instructing all faculty, in person, on expectations about mentorship.
    c. Establishing regular reviews and structured feedback systems to ensure the quality of mentorship experiences for both mentors and mentees.
    d. Intervening when mentorship is poor.

2. Improve access to high-quality mentorship training (e.g. CIMER). We propose that all faculty be required to take at least one, in-person, daylong mentorship training and annual refreshers that also further skill development (likely to be an NIH requirement soon).

3. Create a system of accountability where a mentorship problem is first discussed between program head, the faculty member in question, and the faculty member's department Chair. Persistent or repeated problems would be referred to a committee selected from the HILS Steering Committee. Faculty, program directors, or entire programs could be referred to this committee because of mentorship problems. The committee could require mentorship training, place mentors or programs on probation, and, in extreme cases, recommend that the University remove the privilege of mentoring students, replace program directors, or close programs.

4. Establish policies to incentivize and recognize faculty efforts in mentorship, education, and graduate program administration. Such recognition should be substantively meaningful to faculty, such as impacting promotion, tenure, and laboratory space.

Student mentee training
Provide mentee training to enable mentees to be more proactive in shaping mentorship relationships. Suggested areas include:
    a. Recommending CIMER mentee training as put forth the in the NAS 2019 report.

b. Helping students develop skills around managing relationships with unequal power dynamics. The Ombuds Office supports training in this area.
c. Guiding students in how to navigate and run a meeting, with a goal of maximizing effectiveness of meetings with their PI and other advisors and mentors.
d. Guide and provide opportunities for mentees to develop broad networks of mentors to meet their professional needs.

Graduate education
Graduate student classes are notoriously variable in the quality of teaching and the demands placed on students. We make these recommendations:

1. Programs require that courses be a coordinated series of lectures and other activities, rather than a succession of lectures that are unconnected with each other. Faculty should coordinate their plans and attend each other's lectures or other course activities. As the number of faculty who present sequentially in a course rises, this coordination becomes increasingly difficult.

2. That HILS explore better means to provide computational instruction in a way that is available to students when they need to develop these skills, rather than so far in advance that its utility is hard to perceive. All levels of computational skills, from beginner to advanced, should be accommodated and supported through a set of course offerings.

3. HILS should maintain a curated database of graduate courses, grouped by subject area, which includes learning goals, teaching methods, and student feedback on course strengths and weaknesses.

Student career exploration
HILS and individual programs should increase their efforts to expose students to scientists who work in a wide range of science-related careers and allow students to perform internships that help them to explore career pathways.

1. HILS and individual programs should maintain alumni databases that will allow current students to contact predecessors, with their prior permission, who have chosen a range of careers.

2. All graduate programs should make internships available to students and GSAS should establish funding to allow internships at non-profit organizations. Guidelines for the timing and prerequisites for internships should be clarified and better publicized to both students and faculty. Program directors should work toward a cultural change across program faculty of acceptance of the importance and value of internships even given the time away from the lab.

3. HILS and individual programs should organize events that introduce current students to alumni who have chosen a wide range of careers. Foundational work by DMS is reflected in the current Paths Programs, which are groups organized around different career areas that hold networking events and other career-oriented para-curricular activities. This program should be enhanced and extended by HILS.

4. Withdrawing from graduate school without a Ph.D. should be seen as an acceptable trajectory towards finding other uses of their skills that are more rewarding. Programs should find better ways to identify and advise these students, allowing for open-ended discussion whose goal is to achieve outcomes that best match a student's interests and talents.

Findings & Recommendations 5: Celebrating and Empowering our Graduate Students

Modern science is increasingly interdisciplinary and many discoveries occur when groups of scientists realize that they are working on related problems. Maximizing the chances of such interactions increases the scope and impact of Harvard science, broadens the training of our graduate students, and often leads to life-long academic friendships. When science works, it can be the ultimate thrill, and when it persistently doesn't, it can be the ultimate frustration. We need to find ways to celebrate our students when things work and support them when they don't.

Vision
A cohesive, integrated life science community that reflects and reinforces the multidisciplinary nature of life science research, the innovation born at the interface between fields, and the value of interactions and knowledge sharing among students horizontally across programs and vertically across years.

Problems
Most students have three concentric circles of intellectual and social relationships with other scientists: first their research laboratory, second the students in their year of their graduate program, and third the other students in their program. Some students find these relationships supportive and easy to forge, while others struggle to form personal connections, which can lead to debilitating isolation and insecurity that can spiral into diminished creativity, productivity and well being. Like other competitive professions that have objective metrics for the success or failure of short- and long-term efforts, science is stressful. For many students, this stress affects their mental health as they deal with the uncertainties and frustrations of independent research, worry about whether they are imposters, and face important decisions about their future careers.

Solutions
We make these recommendations to better support our students and connect them to each other:

Student support
1. Provide more resources to support students in career choices, dealing with problems they encounter, and access to health services, including mental health. In particular, there is a shortage of services for students with mental health concerns who are currently reluctant to begin formal therapy sessions in a clinical setting. We need more services with minimal scheduling/paperwork/stigma; one option would be to extend the availability of the 'Let's Talk' service offered by HUHS-CAMHS.

2. Provide all students with both peer mentors and neutral faculty mentors. We recommend that all programs schedule annual, one-on-one meetings with a 'personal advisor' for all students who have passed their preliminary qualifying exam. The 'personal advisor' would be a faculty member who is not the student's primary mentor, and it is recommended that they also not be a dissertation advisory committee member, so as to be best positioned to offer dispassionate advice. This annual meeting would be an opportunity to review the student's personal goals and challenges with a person whose only objective is to help the student flourish. In addition, efforts should be made to make the dissertation advisory committee meetings more responsive to the needs, professional and scientific development, and career trajectories of our graduate students.

3. Train these mentors and faculty more broadly to recognize struggling students and direct them to appropriate resources, especially as relates to mental health.

Student interactions and community spirit

1. Provide more resources to support students in career choices and dealing with the wide variety of problems that are neither technical nor intellectual that arise during their studies. Programs, both in person and web-based, run by Jason Heustis through PGE are models of these activities.

2. Create Longwood-based resources for social and other activities to complement those offered by Lehmann Hall in Cambridge. HILS should organize, rebrand, and enhance the visibility of an office devoted to student support services, spanning diversity, inclusion, and belonging, to career and academic support services. It would link to a web presence inclusive of the new Harvard University Career & Professional Development Navigator (https://careernavigator.gradeducation.hms.harvard.edu/). It would equitably serve Longwood and Cambridge based programs.

3. Program specific activities designed to promote vertical interactions between students in different years, including graduate-student centered retreats.

4. Mount a variety of HILS-based activities to support interaction between students from different programs. Feedback from students suggest that different students are interested in different activities from informal social interactions to HILS-student organized research seminars.

5. Create a Harvard-accessible, searchable database that lists research areas and technical expertise of labs and the individual research projects of students.

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Appendices

Appendix A: Charge of the Life Sciences Ph.D. Review Committee

Appendix B: Recommendations for Revision of HILS and Life Science Program Websites

Appendix C: Example Mentor-Student Compact

Appendix A

Charge of the Life Sciences Ph.D. Review Committee

In May 2019, Provost Alan Garber and Dean Emma Dench charged this faculty committee to review how Harvard can provide the best training environment for our life science Ph.D. students, while increasing our ability to attract the most talented and diverse cohort of students. The charge was laid out as follows.

The committee will study life science Ph.D. programs at Harvard and our competitors, report on them, and make recommendations intended to ensure that our programs are as strong as possible, work well together, attract a diversity of students across all axes, are equitably supported, and compete effectively against those at other institutions.

Graduate education in the life sciences was a major topic of interest to the 2015 University-wide Life Sciences Review Committee. It recommended that Harvard take a closer look at the structures established for the recruitment, admission and training of graduate students in the life science Ph.D. programs, recognizing that graduate students are critical to research, education, and faculty recruitment and retention in the life sciences at Harvard.

In response to this recommendation, last year the Provost's Office and GSAS worked to conduct a high-level review of the Harvard Integrated Life Sciences Program. At the same time, HMS conducted a review of the Program in Graduate Education. Both reviews pointed to the need for Harvard to re-examine what factors will ensure that the University will remain attractive to the best, most talented and diverse group of graduate students in the life sciences, and allow Harvard to be competitive with its peer institutions in recruiting them.

We would like this faculty committee to provide us with recommendations that address the following:

Competitiveness and admission yields

- What can we learn from comparative data for peer institutions bearing on selectivity, yield, external communications, recruitment best practices, student services, and mentoring and advising?
- What barriers exist that might interfere with our ability to recruit the best and most diverse cohort of students?

Organization and structure

- What are the optimal mechanisms and structures for administration and funding of our graduate programs?
- How can we preserve the scientific diversity present in our current programs and also be flexible enough to incorporate new areas of research or interdisciplinary approaches?
- The number and diversity of our graduate programs in the life sciences and the large number of faculty available for graduate students to work with is a strength at Harvard. However, how well are we currently integrating these programs and faculty so that students perceive that there is a comprehensive life sciences program at Harvard that provides more than just a wide selection of individual choices? If not, what changes should we consider?
- Is there unnecessary redundancy in our graduate programs, in appearance or in practice?
- What is the optimal process for planning and decision-making related to the scale and organization of our graduate programs?
- Are there programs that would benefit from revitalization?

- Do our students experience real fluidity across our graduate programs in the life sciences, from the ability to do rotations in their choice of labs, take classes in any program, and obtain advising from appropriate faculty?

Student-centric training and support

- How do we best promote student well being and student-centric priorities in training and professional development?
- Do our current graduate students benefit from the full range of resources of the University, and are comparable resources available to all graduate students regardless of their geographic location and program membership? Are additional support structures needed?

Appendix B

Recommendations for Revision of HILS and Life Science Program Websites

As part of the 2019 Life Sciences Ph.D. Review, we conducted an *ad hoc* assessment of the Harvard life sciences application process and the HILS website and compared them with those of our peer institutions including Stanford University, Massachusetts Institute of Technology, University of California San Francisco, and Johns Hopkins University. This analysis revealed that Harvard's life sciences web presence lags well behind our peers. Below, are some key recommendations for improving the online presence and organization of the life sciences at Harvard.

1. Harvard life sciences should have a central landing page as opposed to existing as a subsection of the GSAS website. This will allow for streamlined information about HILS and provide clearer navigation paths for students applying to a program.

    a. The top navigation bar should include: prospective students, current students, resources for students, a list of all 14 programs with links to their homepages, and additional information about HILS as an umbrella program for life sciences at Harvard.

    b. Content on HILS affiliated webpages should be succinct and should outline clear objectives and goals for each program. There should be a limit on the information that is provided on the side bars of each page.

    c. The website should incorporate the contact information for each of the 14 programs and program heads that fall under HILS for students to ask questions and address concerns. This information should also be provided on each program's page within HILS.

2. Programs that are affiliated with HILS should create an ad hoc assessment of their own websites to create a digitally accessible and user-friendly experience. The following information should be made easily accessible:

    a. Information about the program

    b. Faculty members (ability to search via interest as opposed to name)

    c. Resources/funding

    d. Program of study/Course work

    e. Diversity/Student Life

Appendix C

Example Mentor-Student Compact

Below, we provide information and links to an example compact created by the Association of American Medical Colleges (AAMC). The Compact is also available on the AAMC Web site at: www.aamc.org/gradcompact.

Introduction

The *Compact Between Biomedical Graduate Students and Their Research Advisors* presents guiding principles intended to support the development of positive mentoring relationships between predoctoral students and their research advisors. A successful student-mentor relationship requires commitment from the student, mentor, graduate program, and institution. This document offers a set of broad guidelines that are meant to initiate discussions at the local and national levels about the student-mentor relationship.

There are several potential uses for this document. Among those suggested are the following:

- As a starting point for discussions between predoctoral students, research advisors, and institutional administrators about the issues addressed by the compact
- As part of the orientation for new predoctoral students
- As part of a regular and ongoing discussion between predoctoral students and their research advisors
- As a source of topics to be discussed in graduate research programs
- As a part of the orientation for new research faculty
- As a source of topics to be discussed in faculty mentorship programs
- As a component of faculty evaluations
- As a tool to initiate the development of additional programs and support services for predoctoral students within a graduate research program

This compact was originally drafted in 2008 in collaboration with representatives of the AAMC Group on Graduate Research, Education, and Training (GREAT Group) and is modeled on the AAMC's *Compact Between Postdoctoral Appointees and Their Mentors*, available at www.aamc.org/postdoccompact. Input on this document was received from GREAT Group representatives and members of the AAMC governance. The document was endorsed by the then AAMC Executive Council on September 25, 2008. In 2016, a team consisting of representatives from the GREAT Group and the AAMC Council of Faculty and Academic Societies (CFAS) reviewed and updated the document. The GREAT Group, CFAS, and AAMC staff leadership provided input on the revised draft.

Compact Between Biomedical Graduate Students and Their Research Advisors

Predoctoral training entails both formal education in a specific discipline and research experience in which the graduate student trains under the supervision of one or more investigators who will mentor the student through graduate school. A positive mentoring relationship between the predoctoral student and the research advisor is a vital component of the student's preparation for future careers and mentoring roles.

Individuals who pursue a biomedical graduate degree are embarking on a path of lifelong learning and are therefore expected to take responsibility for their scientific and professional learning and development from the onset. Graduate students must be in charge and take ownership of their progress through the graduate program. This means seeking guidance on and knowledge about course requirements and program requirements, policies, and procedures. Students must also commit to working on an individual development plan. Faculty members who advise students—with the backing of the graduate program and institution—are expected to fulfill the role of mentor, which includes providing scientific training, guidance, instruction in the responsible conduct of research and research ethics, and financial support. The faculty advisor also serves as a scientific and professional role model for the graduate student. In addition, the advisor offers encouragement as the graduate student prepares an individual development plan and facilitates the experiences and professional skills development essential for a broad set of career paths.

Core Tenets of Predoctoral Training

Institutional Commitment

Institutions that train biomedical graduate students must be committed to establishing and maintaining rigorous graduate programs with the highest scientific and ethical standards. Institutions should work to ensure that students who complete their programs possess the foundational knowledge, skills, and values that will allow them to mature into scientific professionals of integrity. They should have oversight of the graduate curricula, length of study, stipend levels, benefits, career guidance, grievance procedures, and other matters relevant to the education of biomedical graduate students (e.g., consideration of, preparation for, and exposure to various career paths). Institutions should recognize and reward their graduate-training faculty. With changing and diversified biomedical workforce needs, institutions should recognize the necessity of faculty development around multiple career paths for trainees and provide opportunities for faculty to acquire such skills and experiences. Additionally, institutions should also foster an environment that is diverse and inclusive.

Program Commitment

Graduate programs should establish training that prepares students with broad and deep scientific knowledge and the technical, professional, and leadership skills necessary for a successful career in the biomedical sciences. Programs should closely monitor the progress of graduate students during their course of study by establishing milestones and clear parameters for outcomes assessment, as well as maintain and make available career outcomes data.

Quality Mentoring

Effective mentoring is crucial for graduate school trainees as they begin their scientific careers. Faculty mentors must commit to dedicating substantial time to the scientific, professional, and personal development of the graduate student. Whether a faculty member acts as the primary research advisor or sits on a student's advisory committee, a relationship of mutual trust and respect between mentor and graduate student is essential for healthy interactions and to encourage individual growth. Effective mentoring should include teaching the scientific method, providing regular feedback in the form of both positive support and constructive criticism to foster individual growth, teaching the "ways" of the scientific enterprise, and promoting careers by providing or directing students to appropriate opportunities. The best mentors are careful listeners who actively promote and appreciate diversity. They possess and consistently maintain high ethical standards, acknowledge and recognize the contributions of students—in publications and intellectual property, for example—and have a record of research accomplishments and financial support. Finally, it should be recognized that mentoring does not end with a student's completion of the graduate program but continues throughout the student's professional life.

Skill Sets and Counseling for a Broad Range of Career Choices

The institution, training programs, and mentor should provide training relevant to a broad variety of careers that will allow graduate students to appreciate, navigate, discuss, and develop career choices. Effective and regular career guidance activities should be offered.

Commitments of Graduate Students

- **I acknowledge that I have the primary responsibility for the successful completion of my degree.** I will be committed to my graduate education and will demonstrate this by my efforts in the classroom, the research laboratory, and all other related academic and professional activities. I will maintain a high level of professionalism, self-motivation, initiative, engagement, scientific curiosity, and ethical standards, including complying with institutional and research group standards for contributing to an inclusive research environment.

- **I will meet regularly with my research advisor to provide updates on the progress and results of my course work, research, and professional and career development activities.**

- **I will work with my research advisor to develop a thesis/dissertation project.** This will include establishing a timeline for each phase of my work. I will strive to keep engaged with the work, discuss experimental findings and any pitfalls, and meet the established goals and deadlines.

- **I will work with my research advisor to select a thesis/dissertation committee.** I will commit to meeting with this committee at least annually (or more frequently, according to program guidelines). I will discuss my progress to date and be responsive to the advice and constructive criticism from my committee.

- **I will be a good lab citizen.** I agree to take part in shared laboratory responsibilities and will use laboratory resources carefully and frugally. I will maintain a safe and clean laboratory space. I will be respectful of, tolerant of, and work collegially with all laboratory personnel. I will be an active contributing member to all team efforts and collaborations and will respect individual contributions. I will also contribute to an environment that is safe, equitable, and free of harassment.

- **I will maintain detailed, organized, and accurate research records. With respect to data ownership, I acknowledge that original notebooks, digital files, and tangible research materials belong to the institution and will remain in the lab when I finish my thesis/dissertation so that other individuals can reproduce and carry on related research, in accordance with institutional policy.** Only with the explicit approval from my research mentor and in accordance with institutional policy may I make copies of my notebooks and digital files and have access to tangible research materials that I helped to generate during my graduate training.

- **I will discuss policies on work hours, medical leave, and vacation with my graduate program and research advisor.** I will consult with my advisor in advance of any planned absences and apprise my advisor of any unexpected absences due to illness or other issues.

- **I will discuss policies on authorship and attendance at professional meetings with my research advisor.** I will work with my advisor to disseminate all relevant research results in a timely manner before completion of all degree requirements.

- **I will be knowledgeable of the policies and requirements of my graduate program, graduate school, and institution.** I will commit to meeting these requirements in the appropriate time frame and will abide by all institutional policies and procedures.

- **I will attend and actively participate in laboratory meetings, seminars, and journal clubs that are part of my educational program.** To enhance research, leadership, and additional professional skills, I will seek out other enrichment opportunities, such as participation in professional organizations and meetings, student representation on institutional committees, and coordination of departmental events.

- **I will be knowledgeable of all institutional research policies.** I will comply with all institutional laboratory safety practices and animal-use and human-research policies. I will participate in my institution's Responsible Conduct of Research Training Program and practice the guidelines presented therein while conducting my research. I will also seek input on and comply with institutional policies regarding my research design and data analysis.

- **I acknowledge that I have the primary responsibility for the development of my own career.** I recognize that I need to explore career opportunities and paths that match and develop my individual skills, values, and interests to achieve my desired career goals. I understand that there are tools such as the individual development plan that I should use to help me define my career goals and develop my training plan. I will seek guidance throughout my graduate education from my research advisor, career counseling services, thesis/dissertation committee, other mentors, and any other resources that can offer advice on career planning and the wide range of opportunities available in the biomedical workforce.

Commitments of Research Advisors

- **Throughout the graduate student's time in my laboratory, I will be supportive, equitable, accessible, encouraging, and respectful.** I will foster the graduate student's professional confidence and encourage intellectual development, critical thinking, curiosity, and creativity. I will continue my interest and involvement as the student moves forward into a career.

- **I will be committed to meeting one-on-one with the student on a regular basis. I will regularly review the student's progress and provide timely feedback and goal-setting advice.**

- **I will be committed to the graduate student's research project.** I will work with the student to help plan and guide the research project, set reasonable and attainable goals, and establish a timeline for completion of the project.

- **I will help the graduate student select a thesis/dissertation committee.** I will assure that this committee meets at least annually (or more frequently, according to program guidelines) to review and discuss the graduate student's progress and future directions. I understand that the function of this committee is to help the student complete the doctoral research, and I will respect the ideas and suggestions of my colleagues on the committee.

- **I will provide an environment that is intellectually stimulating, emotionally supportive, safe, equitable, and free of harassment.**

- **I will demonstrate respect for all graduate students as individuals without regard to gender, race, national origin, religion, disability or sexual orientation, and I will cultivate a culture of tolerance among the entire laboratory.**

- **I will be committed to providing financial resources, as appropriate and according to my institution's guidelines, for the graduate student to conduct thesis/dissertation research.** I will not require the graduate student to perform tasks that are unrelated to the training program and professional development.

- **I will expect the graduate student to share common laboratory responsibilities and use resources carefully and frugally.** I will also regularly meet with the graduate student to review data management, storage, and record keeping. I will discuss with the student intellectual policy issues regarding disclosure, patent rights, and publishing research discoveries.

- **I will discuss with the graduate student authorship policies regarding papers.** I will acknowledge the graduate student's scientific contributions to the work in my laboratory, and I will provide assistance in getting the student's work published in a timely manner.

- **I will be knowledgeable of and guide the graduate student through the requirements and deadlines of the graduate program and the institution, as well as teaching requirements, if any, and human resources guidelines.**

- **I will encourage the graduate student to attend and present their research at scientific/professional meetings and make an effort to secure and facilitate funding for such activities. In addition, I will provide opportunities for the student to discuss science and their research findings with colleagues and fellow scientists within the institution and broader scientific community—for example, at lab meetings, research days, and seminars.**

- **I will promote the training of the graduate student in professional skills needed for a successful career. These skills include but are not limited to oral and written communication, grant writing, management and leadership, collaborative research, responsible conduct of research, teaching, and mentoring.** I will encourage the student to seek opportunities to develop skills in other areas, even if not specifically required by the student's program. I will also encourage the graduate student to seek input from multiple mentors.

- **I will create an environment in which the student can discuss and explore career opportunities and paths that match their skills, values, and interests and be supportive of their career path choices.** I will be accessible to give advice and feedback on career goals. I will work with the student on an individual development plan to help define career goals and identify training milestones. I will provide letters of recommendation for the student's next phase of professional development.