

21st Century Graduate Education Implementation Task Force Report

Executive Summary

Rationale: Two core objectives that CNS identified in our 2013 Strategic Plan are to prepare the next generation of scientists and to shape the future of science by promoting innovation. Furthermore, in an emerging national consensus, the Association of American Universities and many STEM professional organizations recognize that existing traditions of graduate education need to be reevaluated and transformed to adapt to the evolving needs of our students. In a 2015 *Science* editorial, the AAAS CEO wrote: *“All available evidence suggests that over 60% of new Ph.D.’s in science in the United States will not have careers in academic research, yet graduate training in science has followed the same basic format for almost 100 years, heavily focused on producing academic researchers. Given that so many students will not join that community, the system is failing to meet the needs of the majority of its students.”* Outcomes for CNS graduates are not far from the national average he quoted: from all cohorts entering in 2000-06, 27% of our PhD recipients are now in tenure-track positions, another 23% are in other academic positions, and the remaining 50% are outside academia altogether.

CNS is home to almost 1,200 PhD students in fifteen programs. In 2015-16, the College convened the *21st Century Graduate Education Working Group* and charged this committee to recommend bold innovations for the future of graduate education in CNS. The committee recommended changes to improve student readiness for rapid progress through PhD programs, to improve programs’ efficiency and flexibility, to enhance mentoring within programs and sharpen the focus of degree pathways, and to prepare students for diverse career paths. To implement these recommendations, we propose changes to CNS graduate education designed to increase the research productivity of our PhD students and improve their preparation for careers both inside and outside of academia, through new training delivered in innovative ways. These changes will make our PhD recipients more competitive for, and more effective in, their preferred career paths. In so doing, these changes will enhance the reputations of our programs, increasing their rankings and their ability to attract the best graduate students from around the world.

The changes we recommend are designed to accomplish the following broad goals:

I. Streamline and enhance students' paths to degree. We will (a) redesign orientation activities to get necessary information to students when they need it, (b) provide training in basic workplace skills, (c) implement best practices in mentoring, including formalized assessments of student progress, and (d) offer continuous learning opportunities for faculty to stay aware of advances in graduate education.

II. Make graduate education more flexible and efficient. We will (a) develop “boot camps” to give incoming students the strongest possible starts toward their degrees, (b) modernize degree plans to facilitate earlier entry into research, (c) enable the offering of modular courses to increase breadth without increasing time to degree, (d) promote inclusivity in our programs, and (e) examine TA workload policies.

III. Ensure that all students explore and prepare for desired career opportunities. We will (a) ensure all students have Individual Development Plans, (b) expand career counseling services, (c) provide elective specialized training in skills such as communication, pedagogy, leadership, project management, and organization, and (d) form an advisory board of PhD alumni who are successful outside of academia.

IV. Ensure that all PhD students acquire big data skills. We will develop and pilot intensive short courses in descriptive and inferential statistics and computer programming for scientists.

We recommend specific assessment and evaluation strategies to measure the degree to which the innovations we propose contribute to the goals above. These strategies will use formative assessments – data collected within implementation to revise and improve practices – along with summative assessments – data collected after implementation to determine if outcomes align with those goals and our institutional priorities. By analyzing and learning from these data, we will be equipped to make informed decisions as we continually strive to improve graduate education in the College of Natural Sciences.

I. Recommendations for Change	3
A. Motivation.....	3
B. Broad Goals.....	5
C. Strategies to Accomplish Goals.....	5
II. Assessment and Evaluation	12
A. Formative Assessments.....	12
B. Summative Assessments.....	12
III. Appendix: Graphical Summary of New Activities	14

I. Recommendations for Change

A. Motivation

The College of Natural Sciences (CNS) identified two core objectives in its 2013 Strategic Plan: to prepare the next generation of scientists and citizens, and to promote innovation and shape the future of science. Both of these are directly relevant to our graduate education mission. There are growing realizations across AAU institutions and within STEM professional organizations that current traditions of graduate education need to be thoughtfully reevaluated and creatively transformed to better adapt to evolving needs of our graduates. It is thus in alignment with our objectives as a College and the emerging national consensus about graduate education that we should identify ways to improve the future of graduate education in CNS. Crafting effective graduate programs in science and mathematics that produce PhDs with skill sets required for success in tomorrow's job markets, whether within or outside the traditional academic path, is advantageous to society at large: these PhDs will be prepared to act as agents of innovation and growth, increasing the impact of science on society and the economy. Thus we believe the changes we propose are well aligned with the core purpose of the University of Texas *to transform lives for the benefit of society*.

In this report, we propose changes to CNS graduate education intended to increase the research productivity of our PhD students and improve their preparation for careers both inside and outside of academia, through new training delivered in innovative ways. By enhancing graduate training in the College, these changes will make our PhD recipients more competitive for and more effective at jobs in their preferred career paths, whether these are inside or outside of academia. Those improvements in our graduates' experiences and outcomes will enhance the reputations of our programs, increasing our rankings and our competitiveness to recruit the best graduate students from around the world and to support them intellectually as they contribute to future discoveries in science and mathematics.

A narrower but nonetheless important motivation for the changes we propose comes from our desire to provide CNS PhDs with skill sets required for success in tomorrow's job markets, beyond the confines of the traditional academic path. In a 2015 editorial in *Science*, AAAS CEO Emeritus Alan Leshner wrote:

"All available evidence suggests that over 60% of new Ph.D.'s in science in the United States will not have careers in academic research, yet graduate training in science has followed the same basic format for almost 100 years, heavily focused on producing academic researchers. Given that so many students will not join that community, the system is failing to meet the needs of the majority of its students. Many academic, governmental, and professional leaders and organizations have lamented this disconnect and have suggested worthwhile adjustments, but most of these have been minor changes in graduate course offerings. It is time for the scientific and education communities to take a more fundamental look at how graduate education in science is structured and consider, given the current environment, whether a major reconfiguration of the entire system is needed."

Outcomes for CNS graduates are not far from the national average quoted above: data collected by the College for the seven cohorts entering in 2000-06 show 27% of our PhD recipients in tenure-track positions, another 23% in other academic positions, and the remaining 50% outside academia altogether. In spite of this trend, in a recent NSF-funded study by the Council of Graduate Schools,¹ only 44% of respondents from 134 institutions reported having any existing formal programs for graduate students to develop skills for non-academic careers. It will benefit our programs' reputations and our students' outcomes if we design training that better prepares our students for the directions in which PhD career opportunities are evolving. Even the preparation of students determined to pursue faculty careers could benefit from modernization.

CNS is home to almost 1,200 PhD students in fifteen programs: Astronomy; Biochemistry; Cell and Molecular Biology; Chemistry, Computer Science; Ecology, Evolution, and Behavior; Human Development and Family Sciences; Marine Science; Mathematics; Microbiology; Neuroscience; Nutrition; Physics; Plant Biology; and Statistics. In 2015-16, the College convened the *21st Century Graduate Education Working Group* and charged that committee to make bold and innovative recommendations about the future of graduate education in CNS. The committee recommended innovations intended to improve student readiness for rapid progress through PhD programs, to improve programs' efficiency and flexibility, to enhance mentoring within programs and sharpen the focus of degree

¹ Denecke, D., Feaster, K., & Stone, K. (2017). Professional development: Shaping effective programs for STEM graduate students. Washington, DC: Council of Graduate Schools. (cgsnet.org/ckfinder/userfiles/files/CGS_ProfDev_STEMGrads16_web.pdf)

pathways, and to prepare students for diverse career paths. This report describes how we believe the College, its Departments, its programs, and its faculty should implement and then evaluate those recommended innovations. While this implementation will undoubtedly involve challenges, we are confident that those can be overcome by the strategies and actions we recommend below.

B. Broad Goals

The changes we recommend are designed to accomplish the following broad goals:

- I. Improving students' navigation of their paths to degree, by improving orientation and implementing best practices in mentoring, including formalized and strategically timed assessments;
- II. Making graduate education more efficient by offering a wider variety of instructional methods, including “boot camps,” more flexible modular course work, modernization of degree plans, and early entry into research;
- III. Ensuring that all students have opportunities to identify and explore career options early in their graduate training, and then to receive enhanced opportunities to develop related professional skills of their choosing, like communication, pedagogy, leadership, management, and organization; and
- IV. Ensuring that all PhD students can acquire interdisciplinary skills like statistics and programming that are needed to take advantage of the big data revolution.

In this report, we recommend specific actions that the College, Departments, and PhD programs should make in pursuit of these goals – by better supporting faculty in their responsibilities as mentors, and adding value to student experiences. *It is a priority that all of these actions be implemented in ways that protect and improve the diversity and inclusivity of CNS graduate programs.*

We recommend specific Assessment and Evaluation strategies to measure the degree to which the innovations we propose contribute to the goals above. These strategies use formative assessments – data collected within implementation to revise and improve practices – along with summative assessments – data collected after implementation to determine if outcomes align with those goals and our institutional priorities.

C. Strategies to Accomplish Goals

Goal I: improving students' navigation through programs

Rationale: We want to broaden the academic and professional training our students receive, without diminishing the depth of their research, increasing their time to degree, or damaging our programs' diversity. A key strategy to accomplish

this is for the College and its programs to put in place structures that help faculty better fulfill their responsibilities as mentors and facilitate students' navigating programs more efficiently. This strategy has four main components.

A. Improved Orientation Activities: College orientation activities for new students should be revised and enhanced to provide a comprehensive overview of the support framework for students provided within the University, including boot camps, career planning services, and professional development programming. This revision should be done in coordination with Graduate School and individual PhD program orientation events to avoid duplication. Each program should ensure that its orientation process fully informs incoming students of their responsibilities, expectations, and upcoming milestones. We propose to deliver information through a series of "just in time" orientation events sequenced so that students receive information when it will be immediately relevant. This model could include a "reorientation" at the end of each cohort's first year. By the end of this process, all students should be aware of relevant resources available to them, such as journal access, free software, the University Writing Center, statistical consulting services, and services for international students. We recommend that programs' graduate handbooks and CNS web resources be updated if necessary to help students remain aware of relevant resources.

B. Ongoing Training in Workplace Skills: The College should provide workshops on foundational workplace skills, including standards of appropriate professional behavior (e.g., sexual harassment policies), inclusivity training, strategies of self advocacy, and strategies for maintaining constructive and open communication with peers and research supervisors – and provide recourses should such communication break down.

C. Improved Assessments: We recommend that programs implement structured assessment protocols for students throughout their graduate careers. There should be an early assessment point to ensure that students complete program breadth requirements within a required timeframe. There should be a "mid-career checkpoint" (ideally before completion of the fifth long semester of PhD studies) at which each student meets with her/his research supervisor (PI), dissertation committee, and the program's Graduate Adviser (if feasible and appropriate) to critically review progress, refine research plan scopes and timelines for degree completion, and discuss desired career paths. Thereafter, programs are strongly encouraged to continue regular dissertation committee meetings, optimally every year. Tying these in to the *Milestones*² system would provide automatic reminders.

² *Milestones* is a program provided by the Graduate School in which doctoral students are required to review the degree plans for their program, along with information about specific degree requirements and estimated timelines to reach various benchmarks for their degree plan specializations.

To assist faculty and students in making these assessments as valuable as possible, the College should develop annual review templates that assess student progress and address what additional work is required to graduate, the expected time of graduation, and what realignment may be needed to meet these goals. The review templates should facilitate planning by the student and committee regarding any additional course work, networking, internships, or other professional development opportunities that would constitute the most effective preparation for that student's desired career path. Both the faculty mentor and the student should sign these annual reviews. Finally, programs should ensure that Master's options (including, where appropriate, NTNR – no thesis, no report – options) are available to students who enter graduate study seeking a doctorate but who exit without a PhD (an outcome that can occur for a variety of reasons).

D. Learning Opportunities for Graduate Faculty and Staff. We recommend that CNS provide continuous learning opportunities for faculty and staff who want to stay aware of emerging best practices in graduate education. This awareness will help GSC members ensure that our graduate programs are founded on sound principles and evolve to optimally serve students. CNS should expand access to the CNS Graduate Education Wiki from Graduate Coordinators to GSC Chairs and Graduate Advisers, and should develop orientation materials for new Graduate Advisers. We recommend ongoing dissemination of information concerning graduate education at periodic informal meetings open to interested graduate program faculty and administrators, and attended by the Associate Dean or other relevant College personnel.

Goal II: increasing program flexibility and efficiency

Rationale: We want to make it possible for students to receive enhanced professional development opportunities and training in interdisciplinary skills without increasing time to degree, harming research productivity, or damaging efforts to improve diversity. Our strategy to make this possible consists of four main components. The common intent is to reduce the time needed for students to advance to research by creating efficiencies early in their graduate training.

A. Degree Plan Modernization: Each Graduate Studies Committee (GSC) should be encouraged to critically examine, and modernize if necessary, its degree plan(s), requirements, and curriculum. This process should use comparative data gathered from peer and aspirational peer programs. Careful attention should be paid to the balance between depth and breadth, particularly in fields where interdisciplinary and collaborative skills will be most valuable for emerging research directions.

B. Boot Camps: Programs may develop boot camps to prepare incoming cohorts of diverse³ graduate students for their rigorous graduate curricula near the beginning of their first semester. We recognize that boot camps may be more useful for some programs than for others. For participating programs, we strongly recommend inviting entire cohorts to participate in boot camps. A boot camp is a discipline-specific intensive short course delivered to incoming students to ensure that they have uniform foundational skills in their discipline. Programs who wish to develop boot camps should have flexibility in their implementation. For example, a boot camp could be delivered in a one or two week short course before the start of an incoming cohorts' first semester (with extra financial support offered to participating students), it could be delivered on weekends early in the fall semester, it might replace the first week or two of an existing first-semester course, or it could even be delivered via online components. Boot camps should enable programs to recruit students from a broader range of undergraduate majors without increasing these students' time to degree. Boot camps may also benefit students from nontraditional backgrounds who might not have had educational or research opportunities comparable to those enjoyed by students from majority backgrounds. We recommend that funds to support boot camp development and piloting by GSC members be made available on a competitive basis to programs wishing to develop boot camps for their incoming cohorts.

C. Efficient Content Delivery: While necessary for some courses, semester-long classes may not be the optimal way to train students in all competencies. We recommend that the College restructure administrative frameworks governing teaching credit for faculty, and that Graduate Studies Committees restructure course credit requirements for students, to make it possible to deliver content more efficiently – for example, in five- and ten-week modules in cases where this is appropriate. Some programs have already taken steps in this direction by adding professional development components to their teaching practicums (“Supervised Teaching,” i.e., 398T) courses. The aim of this recommendation is to make it possible to increase breadth in training without increasing the amount of time students spend in class, away from research.

D. Enhancing Diversity. Although all activities recommended in this report should be conceived and implemented to enhance inclusivity, we include here some specific suggestions. We recommend that programs re-examine traditional biases toward not admitting UT undergraduates, and consider recruiting promising UT undergraduates when they are juniors. Promising undergraduates, especially those from traditionally underrepresented backgrounds, could be encouraged to try graduate course work. We recommend experimenting with new recruiting events like “SURE in CNS” (Symposium for Undergraduate Research and

³ Here, “diverse” means with respect to scientific, socioeconomic, or educational backgrounds.

Exploration in CNS) to recruit traditionally underrepresented students from other institutions. We recommend working with the Graduate School to realign its Mentoring Fellowship application process and timeline to make these more effective for diversity recruiting.

E. Uniform TA Workload Guidelines. We recommend that Departments and other units employing Teaching Assistants should develop guidelines for TA appointments that ensure that students' instructional duties will not excessively or unfairly impact their academic performance or research progress. The guidelines should respect the variety of course types taught within the College, and should be sufficiently flexible to adapt to reasonable pedagogical preferences of individual instructors. TA workload policies should be reviewed, evaluated, and if necessary updated periodically.

Goal III: exploring and preparing for desired career outcomes

Rationale: CNS PhD students currently have access to an array of activities that can expand their professional skillsets beyond those embedded in the traditional graduate experience. However, improvements are needed to increase student awareness of these resources, to add opportunities in a broader range of topics, and most importantly to help faculty members and their students effectively incorporate these into their plans for graduate training. Our strategy to achieve these improvements consists of four main components.

A. Use of Individual Development Plans: In orientation activities and CNS Professional Development Seminars, students should receive instruction in how to prepare and periodically revise Individual Development Plans (IDPs). The College should also provide opportunities for interested faculty supervisors, Graduate Advisers, and Graduate Coordinators to receive information on the effective incorporation of IDPs into student mentoring plans and annual reviews. To help students efficiently identify and prepare for careers after graduation, and to help their faculty supervisors effectively plan their training, we recommend that all students complete and annually revise IDPs. Where appropriate, programs should provide discipline-specific templates for faculty and students. We recommend that programs consider making IDP preparation one of their required *Milestones*.

B. Career Counseling: All students should be aware of and be strongly encouraged to attend CNS Career Counseling and Professional Development seminars. We recommend that programs consider making meeting with a career counselor as a cohort of their required *Milestones*. To further help students identify career options, we recommend that the College and/or graduate programs invite external speakers, including PhD alumni, to regularly scheduled career development and networking events. These would provide students with opportunities to meet, network with, and learn from speakers who have been

successful in diverse careers such as entrepreneurship, industry, science policy, consulting, and others. Strategic use of summer internship opportunities can also contribute to students' career exploration and preparation. CNS currently provides all of its students with access to *Handshake*,⁴ but additional work is needed to increase students' awareness and use of this resource. As part of a broad dissemination effort, the College should enhance central webpages that list all career guidance and professional development opportunities, including internships, open to CNS graduate students.

C. Elective Training: As soon as students identify desired career paths, they should have opportunities to participate in elective specialized training. A model for this is a three-course *Concentration in Teaching and Mentoring* currently being piloted by CNS. Its instruction is not delivered in traditional semester-long courses but instead is offered in diverse formats (e.g., evening and summer short courses) so as not to interfere with students' time for research or to increase time to degree. If justified by student interest, the College should develop and prototype other concentrations. CNS will work with the Moody College of Communications to develop a new course on *Communicating Science to General Audiences* for interested CNS PhD students. CNS will also collaborate with the McCombs School of Business to pilot a two-course *Concentration in Leadership and Project Management*. These courses should be available to interested students at convenient times and without excessive time commitments or extra tuition costs (e.g., as zero-credit hour classes). Additional concentrations could be introduced in the future in response to surveys of student interest. For example, four additional possibilities are concentrations in: (a) *Science and Public Policy*, to be developed jointly with the LBJ School of Public Affairs; (b) *Intellectual Property Policies*, to be developed jointly with McCombs and the UT School of Law; (c) *Writing within the Sciences*, which could be developed jointly with the University Writing Center; and (d) *Entrepreneurship and Commercial Innovation*, to be developed with the Innovation Center in the Cockrell School of Engineering. We recommend periodically surveying students to determine which concentrations should be developed and which, if any, should be discontinued.⁵ We emphasize that students should participate in only those professional development concentrations that prepare them for their desired career outcomes.

D. PhD Alumni Advisory Board: We recommend that the College consider forming an advisory board consisting of PhD alumni who have been successful inside and outside of academia. Board members would provide input on emerging

⁴ *Handshake* provides an online database that students can search for internship opportunities in their areas of interest.

⁵ We note that there is a growing body of commercial enterprises providing outsourcing options in case students desire instructional opportunities that cannot be economically provided within the University.

workforce needs in their specific fields, and recommendations for career development activities that would improve our students' preparation and competitiveness for academic and nonacademic careers.

Goal IV: acquiring necessary interdisciplinary skills

Rationale: Technology has made it possible to collect large amounts of data in almost any area of activity, including the sciences, providing fundamentally new opportunities of analysis. The big data revolution requires skill sets that traditional graduate programs may find challenging to deliver. We propose that the College develop methods to deliver training in interdisciplinary skillsets available to all CNS PhD students. Because science is continually evolving, the topics will need to be revised periodically. At present, we propose developing two components of interdisciplinary training. For both, issues of accessibility need to be addressed. Ideally, at least some of the course materials would be available online. Each program may determine the appropriate level of participation for its students, depending on student research and career needs, and the program's capabilities to internally train students in these topics.

A. Descriptive and inferential statistics. We recommend developing and piloting an intensive short course on descriptive and inferential statistics, up to and including regression analysis. It should be available to all CNS PhD students, at latest, after they have completed required coursework and exams in their respective disciplines. Students needing a deeper knowledge of statistical techniques should have opportunities to take additional short-course modules. Ideally, two versions of the course would be developed, one focusing on applications to Physical Sciences and the other on applications to Life Sciences, so that students can learn using examples close to their primary disciplines. We recommend involving Statistics and Data Science (SDS) in developing the course, modeled on their successful Summer Statistics Institute (SSI).

B. Computer Programming for Scientists: We recommend developing and piloting an intensive short course to provide CNS graduate students with effective programming skills at a sufficiently abstract level that they will be able to become proficient in new languages and paradigms that appear in the future. The course should also introduce various types of machine learning. It should be available to all CNS PhD students, at latest, after they have completed discipline-specific coursework. Those developing the course should investigate material already available in the *Computer Programming* and *Software Engineering for Sciences* courses offered in Computer Science (CS), as well as existing short courses offered by the Center for Computational Biology and Bioinformatics (CCBB).

II. Assessment and Evaluation

A. Formative Assessments

Formative assessments are made while educational activities are in progress in order to generate feedback that makes it possible to modify those activities in order to improve student outcomes. Each new activity should include formative assessments, especially during its pilot phase. These assessments should be both quantitative and qualitative.

We recommend three main types of formative assessments and provide one generic example of each below. Faculty members developing and piloting new activities may use these examples, as they deem necessary, to create specific assessments adapted to their activities. We recommend that CNS provide consulting expertise through TIDES (the Texas Institute for Discovery Education in Science) to assist those charged with assessment development.

- Feedback opportunities embedded within informational activities like orientation or professional development seminars to solicit real-time feedback. (For example, participants can be asked to complete “minute papers” about what they found most/least clear or valuable in an activity.)
- Quizzes embedded within learning activities like boot camps and short courses to measure whether content is being delivered effectively. (For example, students can be quizzed to determine if they are acquiring an adequate understanding of regression.)
- Periodic surveys to measure longitudinal changes in student knowledge, behaviors, attitudes, and confidence. (For example, students can be asked about confidence⁶ in their abilities to complete and update IDPs, to complete degree milestones within desired timeframes, and to realistically predict the scope of work and time required for degree completion.)

Those organizing the activities should evaluate the results of these assessments to continuously review and improve their effectiveness.

B. Summative Assessments

Summative assessments measure outcomes at the end of educational activities. Their purpose is to give information about the extent to which each activity contributed to our objectives for the College, our programs, and our students. It will be necessary to create summative assessments to measure the outcomes of our recommendations and determine how these align with our short- and long-term priorities.

⁶ This confidence has been shown to predict competence.

To enable future summative assessments to evaluate the extent to which our proposals will have their intended effects, we recommend that the College conduct a baseline survey of its students as soon as possible.

Because of the timescale of graduate studies, some outcomes of the activities we propose will only be observable on a long time scale. However, some summative data will be available fairly soon and should be evaluated, including:

- Student performance on required coursework and exams. (For example, we should measure correlations between boot camp participation and subsequent performance.)
- Time to completion of required coursework and exams. (For example, we should measure correlations between time to completion and programs' implementation of curricular reform.)
- Time to attrition, because it is preferable that students who need or want to leave realize this as soon as possible. (For example, we should measure correlations between time to attrition and programs' implementation of structured student assessment protocols.)
- Time to candidacy. (For example, we should measure correlations between time to candidacy and programs' implementation of curricular reform and/or adoption of modular course work.)

We recommend long-term summative assessments that measure alignment of outcomes with our institutional objectives, including:

- Improving admissions diversity, selectivity, and yield.
- Improving the quality of students we successfully recruit (ideally measured by the quality of the offers and institutions those students rejected).
- Decreasing the time to PhD relative to national trends within discipline.
- Increasing the quality of student research (measured by number and impact of student publications, number of conference presentations, etc.).
- Enhancing the reputations and competitiveness of our PhD programs.

Long-term summative assessments should also measure outcome alignment with our objectives for our students, including exit surveys data regarding:

- Improved satisfaction with student-supervisor mentoring relationships.
- Earlier and more accurate identification of preferred career directions.
- Changes in student career aspirations and expectations while in program.
- Improved alignment of post-PhD placements with those preferences.
- Improved quality of those placements.

In the future, College, Department, and program leadership should evaluate the results of these assessments to make informed decisions about whether activities should be continued, replaced, or discarded.

III. Appendix: Graphical Summary of New Activities

<p>Goal 1 Improving students' navigation through programs</p>	<p>Goal 2 Increasing program flexibility and efficiency</p>	<p>Goal 3 Exploring and preparing for desired career outcomes</p>	<p>Goal 4 Acquiring necessary interdisciplinary skills</p>
<p>Improved Orientation Activities</p> <ul style="list-style-type: none"> Coordinated with programs and Graduate School Provide just-in-time awareness of available services as well as responsibilities, milestones, and expectations Reinforce in subsequent reorientation <p>Training in Workplace Skills</p> <ul style="list-style-type: none"> Professional standards Inclusivity Self-advocacy Workplace communication <p>Improved Student Assessment</p> <ul style="list-style-type: none"> Programs should implement structured assessment protocols Early assessment point, mid-career checkpoint, annual meetings thereafter CNS should develop customizable annual review templates <p>Professional Development of Graduate Faculty and Staff</p> <ul style="list-style-type: none"> CNS should expand dissemination of information about graduate education through multiple channels 	<p>Degree Plan Modernization</p> <ul style="list-style-type: none"> Each GSC should critically examine and modernize degree plan(s), requirements, and curriculum Use comparative data from peers and aspirational peers <p>Boot camps</p> <ul style="list-style-type: none"> Interested programs may partner with CNS to develop intensive short courses to all incoming students Ensure uniform foundational skills in discipline Enable recruiting students from broader ranges of backgrounds and majors <p>Efficient Content Delivery</p> <ul style="list-style-type: none"> CNS can restructure policies on faculty teaching credit GSCs should consider restructuring course credit requirements in programs <p>Enhancing Diversity</p> <ul style="list-style-type: none"> Re-examine admissions practices Experiment with new recruiting events <p>Uniform TA Workload Guidelines</p>	<p>Individual Development Plans</p> <ul style="list-style-type: none"> Students should receive instruction in how to prepare and periodically revise IDPs CNS should provide IDP training for students and interested graduate faculty and staff <p>Career Counseling</p> <ul style="list-style-type: none"> Programs should strongly encourage student utilization Invite PhD alumni to career development and networking events Increase <i>Handshake</i> awareness <p>Elective Training</p> <p>CNS should develop and pilot concentrations available to students interested in:</p> <ul style="list-style-type: none"> Teaching and Mentoring Communicating Science Leadership and Management Others as determined by student interest <p>PhD Alumni Advisory Board</p> <ul style="list-style-type: none"> CNS should consider forming a group of PhD alumni who are successful outside academia Provide input on emerging workforce needs and improving students' competitiveness outside academia 	<p>Descriptive and Inferential Statistics</p> <ul style="list-style-type: none"> CNS should develop and pilot intensive short courses on descriptive and inferential statistics and regression analysis Ideally one version for life sciences and another for physical sciences GSCs determine appropriate level of participation as soon as students have completed required coursework <p>Computer Programming for Scientists</p> <ul style="list-style-type: none"> CNS should develop and pilot intensive short courses in programming, big data, and machine learning for scientists GSCs determine appropriate level of participation as soon as students have completed required coursework <p>Looking forward...</p> <ul style="list-style-type: none"> Experiment to find best modes of content delivery Ensure accessibility Revise topics as science evolves