

**The Impact of the COVID-19 Pandemic on
Graduate Students and Programs in the Chemical Science:
Results from an ACS-Sponsored Survey**

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Summary

In the fall of 2022, the American Chemical Society (ACS), in collaboration with COACH, surveyed Masters and PhD students in the chemical sciences and graduate program coordinators regarding the impact of the COVID-19 pandemic and ways to help address concerns. This document summarizes analyses of data from over 900 students and 38 coordinators.

Results indicate that the vast majority of students experienced negative personal impacts of the pandemic, most often involving mental health, and that the negative impact has not yet abated. Large numbers of first year students had delayed entrance into graduate school in part because of the pandemic. Both students and graduate coordinators reported numerous negative impacts on the quality and nature of their graduate programs during the pandemic.

The majority of students and graduate coordinators believed that there would be continuing negative impacts of the pandemic. A large majority of students believed the pandemic would have a negative impact on their careers and about half of the returning students indicated that their career plans had changed during that time. While students' commitment to pursue a career in the chemical sciences was similar to that found in earlier ACS surveys, there were changes in both fields of interest and preferred sectors of employment. Students were also less likely than those in earlier ACS surveys of graduate students to believe that they would complete their degrees and PhD students were less likely to plan to pursue a post-doc. Students who reported more severe personal impacts of the pandemic were more likely to anticipate future negative impacts and to report changing career plans.

The majority of students and graduate coordinators supported efforts by the ACS, universities, and funding agencies to counter the negative impact of the pandemic. Programs and policies that were most often endorsed included funding for graduate student travel to conferences, career-related experiences including networking opportunities, increased mental health services, and networking opportunities for graduate coordinators.

The Impact of the COVID-19 Pandemic on Graduate Students and Programs

in the Chemical Sciences: Results from an ACS-Sponsored Survey

1. Introduction

This document summarizes information from an American Chemical Society (ACS) sponsored survey regarding the impact of the COVID-19 pandemic on graduate students and programs in the chemical sciences and ways to help address concerns. Data were obtained through internet-based surveys sent to graduate students and graduate program coordinators in the fall of 2022. The surveys were developed through a careful, multi-step process to identify key issues, ensure that question wording was appropriate, and that the format was short and easy for respondents to complete. Links to the survey were distributed via email by the ACS in fall 2022. Usable data were obtained from 925 students and 38 coordinators of graduate programs.

All students were asked about ways in which the pandemic had affected their lives, career plans, and the quality of their graduate education, as well as how the ACS and other organizations might help students recover from the effects of the pandemic. Graduate coordinators were asked about the impact of the pandemic on their students and programs, both during the pandemic and continuing, and ways that the ACS might help address continuing issues. The survey data were supplemented by contextual information obtained from national databases regarding universities and departments. These data included indicators of research funding, participation in equity-related programs, the size and sector of schools, COVID-related restrictions that were adopted during the pandemic, and the impact of the pandemic on the county in which the university was located. Following standard procedures in the social sciences, summative, composite measures were created to facilitate analysis and enhance the reliability of results.

Data analyses were designed to understand the issues that face graduate students and graduate programs building on the hypothesis that students' views and future plans could be influenced by their personal characteristics and experiences as well as the environments in which they lived and studied. Thus, the analysis examined general patterns of responses as well as differences among students with varying background characteristics and in different settings. When possible, students' responses were compared to information gathered in ACS surveys of graduate students in 2013 and 2019. Much of the analysis was statistical in nature, involving both bivariate and multivariate analyses and supplemented by qualitative analyses of narrative material provided by the students.

The general pattern of results is summarized in the following sections. Section 2 describes the characteristics of the respondents, and Section 3 summarizes respondents' reports of the impact of the pandemic on students and graduate education. Section 4 looks to the future and reports respondents' views regarding the ways in which the pandemic could affect graduate programs in the coming years and changes in students' educational and career plans. Section 5 summarizes respondents' views of policies and programs that could help students and graduate

programs in the future, and Section 6 provides a brief summary and discussion of potential implications of the results. Extensive statistical details, copies of the surveys, a summary of the preliminary focus groups and interviews used to develop the 2022 survey, and students' open-ended comments are in the technical appendix.

2, Characteristics of the Sample

A majority of the students were midway through their graduate program (years 2 to 4 for doctoral students and year 2 for masters students), about a third were in later years, and somewhat fewer were in their first year. Over 90% were in doctoral programs. Most were in publicly supported institutions located in medium or large cities and with more than 20,000 students. A small minority were from schools located outside the US, most often in Canada. Over a third were in schools ranked in the top 25 in terms of research funding, and three-fourths were in schools ranked in the top 100. Over three-fourths were in schools that had at least one representative participate in the Center for the Improvement of Mentored Experiences in Research (CIMER) training program. Almost three-fifths were in schools that had dropped the GRE requirement for admission, and slightly more than ten percent were in schools that participated in the ACS Bridge program to increase the number of PhDs awarded to traditionally underrepresented students.

The students had diverse demographic characteristics. Two-thirds were citizens or permanent residents of the United States. Of students from another country, three-fifths indicated that they were of Asian heritage. Close to a fifth identified as representing a racial-ethnic group traditionally under-represented in the field, including Hispanics, African Americans, American Indians, and Pacific Islanders. Slightly more than half were women, and around one-fifth identified as LGBTQ. While over a third were married or partnered, only five percent reported having children. Compared to the 2013 and 2019 ACS surveys of graduate students, the present sample included significantly more women, U.S. citizens or permanent residents, and those who identified with a racial-ethnic group traditionally under-represented (i.e., underrepresented minority (URM)) in the field. (See Figure 1.) It is not possible to know if these differences indicate changes in the composition of graduate students in the field or differences in the extent to which the samples represent the population. Importantly, however, these variables were controlled in the multivariate analyses of changes in students' plans over time.

Data were available from 38 graduate program coordinators. All but three represented programs that offered doctoral degrees. The programs ranged in size from those that awarded less than 20 PhDs a year (64%) to those that awarded 40 or more doctoral degrees (9%). They also varied in the amount of research funding received, with around a third ranked in the top 50 and almost as many unranked. The majority represented schools that had at least one representative participate in the research mentorship training program from CIMER, about half did not require the GRE for admission, over half were from large public institutions, and a few participated in the ACS Bridge program. Over half of the graduate coordinators were tenure-track faculty.

Most colleges and universities implemented policies to reduce the spread of COVID-19. The vast majority of students (85%) were in schools that required masks, and a quarter of the

students were in schools that required both vaccinations and testing. Almost all graduate coordinators reported requirements of social distancing and remote learning. About four-fifths reduced lab hours and three-fourths closed campuses. (See Figure 2.)

Finally, the students' universities were located in counties that varied substantially in the toll of the pandemic. One-fourth of the students were in counties that the U.S. Center for Disease Control (CDC) has classified as highly vulnerable to disasters. About a third were in counties with at least some hesitancy regarding vaccinations, and there was a large variation in the percentage of adults who were fully vaccinated (15% to 75%). COVID-related mortality also varied greatly. On average students were in counties where COVID deaths were about 20% of all deaths, but this value ranged from a low of 9% to almost 40%.

3. Impact of the Pandemic

Data gathered in the survey addressed how students' personal lives, educational decisions and graduate programs were affected by the pandemic.

3. A. Personal Impacts

The vast majority of students (94%) indicated that they had experienced at least one personal negative impact from the pandemic. (See Figure 3.) Over three-fourths of the students reported mental health issues and over half reported increased financial concerns. Almost a third reported problems with their physical health, and over one-fourth reported increased care-taking responsibilities. There was little indication that the increased personal strains had diminished significantly over time. (See Figure 4.) Almost two-thirds of the students who reported financial concerns indicated that these concerns have worsened. Over two-fifths of those who reported issues with mental or physical health reported that these issues had become more problematic. Multivariate analyses indicated that, when other variables were equalized, students who identified as URM or LBGQT and students in large public universities reported more severe and continuing personal impacts of the pandemic. U.S. citizens or permanent residents reported fewer personal challenges.

The graduate coordinators recognized the severity of these issues. They all indicated that students had negative experiences associated with reduced interaction with peers. The vast majority also reported negative impacts on students' mental health, their morale, their interactions with faculty and other professionals, and the general quality of the learning experience. In contrast, only a fifth believed that the pandemic had negatively affected their students' commitment to the chemical sciences. (See Figure 5.)

3.B. Delaying or Pausing Graduate School

About half (52%) of the students in the first year of their graduate program indicated that they had delayed starting at least partly because of the pandemic. As reasons for this delay, over two-fifths cited concerns with the quality of education they would receive, their own academic preparation, financial issues, and/or issues involving their mental health. Somewhat fewer cited their own physical health or the health of significant others. (See Figure 6.)

In contrast, a relatively small percentage (13%) of students who were beyond the first year of their program indicated they had taken a break from their graduate studies during the pandemic. For the majority (72%) this break was less than an academic year. The most common reason for pausing their studies involved concerns with their own mental and physical health. A quarter mentioned restrictions on their progress from COVID-related policies, slightly fewer mentioned financial concerns and care-taking duties. Less than a fifth mentioned concerns about the quality of their education. (See Figure 7.)

3.C. The Quality of Graduate Education

Students in their second or later year of graduate studies were asked how the quality of their graduate education had been affected by the pandemic. The most common negative impacts mentioned involved research experiences and interactions with other students, followed by concerns regarding interactions with faculty and classroom instruction. (See Figure 8.) In response to a question about positive effects, half of the students (52%) indicated that there were none, although a few noted better interactions with their research advisor and advantages of on-line and hybrid work. Statistical analyses indicated that students reported a significantly larger number of negative impacts on the quality of graduate education when they were later in their graduate program, were U.S. citizens or permanent residents, experienced more severe personal impacts of the pandemic, and were in higher-ranked departments in private institutions. None of the correlations of the number of positive impacts with student or contextual characteristics were statistically significant.

Graduate coordinators' reports of impacts on their program generally paralleled the comments of students. Over four-fifths reported negative impacts on student morale and their ability to network. Over half reported negative impacts on the quality of students' lab experiences, timely completion, faculty morale, and the number and quality of graduate students. Negative impacts associated with financial issues were mentioned by a third or less. (Table 1) Paralleling the results with students, coordinators from more highly-ranked departments reported more negative programmatic impacts.

4. Continuing Impacts of the Pandemic

Students and graduate coordinators were asked about ways in which the pandemic might continue to affect their graduate program. Using questions from earlier ACS-sponsored surveys, students were asked about their future career and educational plans, allowing comparison with pre-pandemic years.

4.A. Graduate Programs

Almost three-fourths (71%) of the students anticipated at least one continuing negative effect of the pandemic on their graduate education. The most common concerns involved interactions with faculty, noted by over half of the first-year students, followed by concerns regarding interactions with other students and career preparation, expressed by about a third of the students. (See Figure 9.) Students in earlier years of graduate school and those who had suffered more extensive personal issues from the pandemic were significantly more likely to

anticipate continuing negative effects. Few students indicated potential long-term positive effects of the pandemic.

Graduate coordinators were asked about the continuing impact of the pandemic on their students and their graduate programs. Over three-fourths of the coordinators reported that there were continuing negative effects of the pandemic on students' mental health and over half indicated continuing issues with students' financial well-being and timely progress through the graduate program. (See Figure 10.) Over three-fourths expressed program-related concerns regarding students' academic preparation, and over half expressed concerns regarding the uneven size of graduate cohorts. (See Figure 11.)

4.B. The Pandemic and Future Careers

At the beginning of the survey all students were asked their view of the impact of the pandemic on their "career in the chemical sciences in the years to come." The vast majority of the students believed that the impact would be at least somewhat negative, and less than a fifth believed the impact would be at least somewhat positive. (See Figure 12.) Students in the later years of their program, women, and those who had experienced more serious personal impacts of the pandemic were significantly more likely to believe that there would be a negative impact.

Replicating a question from earlier ACS-sponsored surveys, students were asked how likely it was that they would remain within the chemical sciences upon graduation. Even though students believed their career would be negatively affected by the pandemic, there was no decline over time in students' commitment to the field. In all three survey years (2012, 2019, and 2022), around two-fifths of the students indicated that they were extremely likely to remain in the field and about the same proportion indicated that they were very likely to do so. (See Figure 13.) Within the 2022 sample, students who were more advanced in their degree programs, U.S. citizens or permanent resident, in more highly ranked departments, or suffered a more severe personal impact of the pandemic were less likely to believe they would remain in the field.

Even though the strength of students' general commitment to the field was not different from pre-pandemic levels, there are indications that some aspects of their career plans were different. Students in their second year or later of graduate study were asked if their career plans had changed "in any way (e.g. field of interest, career aspirations, etc.)" during the pandemic. About half (49%) of the students indicated that their plans had altered, and students who had experienced more severe personal impacts of the pandemic were significantly more likely to report changed plans.

To provide insight into the possible nature of these changes, the specialty areas and preferred future career paths of students in the current sample were compared to those in the earlier surveys of graduate students. Students in the current, post-COVID sample were significantly more likely to report an interest in analytic, chemical biology, and material chemistry, but less likely to indicate an interest in inorganic. (See Figure 14.) Multivariate analyses indicated relatively few differences in these patterns across students with varying demographic or departmental characteristics.

There were also changes in the preferred sector of employment. Students in the current, post-COVID sample were significantly more likely than students in the 2019 sample to plan a career in industry and less likely to plan to enter academe. (See Figure 15.) Multivariate analyses indicated that the changing interest in academe was not related to the individual and department-associated variables that were examined. In contrast, the increased interest in industry was stronger among students in the top-ranked schools.

4.C. Finishing the Degree Program

Students who were at or beyond their second year of graduate school were asked if their commitment to finishing their degree changed over the last two years. While a little more than half (55%) indicated there had been no change, one-fourth (26%) reported that they had become less committed. Students who had experienced more severe personal impacts of the pandemic were significantly more likely to report a decline in their commitment.

Students who responded to the 2022 survey were significantly less likely than students responding to the 2012 and 2019 surveys to anticipate finishing their graduate programs. In 2013 and 2019, over four-fifths (86%) of Masters' students indicated that they would definitely complete their degrees. But, in 2022, only about one-half (51%) did so, reflecting a sharp decline in commitment among first year students and those in their third year or later of Masters' work. (See Figure 16.) Among doctoral students, the percentage of doctoral students with definite plans to complete also fell over time, and the change was greatest among students in the second to fourth years of their graduate program. (See Figure 17.) Further analyses of the 2022 data indicated that students were significantly less likely to definitely plan to complete their degree if they had experienced more severe personal impacts of the pandemic, but more likely to do so if they were more advanced in their program.

Analyses also indicated significant declines over time in the percentage of doctoral students planning to pursue a post-doc, but the pattern of change varied across students at different stages in their graduate program. There was little change over time in first year students' plans for a post-doc, the decline for those near the end of their program was larger from 2012 to 2019 than from 2019 to 2022, while the decline for those in mid-program occurred consistently throughout the time period examined. (See Figure 18.) Analyses of data from the 2022 survey indicated that students who were farther along in their program, women, and U.S. citizens or permanent residents were less likely to plan a postdoc. In contrast to other analyses, students' post-doc plans were not related to the reported personal impact of COVID.

Masters' students in the three surveys were asked if they planned to pursue a doctoral degree in the future. In contrast to results regarding post-doctoral plans, the percentage of Masters' students definitely planning to pursue a Ph.D. increased substantially over time, from 30% in 2012 to 46% in 2022, while the percentage who were unsure of their plans decreased (42% to 24%). (See Figure 19.)

5. What Could Help

Finally, respondents were asked to indicate policies or programs that could help promote recovery from the impact of the pandemic. Over half of the students supported efforts by the ACS to promote interactions with professionals, provide funding for travel to conferences, and promote career-related experiences, publishing, and job placement. (See Figure 20.) When asked about ways their universities could help, in addition to funding travel, research, and career opportunities, almost three-fifths indicated the importance of mental health services.

When asked about programs that could help their students and programs recover, a vast majority of graduate coordinators mentioned funding for students to attend conferences and support career-related experiences. Two-thirds noted the importance of mental health services. Close to half endorsed greater career opportunities for undergraduate students and promoting networking for graduate coordinators. (See Figure 21.)

6. Summary and Implications

The findings summarized above indicate that the COVID-19 pandemic impacted graduate students in a variety of ways involving mental health, connections with others, changing career plans, and the probability of finishing their degree. Multivariate analyses indicated that for many outcomes, students who had experienced more severe personal impacts of the pandemic also had more negative career and educational outcomes. Some analyses indicated variations in impacts regarding other variables such as year in their graduate program, national origin, and characteristics of their department. But, in general, while students who experienced more severe personal impacts are more at risk, there appeared no indication that the negative impacts were limited to students with certain demographic characteristics or to certain types of departments. In addition, students' and graduate coordinators' views regarding policies and programs that could help counteract negative effects of the pandemic were very similar. The vast majority of respondents emphasized the importance of funding to enhance networking and career development as well as attending to mental health needs of students.

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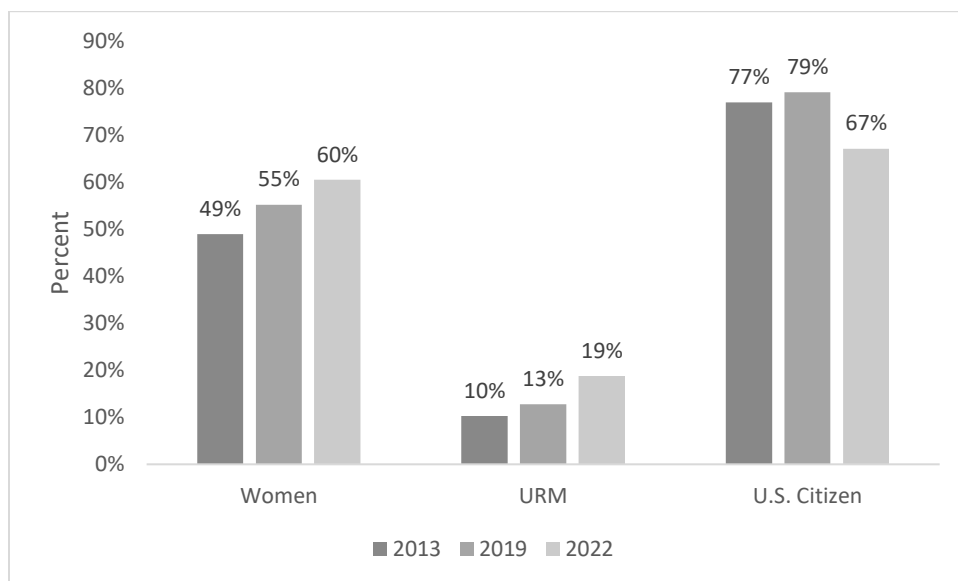
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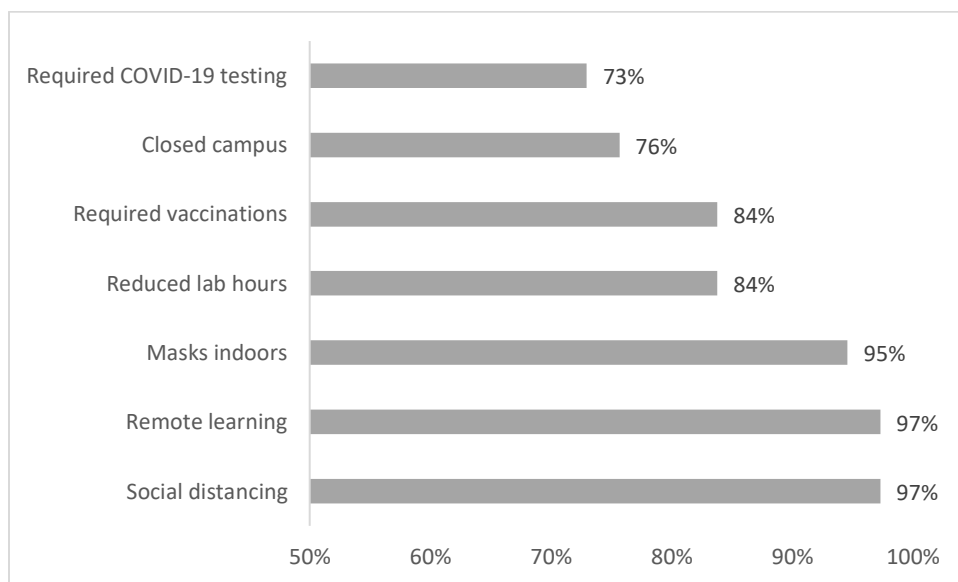
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Figure 1: Demographic Characteristics of Respondents to ACS Surveys of Graduate Students, 2013, 2019, and 2022



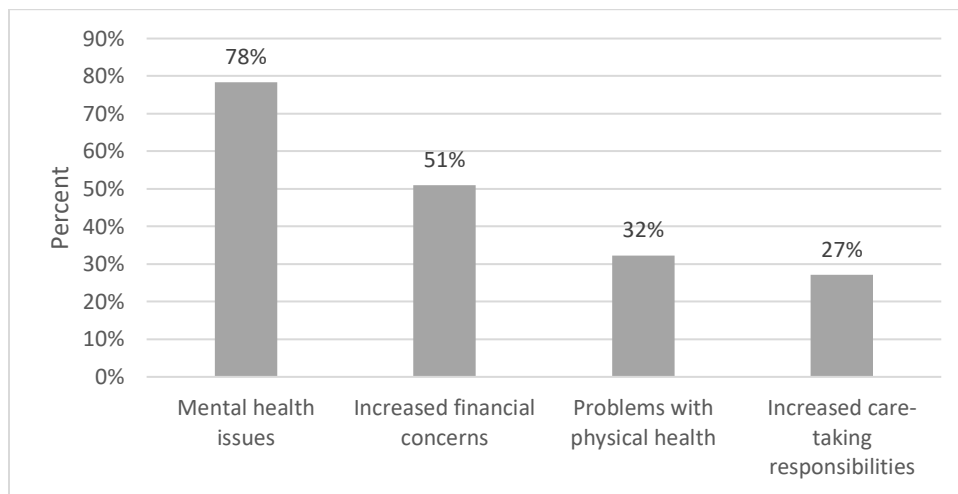
Note: URM indicates students who identified as a member of a racial-ethnic group traditionally under-represented in the chemical sciences.

Figure 2: Policies Enacted During the Pandemic, Reports from Graduate Coordinators



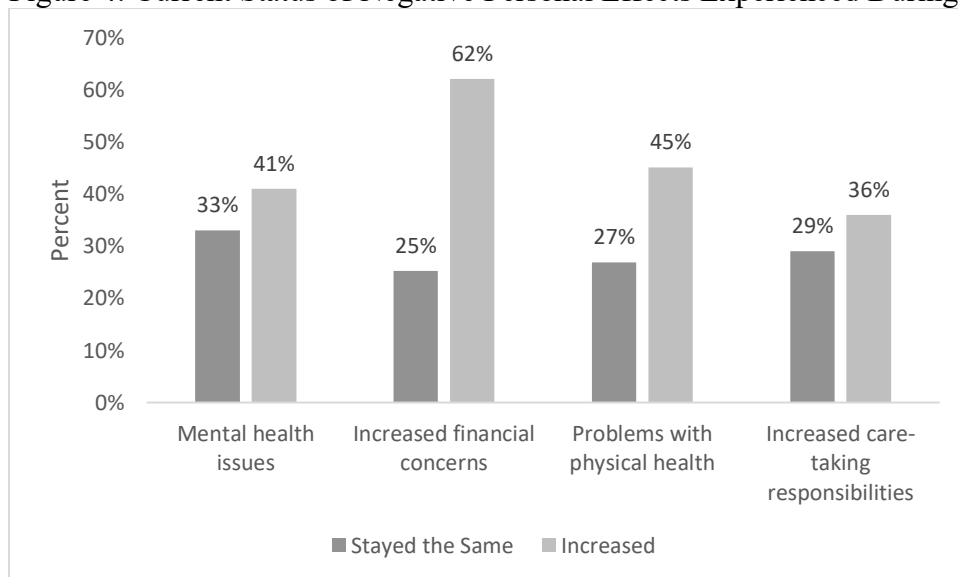
Note: Question was worded, "Colleges and universities around the country adopted a number of different policies related to instruction, student interactions, and research procedures. Which of the following did your campus adopt? Please check all that apply." N=37

Figure 3: Percent of Students Experiencing a Negative Personal Impact of the Pandemic



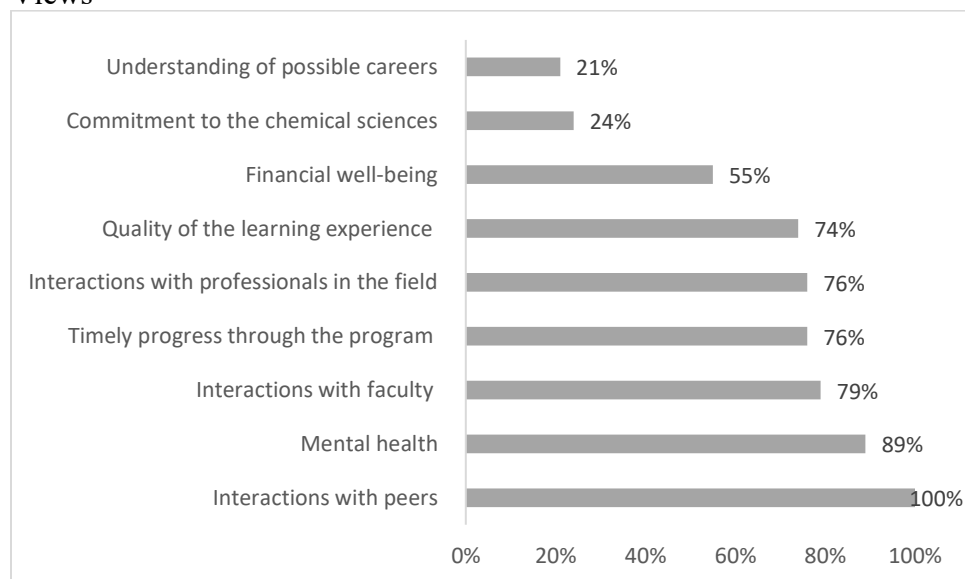
Note: The question was phrased, “Many people reported negative personal experiences during the pandemic over the last two years. Did you experience any of the following?”

Figure 4: Current Status of Negative Personal Effects Experienced During the Pandemic



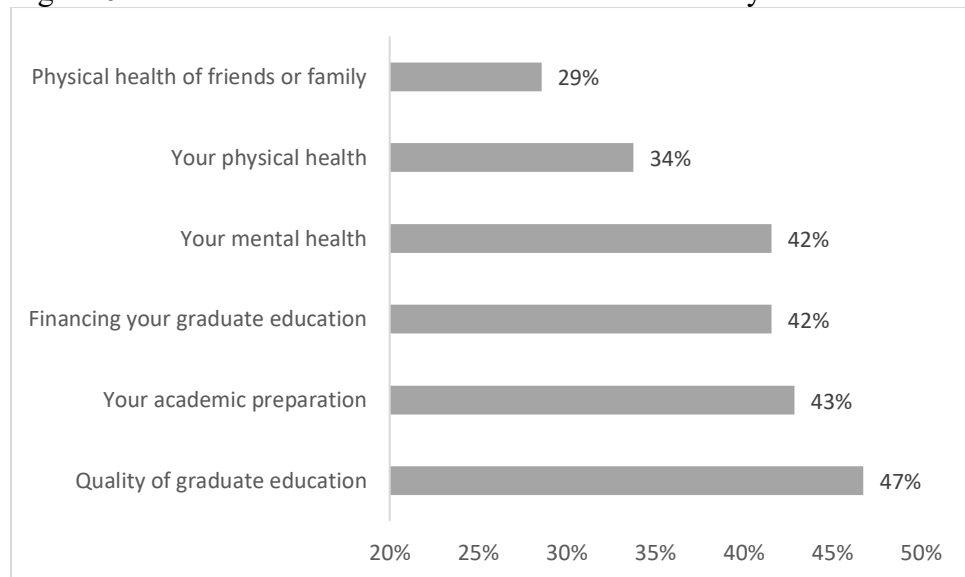
Note: When students indicated that they had a given experience, as indicated in Figure 3, they were then asked, “Has the increased level of ... diminished, stayed the same, or increased further since the pandemic started two years ago?” The percentages were calculated within the sub-sample that reported experiencing an area.

Figure 5: Negative Impacts on Graduate Students during the Pandemic, Graduate Coordinator Views



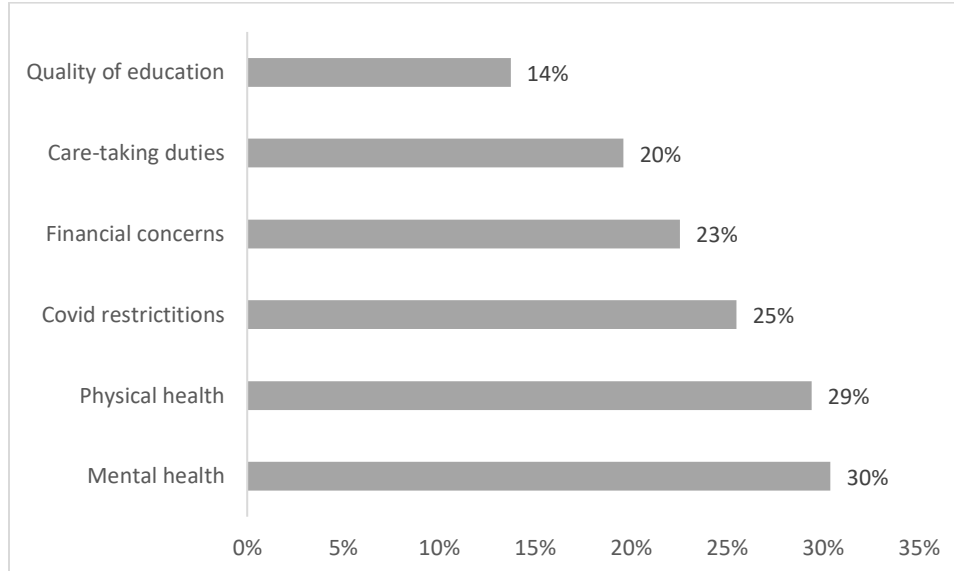
Question was worded, "The pandemic affected graduate students in the chemical sciences in a variety of ways. In the list below please indicate ways in which, during the last two years (academic years 2020-2021 and 2021-2022), students in your program were NEGATIVELY affected by the pandemic. (Please mark all that apply.)" N=38

Figure 6: Reasons that First Year Graduate Students Delayed Entrance to Graduate School



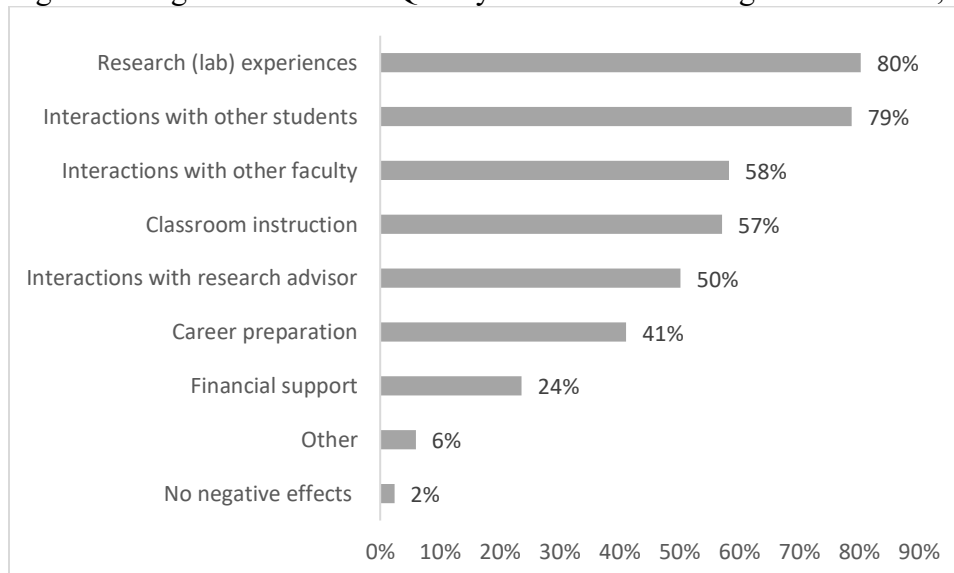
Note: Question was phrased, "There are many reasons why students may have decided to delay graduate school during the pandemic. Which of the following concerns affected your decision to delay graduate school? Please check all that apply." The question was asked only of students who had delayed entrance. N=77.

Figure 7: Reasons that Graduate Students in Second Year or Later Paused Education during the Pandemic



Note: Question was phrased, "Why did you take the break? Please mark all that apply." Question asked only of students who had taken a break. N=102.

Figure 8: Negative Effects on Quality of Education during the Pandemic, Student Views



Note: Question asked only of students in 2nd year or later of graduate program. Question was phrased, "Over the last two years were there areas in which the quality of your graduate education was NEGATIVELY affected by the pandemic?" N=757.

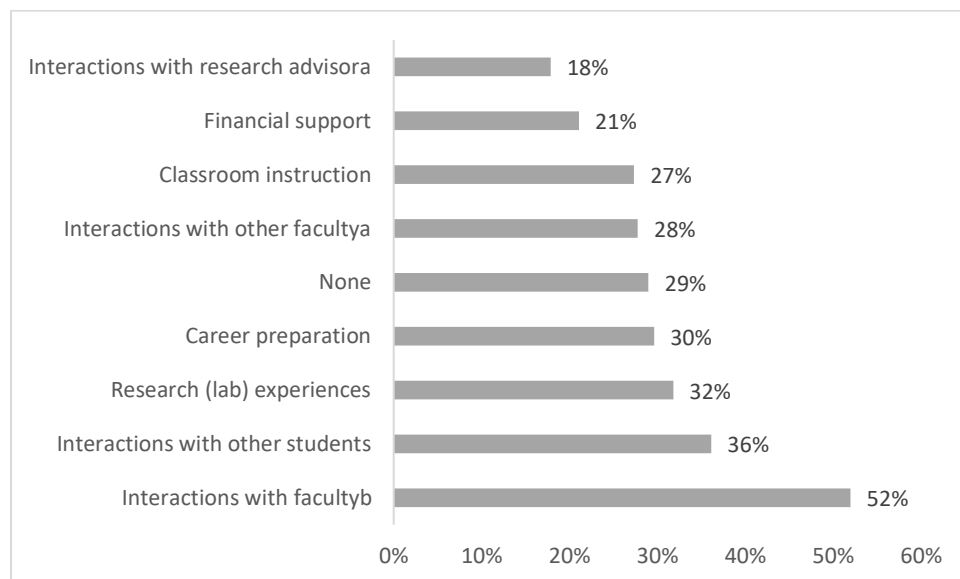
Table 1

Graduate Coordinators' Reports of Ways that the Pandemic Affected Their Graduate Programs

<u>Area of impact</u>	<u>%</u>
Student morale	86%
Ability to network in their department	84%
Ability to network outside their department	84%
Quality of lab experience	73%
Timely completion	68%
Number of graduate students	62%
Faculty morale	59%
Quality of graduate students	51%
Research resources	43%
Ability to discover professional opportunities	43%
Quality of instruction	41%
Retention of students	38%
Financial issues	32%
Financial support	30%
Teaching resources	27%
Student funding	24%
Other	5%

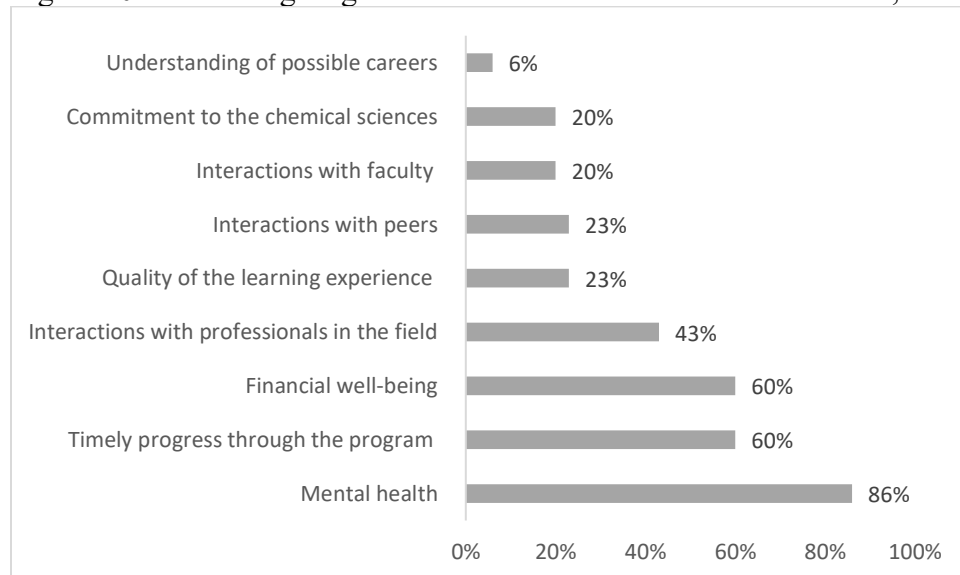
Question was phrased, "Are there ways in which the pandemic had a NEGATIVE impact on your GRADUATE PROGRAM? Please mark all that apply." N=37

Figure 9: Continuing Negative Effects on Graduate Education, Student Views



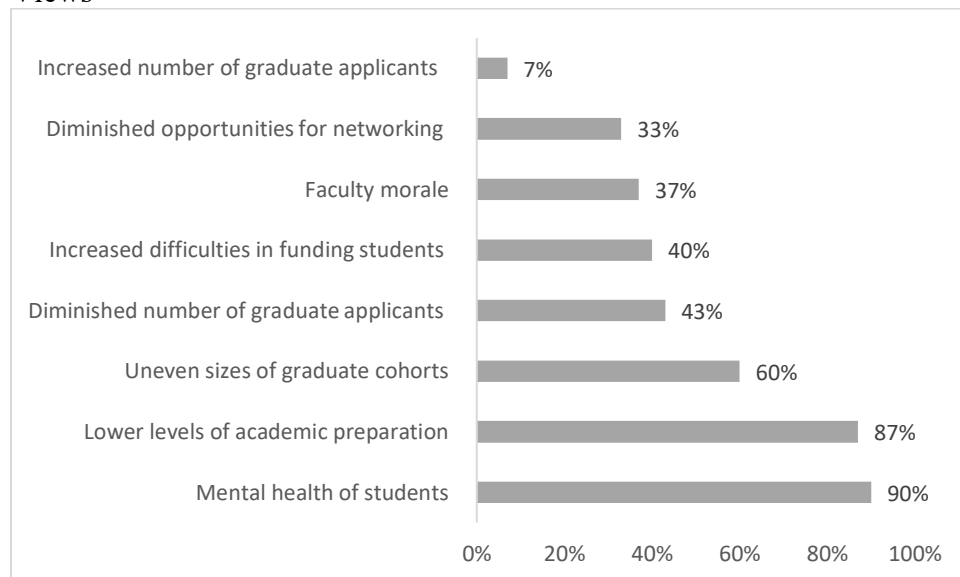
Note: This question was phrased, “Now, consider the future. When you think about the coming years of your graduate program, are there areas in which the quality of your graduate education might be **NEGATIVELY** affected by **POLICIES AND PROCEDURES** adopted because of the pandemic?” Questions marked “a” were asked only of students in 2nd year or later of graduate program, those marked “b” were asked only of first year students. N = 877 students total, 150 in first year.

Figure 10: Continuing Negative Effects of the Pandemic on Students, Coordinators' Views



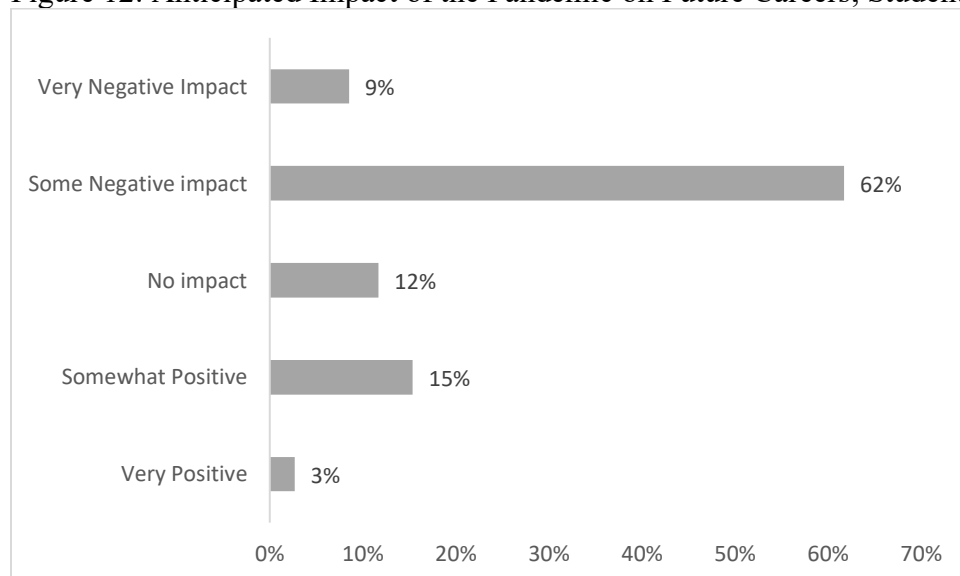
Note: Question was worded, "Please indicate ways in which students in your program **CONTINUE** to be **NEGATIVELY** affected by the experience of the pandemic. (Please mark all that apply.)" Results may be compared to those in Figure 5. N=35

Figure 11: Long-Term Outcomes Anticipated for Graduate Program, Graduate Coordinator Views



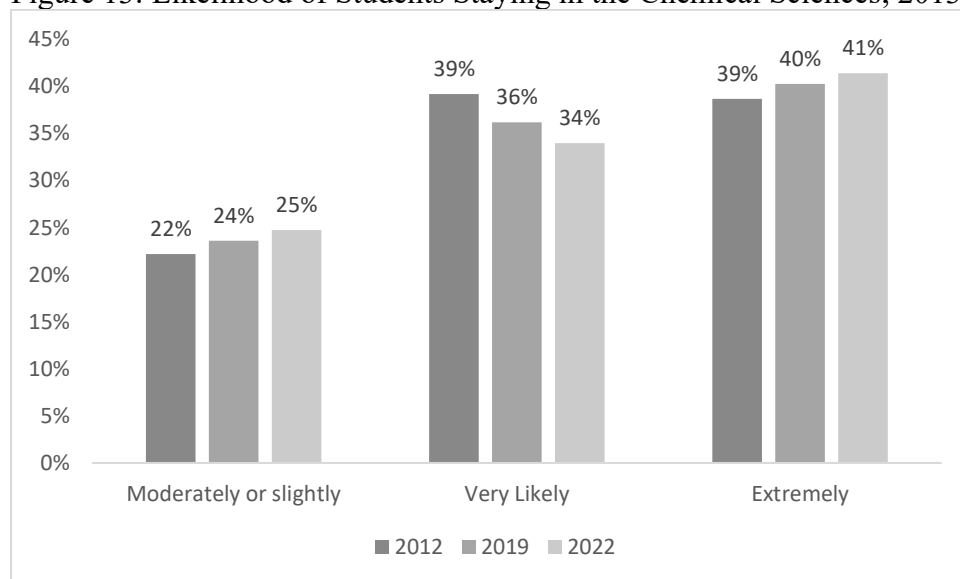
Note: This question was asked only of those who indicated that there might be continuing impacts of the pandemic. The question was worded, "Which of the following long-term outcomes do you anticipate for your program?" N=37

Figure 12: Anticipated Impact of the Pandemic on Future Careers, Student Views



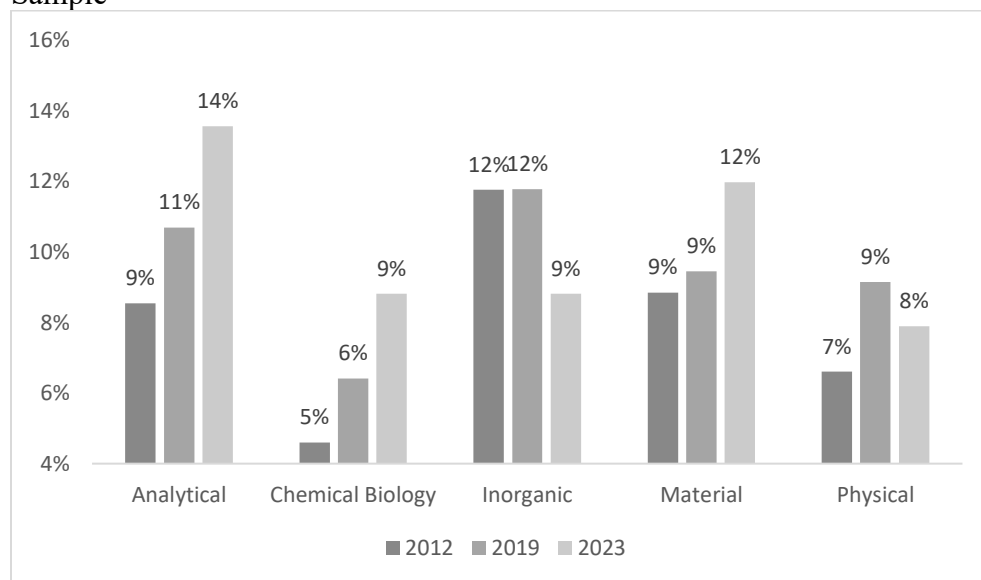
Note: Question was phrased, "In general, what impact do you think the COVID-19 pandemic will have on your career in the chemical sciences in the years to come?"

Figure 13: Likelihood of Students Staying in the Chemical Sciences, 2013, 2019, and 2022



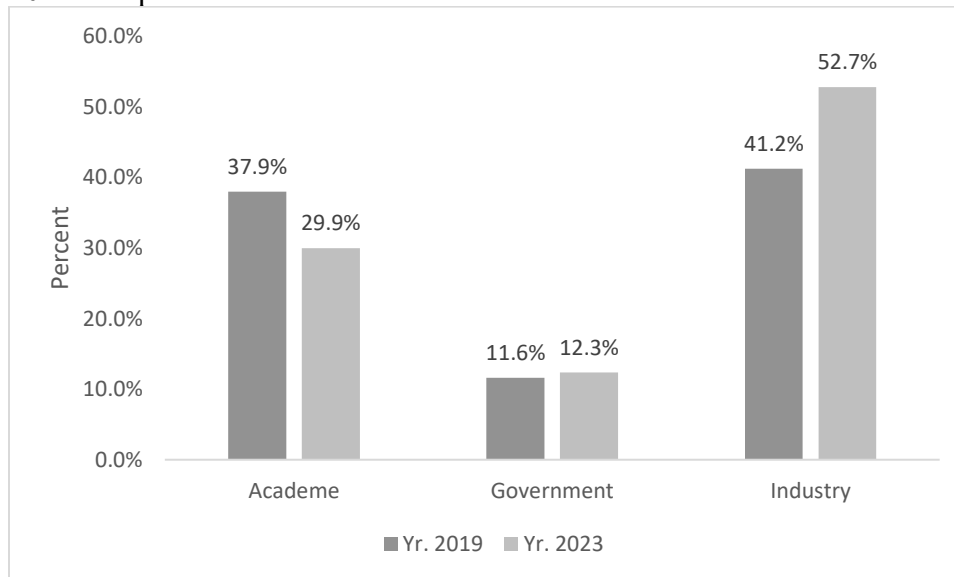
Note: Question was phrased, “Looking ahead, how likely is it that you will stay in the chemical sciences after you graduate?”

Figure 14: Students’ Field of Study, 2013 and 2019 ACS Surveys of Graduate Students and 2022 Sample



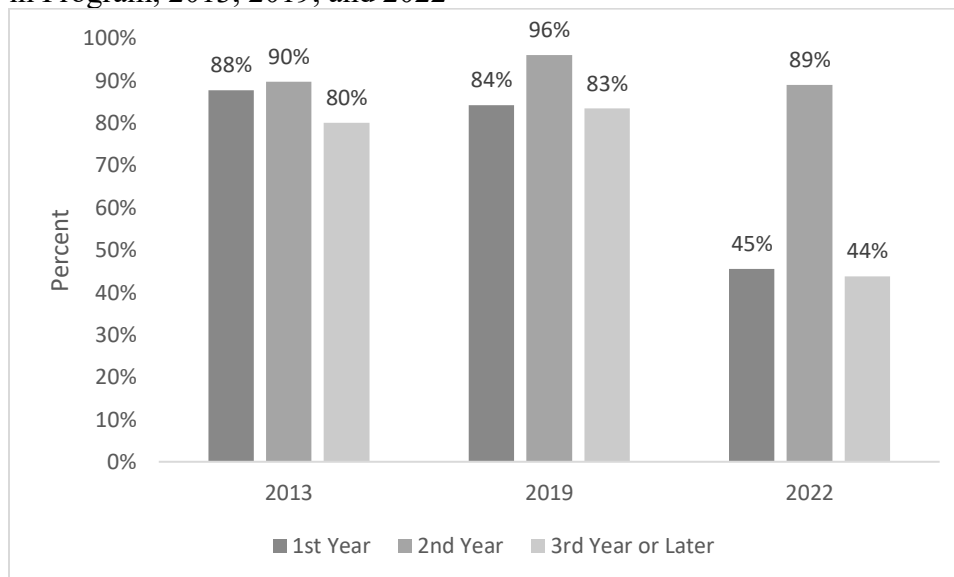
Note: Question was phrased, “What is your primary field of study?” Fields less commonly chosen omitted from the comparison.

Figure 15: Students' Intended Future Career Sector, 2019 ACS Survey of Graduate Students and 2022 Sample



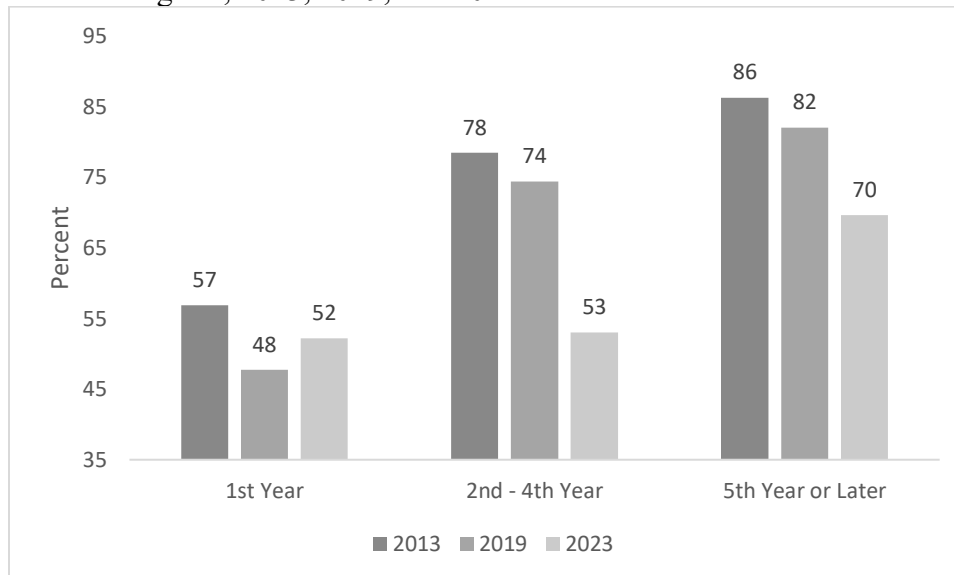
Note: Question was phrased, “When thinking about the future, which of the following career sectors is of most interest to you?” Relatively few students indicated an interest in the nonprofit sector or in an entrepreneurial career. Comparable data were not available for 2013.

Figure 16: Percentage of Masters Students Definitely Planning to Complete their Degree by Year in Program, 2013, 2019, and 2022



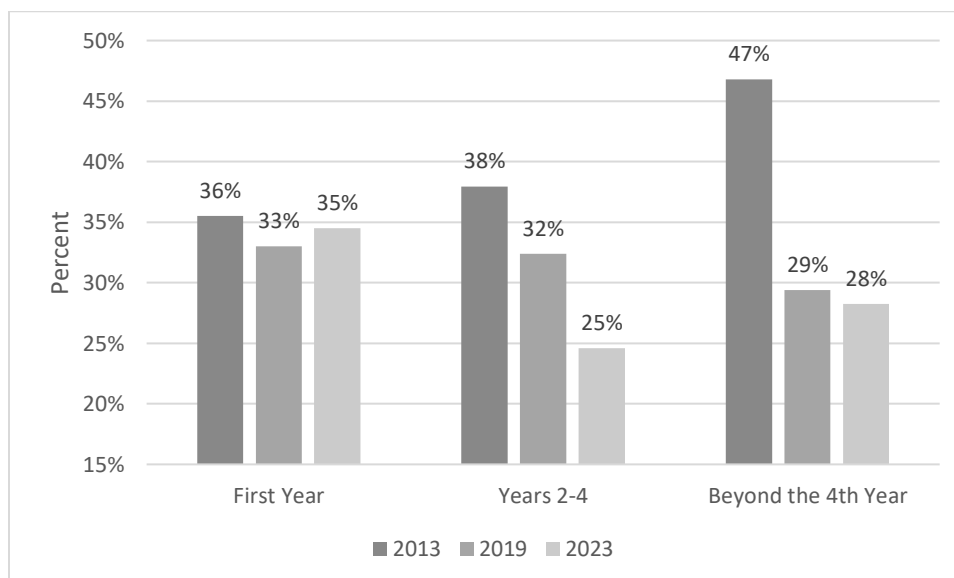
Note: Question was worded, “Looking ahead, how likely is it that you will complete your degree program?”

Figure 17: Percentage of Doctoral Students Definitely Planning to Complete their Degree by Year in Program, 2013, 2019, and 2022



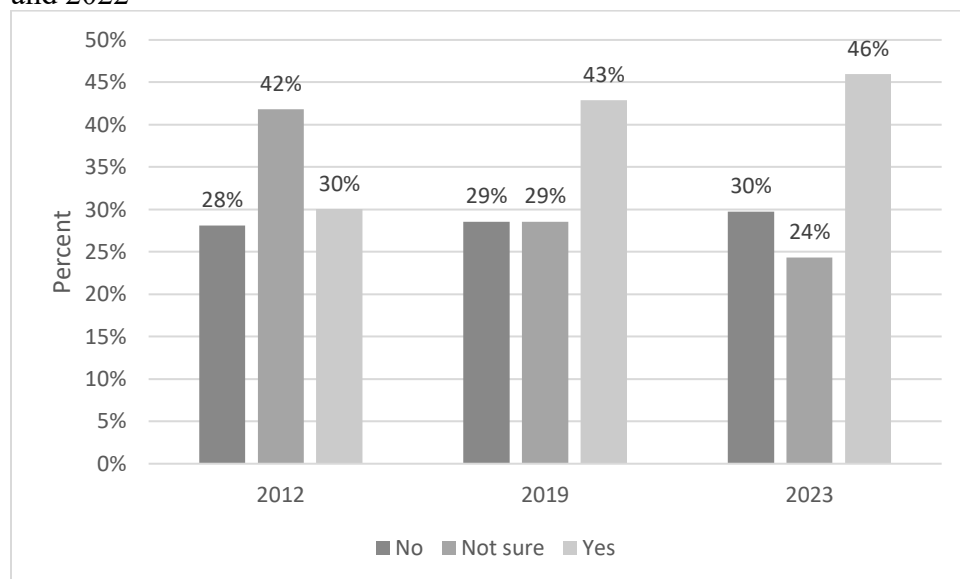
Note: Question was phrased, “Looking ahead, how likely is it that you will complete your degree program?”

Figure 18: Percentage of PhD Students Planning to Pursue a Post-Doc, by Year in Program, 2013, 2019, and 2022



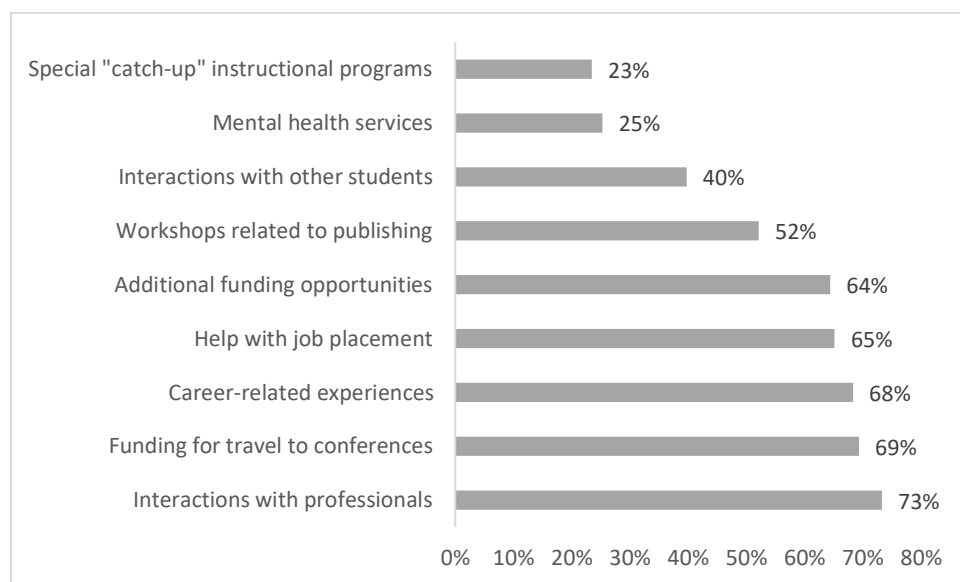
Note: Question was worded, “Do you plan to do a postdoctoral position upon completion of your Ph.D.?” Graph indicates the percentage who responded “yes” rather than “not sure” or “no.”

Figure 19: Percentage of Masters Students Planning to Pursue a Doctoral Degree, 2013, 2019 and 2022



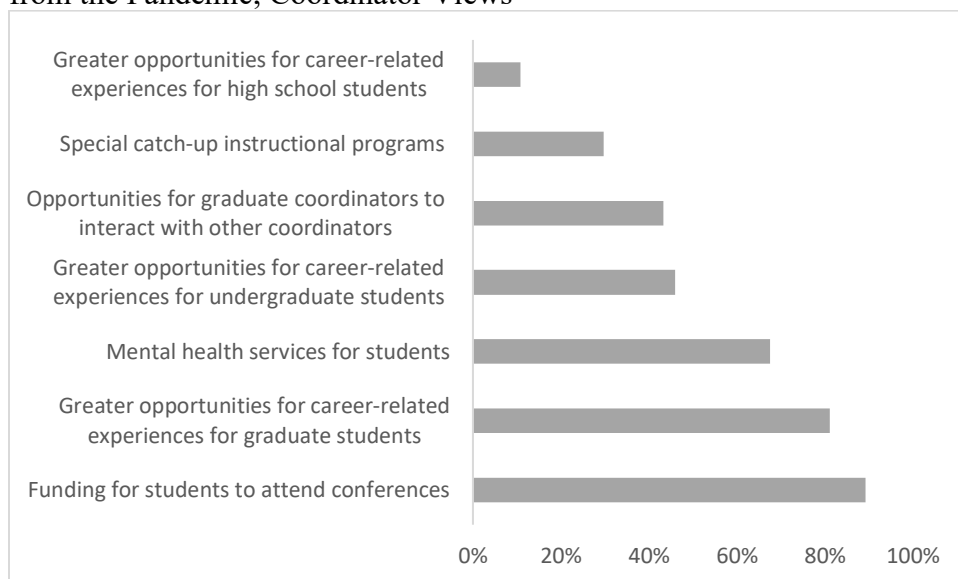
Note: Question was worded, “Do you plan to continue in a Ph.D. program upon completion of your Master's degree?”

Figure 20: Policies and Programs the ACS Could Adopt to Help Recovery from the Pandemic, Student Views



Note: Question was worded, “From the list below please indicate policies or programs that the ACS could adopt to help you complete your degree and launch your career in the chemical sciences. Mark any that apply. N=893

Figure 21: Policies and Programs that Could Help Students and Graduate Programs Recover from the Pandemic, Coordinator Views



Note: Question was worded, “The list below includes suggestions for ways in which ACS might help graduate students and graduate programs address issues resulting from the pandemic. Please indicate ways that would benefit your department or your students.” N=37

**The Impact of the COVID-19 Pandemic on
Graduate Students and Programs in the Chemical Science:
Results from an ACS-Sponsored Survey**

Technical Appendix

This document includes details on the methodology and results. It is designed to aid those who might wish to replicate the work, provide details on results summarized in the full report, present additional tests and further examination of the data including students' open-ended comments about their experiences. Section 1 provides methodology details, Section 2 describes characteristics of the samples, Section 3 discusses analyses of the impact of the pandemic on students' personal lives and decisions to delay or pause their graduate education, Section 4 presents results regarding the perceived impact of the pandemic on the quality of graduate education, Section 5 summarizes data on views regarding the continuing impact of the pandemic on students and graduate programs, Section 6 reports analyses of data from the 2022 survey regarding students' future career plans, Section 7 examines future educational plans, and Section 8 summarizes analyses comparing data from the 2022 survey with data gathered in ACS surveys of graduate students in 2013 and 2019. Statistical tables follow the discussion. Appendix A includes the survey instruments and letters sent to respondents, and Appendix B includes the open-ended responses.

1. Methodology

Details are given below regarding the procedures used in survey design and data collection, the sample, measures, and analysis as well as the results of several sensitivity tests.

A. Procedures

For this work, graduate programs were defined as those serving either masters or PhD students. To develop preliminary understandings of the issues facing graduate students and programs, the authors conducted focus groups with current graduate students, interviews with graduate program coordinators, and open-ended surveys of current faculty and administrators in the chemical sciences. Information gathered was used to develop drafts of internet-based surveys for graduate program coordinators and graduate students. The drafts were then reviewed by graduate students, faculty, and administrators. Based on their recommendations, the surveys were revised and re-tested. The web-based survey was constructed using the Qualtrics computer program.

Links to the survey were distributed via email in the fall of 2022 by the ACS official associated with graduate programs. There were multiple follow-ups to enhance participation. The letter to graduate coordinators asked them to fill out the coordinator survey and to forward a link to the graduate student survey to students in their program. A separate mailing was sent to student members of the ACS, and links to the survey were also included in ACS social media directed at students in the chemical sciences, such as Twitter and Facebook. At the

end of the survey, student respondents could use an anonymous link to enter a random drawing for support to attend ACS meetings. Copies of the surveys and the letters are in Appendix A.

Contextual data regarding the universities and the communities in which they were located were gathered from publicly available data sets. These variables and sources are described in the section on measures below.

B. Sample

Slightly more than 1,000 students (n=1021) began the survey, but 96 (9% of the total) did not complete a majority of the questions. To help ensure a consistent sample through the analyses, these 96 students were eliminated, leaving a final sample size of 925 students, 90% of whom were PhD students. More than two-thirds of the responses were obtained through the link sent by graduate coordinators, about a fifth from the link distributed to ACS members, and the remaining from the link distributed through social media. The students represented 182 different institutions. The median time taken to complete the survey was less than 8 minutes.

In total, 71 people responded to the survey for graduate program coordinators. However, one person was at a school that only offered an undergraduate degree, and 27 completed less than half the survey. These respondents were omitted from analysis. In addition, there were several cases in which a faculty coordinator as well as a graduate student at the same university completed the form. In these instances, responses from the graduate students were deleted. Thus, for graduate coordinators, 38 responses were examined (54% of those who looked at the survey). The median time taken to complete the survey was 6 minutes. Thirty percent of the student respondents (n=274) also had data from a coordinator of their graduate program, and there were seven instances of coordinators who responded while no students in their program did so.

C. Measures

The measures reflect four levels of analysis: 1) graduate students, 2) coordinators of graduate programs, 3) the universities and departments in which the students and coordinators were located, and 4) the county in which the university was located. Note that a given county might include more than one university. When possible, to facilitate analyses and increase reliability, variables were coded as dummy (0,1) variables and summary composite variables were constructed.

Standard methods of qualitative analysis were used to group open-ended responses into descriptive categories. Responses were carefully read and synthesized into themes based on their contextual overlap. Some responses were multi-faceted and categorized into a variety of themes. That is, a given response could be placed into more than one category. Other responses (typically shorter, more straightforward replies) were coded into mutually exclusive categories. More ambiguous responses were highlighted, then later reanalyzed to identify

which categories were most appropriate for placement. Additionally, responses that were not amenable to coding or in which respondents had designated a question as not applicable were noted for record keeping.

Graduate Students. When appropriate, first year graduate students and those who were later in their program were given different questions. Students who were in the second year or later of their graduate program were asked if they had taken a break from their studies during the pandemic, and if so, the reasons for the break; the ways that the pandemic had affected their graduate education during the pandemic; and whether they had changed career plans or their commitment to the field. Students in their first year were asked if they had delayed entrance into graduate school because of the pandemic and, if so, what factors influenced this decision. All students were asked about the ways in which policies and procedures adopted because of the pandemic might affect graduate education in the future, personal impacts of the pandemic, ways that organizations might help students recover from the effects of the pandemic on their graduate education, their future career plans, and demographic characteristics.

Several summative measures were created to facilitate analysis. The first were counts of the number of positive and negative effects reported by the students, both during the pandemic and anticipated for the future. By definition, values on these variables ranged from zero to the total number of possible effects listed in the question. Second, a composite measure was developed from the questions regarding personal impacts of the pandemic and the extent to which they continued by summing the scores on the measures of change. Values could range from zero, for those who listed no personal impacts, to 12, for those who indicated that they had experienced each area and all of these impacts had increased in magnitude in recent months.¹

Program Coordinators. The graduate program coordinators were asked their views on how the pandemic affected students, both during the last two years and afterwards; ways the pandemic affected their graduate program (as distinct from students); ways the pandemic could affect their program in the future; policies adopted by their university and department to address the pandemic; ways in which the ACS could help address issues; and characteristics of their department and their position.

University and Department Level. Data regarding the represented departments were obtained from public sources. Information on the sector of the university (public vs private) and its size were obtained from the Integrated Postsecondary Education Data System (IPEDs) of the

¹ To illustrate the coding, there were three levels of the current status of concerns (diminished, stayed the same and increased). Students who had experienced all four areas that were included and had increased concerns with all four would have the maximum score. Students who had experienced all four areas, but the concerns had stayed the same would have a score of 8, while those who had experienced all four areas but the concerns had all diminished would have a score of 4. Intermediate values would be calculated in similar ways.

National Center for Educational Statistics.² Because the distribution was highly skewed, with relatively few smaller schools, the measure of institution size was collapsed to a dummy variable, with a value of 1 indicating schools with 20,000 students or more. In addition, because the measures of size and sector were highly correlated ($r=.54$, $p<.001$), for multivariate analyses they were combined into a dummy variable that distinguished large public schools from others. Information regarding COVID-related policies was provided by Davidson College and included indicators of regulations regarding masking, vaccinations, and testing.³ The measures were combined into a summative scale, with values ranging from 0, indicating no mask, vaccine or testing policies, to 3, indicating that the university instituted all 3 policies.

There were four measures related to departmental characteristics and policies. The department's focus on research was measured by rank in the amount of research funding from the National Science Foundation.⁴ Dummy variables were used to indicate departments that had permanently dropped the requirement of Graduate Records Examination (GRE) results for applicants;⁵ departments that participated in the ACS Bridge program, designed to increase the number of chemical science PhDs awarded to traditionally underrepresented students;⁶ and departments in which a representative had received training regarding research mentorship from the CIMER project.⁷ These four measures were positively correlated. (See Table 1-1.) Higher ranked programs were more likely to have dropped the GRE requirement, to participate in the Bridge program, and to have participated in the mentorship training program. Thus, for multivariate analyses of the student data, the indicators were combined into an additive composite measure using standardized scores to adjust for different scale ranges ($\alpha=.68$). Higher scores indicate schools with more federal funding, less likely to have a GRE requirement for admission, more likely to participate in the Bridge program, and having at least one trained facilitator to promote quality research mentorships.

² National Center for Education Statistics, *The Integrated Postsecondary Education System*, <https://nces.ed.gov/ipeds/datacenter/DataFiles.aspx?gotoReportId=7&fromIped=true&>

³ Bernhardt, A. F., Martin, R. C., Marsicano, C. R., Francis, A., Gade, S., Gujral, S., Lilly, E., Mirabello, S., McLaren, C., Meyer, M., Navani, I., Sheldon, D., Solum, A., & Webb-Newton, A. (2022) *College and University COVID-19 Testing Policies Fall 2021* [Dataset]. The College Crisis Initiative (C2i); Bernhardt, A. F., Martin, R. C., Marsicano, C. R., Francis, A., Gade, S., Gujral, S., Lilly, E., Mirabello, S., McLaren, C., Meyer, M., Navani, I., Sheldon, D., Solum, A., & Webb-Newton, A. (2022) *College and University COVID-19 Mask Policies Fall 2021* [Dataset]. The College Crisis Initiative (C2i); Marsicano, C. R., Botelho, B., Cummings, A., Daneshvar, S., Eldridge, S., Gade, S., Gujral, S., Lewis, A.L., McLean, R., Moore, A., Nagahashi, E., Oukolov, D., Pearce, C., Wachino, C., Welch, C., Bernhardt, A. F., & Martin, R. C. (2021). *College and University COVID-19 Vaccine Plans Fall 2021* [Dataset]. The College Crisis Initiative (C2i).

⁴ Department rank information obtained from Oxide (<http://oxide.jhu.edu/2/demographics>)

⁵ Data on the GRE requirement for admission were obtained from <https://docs.google.com/spreadsheets/d/19lfwzMSaxqzo5rIR0rIPLc7FPmU3QQBeZAkt4vug7U/edit#gid=461373180>.

⁶ Data on participation in the Bridge program were obtained from <https://www.acs.org/education/students/graduate/bridge-project/about-bridge-program.html>

⁷ CIMER trained facilitator list was obtained from <https://cimerproject.org/entering-mentoring-trained-facilitators/>

County Level. To control for the ways in which the larger socio-political context of universities could have affected students' experiences, several county-level health-related indicators were obtained. Three measures of COVID-related morbidity and mortality were calculated for each county: the number of COVID-cases per 100,000 population, the number of COVID-related deaths per 100,000 population, and the number of COVID deaths as a percent of all deaths. Data on the number of COVID-related cases and deaths as of October 2022 were obtained from the New York Times data base.⁸ Data on county population and total number of deaths were obtained from the U.S. Census Bureau.^{9,10} Data from the U.S. Center for Disease Control (CDC) were also available regarding views of the county residents toward vaccination, social vulnerability of the county to disasters (SVI), the percentage of the population fully vaccinated (CVAC), and the racial-ethnic composition of the county.¹¹ The variables were highly correlated (see Table 1-2) and, for analysis, were combined into an additive scale. Because the variables have different ranges, standardized scores were used. Higher values on the scale indicate counties that had higher COVID death rates (as a percent of all deaths), a higher SVI, were more resistant to vaccinations, had lower CVAC, and a higher percentage of residents who did not identify as non-Hispanic white (Cronbach's alpha = .81).

D. Analysis

Analysis began with examining frequency distributions and univariate statistics, followed by bivariate analyses, looking at the association of views with characteristics of the respondents, their universities and the larger geographic context. As a third step multivariate analyses were used with student data to examine the extent to which relationships observed in the bivariate analyses remained when other factors were controlled. Because the sample size for coordinators was relatively small, the number of valid bivariate analyses was limited and it was not possible to do multivariate analyses

To control for the nesting of students within departments and departments within counties, multi-level, or mixed, models with random effects were used for the multivariate analyses. This allowed examination of both the independent and joint association of the independent variables with each of the dependent measures. Both department and county were included as random effects, reflecting the nesting of students within departments, which, in turn, are nested within counties. Random effects models allow testing the extent to which values of the dependent measure vary among categories of the contextual variables and the extent to which those differences are related to the independent variables. For each dependent

⁸ The New York Times. (2021). Coronavirus (Covid-19) Data in the United States. Retrieved October 31, 2022 from <https://github.com/nytimes/covid-19-data>.

⁹ <https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html>.

¹⁰ Number of deaths were given for both 2020 and 2021. Thus, the calculation of the percent of all deaths used the total number of deaths for the two years as the denominator. For Cases per 100,000 the denominator was the population size. In other words, this variable is the total number of COVID deaths divided by the population, or the death rate through October 2022.

¹¹ <https://data.cdc.gov/stories/s/Vaccine-Hesitancy-for-COVID-19/cnd2-a6zw/>

variable, increasingly complex models were examined building on an initial, baseline, or intercept only, model with department and county as random effects: 1) adding the individual level demographic characteristics as independent variables, 2) adding the university and department-associated measures, and 3) adding the measure of community context. If the results of the baseline model indicated no variation between either departments or counties, that variable was omitted as a random effect. If both random effects were zero, simple regressions were employed. For dependent measures that were dichotomous, logistic regressions were employed. Changes in model fit were examined with the -2 Log Likelihood statistic, which is distributed as chi-square, and with proportionate reduction of error (PRE) measures of the residual and between-group variance.¹²

Fixed effects were examined to determine the relative association of independent variables with the dependent measures. For continuous dependent variables, unstandardized regression coefficients and the associated standard errors are reported. For analyses of dichotomous dependent variables, to facilitate interpretation, odds ratios and the associated z-scores are given.¹³

Some survey questions replicated those used in ACS surveys of graduate students that were conducted in 2013 and 2019.¹⁴ Students' responses were compared to those given in earlier years with simple bivariate comparisons and with mixed model analyses including university as a random effect. In addition to a baseline, intercept only, model, three successively more complex models were examined: 1) a model that included dummy variables for year, with the earliest year as the reference category, 2) adding indicators of student and departmental characteristics that were common to all three data sets, and 3) adding interactions of these characteristics with year to test the possibility that any changes over time might be related to student or institutional characteristics.

E. Sensitivity Tests

Several additional analyses were conducted to help assure the accuracy of the results and any impact of methodological decisions. Factors examined included the use of three ways of contacting students, combining data for PhD and masters' students in the analysis, when students returned the surveys, and restricting the multivariate analyses to students who had data on all the independent variables. Table 1-3 presents correlations between students' level

¹² This was calculated as the $(\text{var1}-\text{var2})/\text{var1}$, where var1 equals the variance of the simpler model and var2 equals the variance of the more complex model. Thus the value indicates the proportion of the variance (the difference between groups of the contextual variable) that was explained by adding additional explanatory measures.

¹³ Z-scores can be calculated by dividing the regression coefficient (b) by the standard error. The z-score for logistic regression is calculated from the regression coefficient, rather than the odds ratio; and thus the z-score is reported for those analyses.

¹⁴ Kuniyoshi, Corrie, Joe Sostaric, and Mary Kirchhoff. 2013 ACS Graduate Student Survey. Washington, DC: American Chemical Society; and American Chemical Society. 2021. 2019 ACS Graduate Student Survey Report. Washington, DC: DOI:10.1021/acs.edu.2019gssrpt

(a dummy variable indicating PhD versus masters students), source of the survey (dummy variables distinguishing surveys from a link from coordinators and the ACS mailing list from those accessing through social media), the date at which the survey was returned, and whether data were available from coordinators for the students' department. There were no substantively large correlations nor patterns of results that could reasonably be expected to alter the conclusions from the multivariate analyses.

It should be noted, however, that students with data on all independent variables and included in the multivariate analyses tended to have slightly less negative views about the future of their graduate education and a greater commitment to staying in the field. In addition, the correlations indicate that the coordinators who responded to the survey were more often from larger, public, more highly ranked institutions that were more likely to participate in the mentorship training program and to have dropped the GRE requirement. They were also in geographic settings that experienced lower impacts of the COVID pandemic. Notably, however, such programs enroll large proportions of graduate students in the chemical sciences, thus potentially enhancing confidence in the extent to which the sample represents larger proportions of the population. There were no differences in the experiences and views of students in schools that did or did not provide coordinator data.

Finally, as noted above, the measures of departmental rank, dropping the GRE requirement and participation in the Bridge and mentoring training programs were correlated to the extent that it appeared appropriate to combine them into a composite measure. Because these variables could be seen as conceptually distinct, a final sensitivity analysis examined the possibility that these variables might have different patterns of association with the dependent measures. Table 1-4 reports the correlations of the component elements of this scale and each of the dependent measures. The results indicate that there were no substantively large differences in the magnitude and level of statistical significance correlations across the component measures, providing additional evidence that the use of a composite measure was not problematic.

2. Characteristics of the Sample

Table 2-1 summarizes information on the students' demographic characteristics and indicate that the sample was relatively diverse. Students were allowed to not answer demographic questions if they desired. Eighteen percent of the students did not provide any demographic information, and, as shown in Table 2-1, the number responding to specific questions also varied slightly. The multivariate analyses reported below include only students for whom there was data on all the demographic and contextual variables. However, as shown in Table 1-4 and discussed above, there were relatively few differences between this more restricted sample and the total group.

Table 2-2 compares demographic characteristics of students and their departments in the 2022 sample with the data gathered in 2013 and 2019. The top panel of Table 2-2 reports the mean and standard deviation of each variable for each year, and the bottom panel reports

the results of analysis of variance comparing the average values across the three years and probabilities associated with the pair-wise Scheffe comparisons. Table 2-3 compares data from the three years regarding students' year in their graduate program. Table 2-4 summarizes information on students' universities and departments and Table 2-5 summarizes information on county characteristics. Both of these summarizes are based on student data, that is, using students rather than departments or counties as the unit of analysis. Table 2-6 summarizes information from the graduate coordinators regarding COVID-related policies that were implemented by their universities and departments.

Finally, Table 2-7 reports descriptive statistics related to the variables in the bivariate and multivariate analyses of students' experiences and views. The first rows of the table report correlation coefficients. While some correlations were statistically significant, the vast majority were less than .20, and none exceeded .50, a level that might prompt concerns of collinearity. Six measures associated with students' individual characteristics were included in the analyses: year in their graduate program, identification as female, LGBTQ, or as an underrepresented minority (URM), US citizenship or permanent residence, and married or partnered status. Correlations among these variables were relatively small. Students who were more advanced in their program were more likely to be U.S. citizens and married or partnered. Women were more likely to identify as LGBTQ and to be U.S. citizens, and those with U.S. citizenship or permanent residency were slightly less likely to identify as URM. There were also some small, but statistically significant correlations of individual characteristics with contextual variables. Students who were US citizens or permanent residents were more likely to be at larger public universities, to be in schools that had more restrictive COVID-policies, and schools that were higher ranked and participated in equity-related programs. Students who identified as URM were less likely to be in schools with more restrictive policies or higher ranked, but more likely to be in schools that were in counties with higher mortality and COVID-related risk.

The majority of the correlations among the contextual variables (shown in the bottom right hand quadrant of Table 2-7) were statistically significant. Students in larger schools were significantly more likely to be in departments that were more highly ranked and participated in equity-related programs ($r=.39$), but less likely to be in schools that had more restrictive COVID-related policies ($r=-.13$). Students that were in schools with more COVID-related restrictions also tended to be in higher ranked departments that participated in equity-related programs ($r=.31$). Counties that were more vulnerable to disaster and had higher rates of COVID mortality and vaccine resistance were less likely to have large public institutions, schools with more restrictive policies, and departments that were highly ranked and more often participated in equity-related programs.

3. The Impact of the Pandemic on Personal Lives and Delaying or Pausing Graduate Education

Sections below summarize analyses of how the pandemic affected students' personal lives and decisions to pause or delay their graduate work.

A. Personal Impacts

Table 3-1 summarizes students' responses to a query regarding how the pandemic had affected them personally. On average the students reported between one and two issues (mean = 1.93). Of those who indicated other impacts (n=33), about one-fourth reported a loss of productivity in academic or professional pursuits, one-fourth reported negative stress on their daily routines or livelihoods, and the remainder expanded upon the impacts included in the other options. There is little or no indication that the increased personal strains had diminished significantly. Almost two-thirds of the students who reported financial concerns indicated that these concerns had increased over time.

Table 3-2 reports the correlations of the composite measure of the severity of the personal impact of the pandemic with students' individual characteristics and characteristics of their departments, universities, and geographic locale included in the multivariate models. (See the first column of data.) Results indicate that students who identified as LGBTQ or URM reported more personal impacts that were continuing, while those who were U.S. Citizens or permanent residents and those in schools with more restrictive COVID-related policies reported less.

Table 3-3 reports model fit statistics for the multivariate analysis of the personal impact of the pandemic. The first two rows report the -2 Log Likelihood statistic, which is distributed as chi-square, and the change in this value across the models. Because the baseline model indicated no variance between universities, only county was included as a random effect in subsequent models. The variance between counties was not significant in any model and disappeared when university-level variables were added in Model 2. In contrast, the estimate of residual (error) variance remained statistically significant and a similar magnitude across all models. Model fit improved significantly when the individual level variables were added in Model 1, but there was no significant change in fit when university and county-level variables were added.

The fixed effects associated with each model are given in Table 3-4. Paralleling the bivariate analyses, when other variables were controlled, students reported more severe personal impacts of the pandemic when they identified as LGBTQ and as URM, but fewer personal impacts if they were U.S. citizens or permanent residents. While the bivariate analysis indicated that students reported a smaller impact when in a school with more restrictive COVID-policies, this association disappeared when the individual level variables were controlled. In addition, there was a trend ($p < .10$), which did not appear in the bivariate analyses, for students in large public universities to report a more severe personal impact.

B. Pausing or Delaying Graduate Work

Thirteen percent of the returning students (those beyond the first year of their program) indicated they had taken a break from their studies during the pandemic. For the majority (72%) this break was less than an academic year. The others reported breaks about

evenly divided between one full year (16%) and more than one year (12%). The respondents were allowed to check multiple reasons for taking the break. Responses are in Table 3-5. The most common reason, marked by almost a third of the respondents, was their own mental and physical health. A quarter mentioned restrictions on their progress from COVID-related policies, slightly fewer mentioned financial concerns and care-taking duties. Less than a fifth mentioned concerns about the quality of their education, while a few mentioned other issues such as job opportunities and family responsibilities.

The students who were beginning their graduate programs were asked if they had delayed their graduate schooling because of the pandemic, and over half indicated that the pandemic had some bearing on their decision regarding when to begin. Table 3-6 summarizes reasons students gave for delaying their graduate program. Over two-fifths indicated concerns with the quality of education they would receive, their own academic preparation, finances, and/or their mental health. About a third cited their own physical health or the health of significant others. Additionally, a few respondents shared that travel bans and restrictions resulted in pauses or delays in their graduate studies. Students' additional comments about reasons for delaying or pausing their education are in Appendix B.

4. The Pandemic and the Quality of Graduate Education

Students who were in at least the second year of their graduate program and the graduate coordinators were asked about ways in which the pandemic had both positively and negatively affected the quality of graduate education.

A. Student Views

Table 4-1 summarizes the responses given by students, and it is clear that the perceived negative impacts on education far outnumbered the positive effects. On average the students marked four of the 8 listed areas as having a negative effect on their education ($sd = 1.7$). In contrast, on average, they noted less than one positive element ($mean = .64$, $sd = .89$). The difference in the number of positive and negative outcomes noted was highly significant ($t = 44.38$, $df = 749$, $p < .001$; Cohen's $d = 1.62$). Over three-fourths reported that their research, or lab, experiences and their interactions with other students had been negatively affected. Over half indicated negative impacts on interactions with faculty and classroom instruction. Two-fifths mentioned issues with career preparation, and a fourth mentioned financial support. Only two percent indicated that there were no negative effects, while over half reported no positive effects.

Six percent of the students indicated that there were additional negative impacts. Of the 45 students who added additional thoughts, about a third ($n = 14$) commented on specific elements of their graduate program such as access to materials and facilities, difficulties with online classwork, and issues with departmental politics and conflict. Twelve of these students mentioned aspects related to career development, such as the ability to attend conferences and interact with other scholars. An equal number mentioned mental-health related issues

including loneliness, isolation, anxiety, and the lack of social support. Some also mentioned stresses associated with teaching and TA responsibilities, personal health issues, and financial strains that their school would not address. Others commented on potentially positive impacts of the pandemic most often involving advantages of on-line and hybrid work, and more time for both academic and personal pursuits. (See Appendix B for a full listing of the comments.)

Table 4-2 reports correlations of the number of positive and negative programmatic impacts with the individual, university, and county-level variables used in the multivariate analysis. Results indicate that students reported a significantly larger number of negative impacts on the quality of their education when they were later in their graduate program, had experienced more severe personal impact of the pandemic, were U.S. citizens or permanent residents, and were in departments that were higher ranked and more likely to participate in equity-related programs. None of the correlations with the number of positive impacts were statistically significant.

Model fit statistics for the multivariate analyses are in Table 4-3. For the analysis of number of negative effects, there were significant differences between universities, which diminished substantially when both individual and department-level variables were added to the models. The fixed effects, shown in the top panel of Table 4-4, paralleled the bivariate results with more negative impacts noted by students who were later in their program, U.S. citizens or permanent residents, reported more severe personal impacts of the pandemic, and were in more highly ranked departments. In addition, independent of these variables, students in large public institutions reported fewer impacts than those in larger private schools. This result did not appear in the bivariate analysis, indicating a suppressor effect. Additional analyses indicated that the finding reflected especially high negative ratings from students in highly ranked schools within the private sector.¹⁵

Model fit statistics for the analysis of students' reports of positive impacts indicated no variance between universities and small and insignificant variance between counties. None of the models had significantly better fit than baseline and, paralleling the bivariate results, none of the independent variables were associated with the number of positive impacts.

B. Coordinator Views

Graduate program coordinators were asked how graduate students in their program were negatively impacted by the COVID-19 pandemic in academic years 2020-21 and 2021-22. Results are summarized in Table 4-5. On average, coordinators marked 6 (of 10) negative impacts on students. All coordinators felt the pandemic had negative impacts on students' interactions with each other and 89% thought students' mental health was negatively affected.

¹⁵ On average students in the highly ranked schools that were not in the public sector marked 4.6 negative impacts. Students in highly ranked large public schools marked an average of 4.4 negative impacts, and those in other departments marked 3.7 to 3.8 negative impacts.

Over three-fourths of coordinators also thought there were negative impacts on students' interactions with faculty, progress through the program, interaction with other professionals.

Less than half of the coordinators (16 of 38) responded to a query about positive impacts of the pandemic on their students, suggesting the majority found no positive impacts on students. On average, those who responded marked less than 1 type of positive impact. About a third thought the pandemic strengthened graduate students' commitment to the field of chemical sciences, while slightly fewer believed it helped students understand different career paths and improved the quality of the learning experience (Table 4-6). No coordinator reported positive effects on students' mental health or interactions with peers. However, in open-ended comments some mentioned the positive effects of students learning different communication techniques, such as conducting virtual meetings or lectures, and one noted that the pandemic had resulted in more institutional support for students who struggled and needed more flexibility, citing allowing students to take required courses online).

Coordinators were also asked about how the pandemic affected their overall program and results are in Table 4-7. Over 80% of coordinators thought the pandemic had a negative impact on student morale and students' ability to network inside and outside their departments. Over two-thirds indicated that timely completion and the quality of lab experience remained concerns, and over half indicated issues with faculty morale, the number of graduate students in the program, and the quality of the graduate students.

5. Continuing Impacts of the Pandemic on Students and Graduate Programs

Both coordinators and students were asked about ways in which effects of the pandemic could continue.

A. Views of Coordinators

When asked about ways students continue to be negatively affected by the pandemic, program coordinators indicated fewer concerns than they had observed in the last two years, marking on average 3 concerns. Over half reported that mental health, timely progress through the program, and financial well-being continue to be problematic (Table 5-1). Some noted additional negative impacts on students, including the need to take care of family members, concerns over exposure to COVID-19 and health impacts after the removal of COVID-19 related policies, and the slow return to pre-COVID-19 activities such as in-person seminars.

When asked if they thought the pandemic would continue to affect their department, half said yes and 29% said maybe. Among those who answered yes or maybe, the most common long-term concerns were mental health, lower levels of academic preparation, and the uneven sizes of graduate cohorts (Table 5-2). There were also some concerns about fewer graduate applicants, faculty morale, and funding. Those who did not think the pandemic would continue to affect their department noted that their program had returned to in-person and normal activities (e.g. students graduating on-time, in-person seminars), and one program

coordinator reported that their program actually grew in the past two years. Bivariate analyses indicated that coordinators from large public universities and that participated in the Bridge program were significantly more likely to report negative effects on their graduate program. (See Table 5-3)

B. Student Views

Tables 5-4 and 5-5 summarize students' responses regarding ways in which the pandemic might negatively and positively, respectively, affect graduate education in the coming years. In each table the responses for first year students are in the first column of data, those for returning students in the second column, and the results for the total group in the third column. The final two columns include t-tests and effect sizes (Cohen's d) that compare the percentages for the two groups.¹⁶ Only a few students (n=27) listed additional negative effects. The majority of the comments involved concerns about support for student and progress through their program; and slightly fewer commented on the timing and impact of specific policies. Even fewer indicated other possible positive effects in open-ended comments. The vast majority of these comments involved increased flexibility in work patterns and accessibility to meetings and seminars through the use of video-conferencing technologies. Others anticipated an improvement in policies and procedures that would promote a safer and healthier environment for students in the future. The total number of positive and negative effects marked was calculated, and the bottom lines of Tables 5-4 and 5-5 report these values. Both groups of students expected significantly more negative than positive future impacts and the difference was similar between the two groups. For the first year students, the paired t-ratio was 8.35, $p < .001$, $d = .68$; for the returning students $t = 11.78$, $p < .001$, $d = .44$. Interestingly, the new students anticipated both significantly more negative and more positive impacts.

Table 5-6 reports the correlations of the summed score of future programmatic impacts with the variables included in the multivariate models. Results indicate that students who had experienced more severe personal impacts, identified as URM, or who identified as LBGTQ anticipated more negative impacts, while students who were U.S. citizens or permanent residents or in more highly ranked departments anticipated fewer negative impacts. The only significant correlation with the number of positive future impacts involved students' year in their graduate program, with students in later years expecting fewer positive long-term effects.

Table 5-7 reports the model fit statistics for mixed models regressing the summed scores on the model variables. For both the negative and positive summative measures there was no variation in student views related to the county of residence. Variation between universities declined to zero when individual level variables were added to the baseline model

¹⁶ The effect size, Cohen's d, equals the difference of the two means divided by the common standard deviation. A value of zero indicates no difference. Thus it translates the difference between two groups into standard deviation units, which can be compared across analyses. Unlike a t-ratio it is not affected by sample size and is used as an indicator of substantive importance.

in Model 1, but adding the university and county level variables (Models 2 and 3) provided significantly better model fit.

Table 5-8 reports the fixed effects associated with Models 1, 2, and 3. Results indicate that, net of other variables, the only significant associations with the number of anticipated negative programmatic effects involved students' year in the program and the extent to which they had experienced more severe personal impacts of the pandemic. The association of identification as URM or LGBTQ with more anticipated negative effects disappeared in the multivariate analysis, reflecting the association of these variables with more severe personal impacts of the pandemic. The fixed effects in the multivariate analysis of anticipated positive programmatic impacts paralleled the bivariate results with significant associations only with students' year in their graduate program.

6. Students' Career Plans and the Impact of COVID

Students were asked several questions about their future career and educational plans and the impact of COVID on these plans. A number of the questions replicated those used in previous ACS surveys of graduate students in the chemical sciences, and Section 8 systematically compares the responses of students in 2022 to those in 2013 and 2019.

A. Anticipated Impact of Pandemic on Future Careers

At the beginning of the survey all students were asked, "In general, what impact do you think the COVID-19 pandemic will have on your career in the chemical sciences in the years to come?" Responses ranged on a 5-point scale, from 1 indicating very positive to 5 indicating very negative. Less than a fifth of the students (18%) thought that the impact would be even somewhat positive, while over two-thirds believed that it would be at least somewhat negative. Bivariate analyses indicated that students who were more advanced in their degree program, women, those who had experienced more severe personal impacts of the pandemic, or were in departments that were higher ranked or had more COVID-related restrictions were significantly more likely to anticipate negative impacts on their future careers. Students who identified as URM were significantly less likely to anticipate negative outcomes. (See first column of Table 6-1.)

Table 6-2 reports results of the multivariate analysis related to expected impact on future careers. Model fit statistics (in the bottom panel) indicate that the best fitting model was Model 2 including individual and university and department characteristics. As in the bivariate analyses, students who were more advanced in their programs, women, and those who had experienced more severe personal impacts of the pandemic were significantly more likely to anticipate a negative impact on their career. Once the measures of county-level COVID-related characteristics were added (Model 3) the association of students' identification as URM and the extent of COVID-related restrictions with expected impact declined slightly in significance.

Students were invited to share an open-ended response addressing, "...how the pandemic affected you personally and how this might impact your future in the chemical sciences." In total, 255 students (27% of the total group) responded. Table 6-3 summarizes the nature of their responses and all of the responses are in Appendix B. The vast majority (92%) of the comments described some type of negative impact, most often involving issues with mental health and isolation, as well as lost academic progress and productivity. From a sample size of 258 open-ended responses, nearly half (41%) of students reported that the pandemic negatively impacted their mental health or provoked negative stressors.

Bivariate correlations reported in Table 6-4 can address the possibility that those who gave additional comments might have been atypical of the total group. The first two columns report correlations based on the total sample of respondents. The first column reports the correlations of whether or not respondents gave a comment and each of the independent variables included in the multivariate models. The second column, again based on the total sample, reports correlations of giving a negative comment with the model variables. The last column reports correlations using only the sub-sample of those who gave comments regarding the impact of the pandemic. Results indicate that those who described negative impacts were significantly more likely to report more negative impacts on the quantitative measure. Students who were later in their graduate programs and had experienced more severe personal impacts of the pandemic were also more likely to comment. While results with the total sample indicated that students were less likely to comment if they were from higher ranked schools or counties that had more severe experiences with the pandemic, the opposite pattern occurred with the analysis limited to students who had submitted comments. Most important, however, none of the correlations were substantively large, suggesting only small differences between those who provided comments and those who did not.

B. Changing Career Plans During the Pandemic

Students in their second year of graduate school or later were asked if their career plans had changed plans during the pandemic. Responses to the query were evenly divided between those who indicated that they had changed and had not. Bivariate analyses, summarized in Table 6-5, indicated that students who were married or partnered or who had experienced a greater personal impact of the pandemic were significantly more likely to report changing plans. Results of the multivariate analysis are in Table 6-6. Because the dependent variable is a dichotomy, logistic regression was used; and, to help facilitate interpretation, odds ratios and z-values are reported rather than coefficients and standard errors.¹⁷ The results parallel those shown in the bivariate results, with students who had experienced more severe personal impacts being more likely to report changing their plans. The association with married or partnered status declined to statistical insignificance when other variables were added.

¹⁷ An odds ratio of zero indicates no association between a dependent and independent variable. Odds ratios greater than 1.0 indicate a greater likelihood, while ratios less than 1.0 indicate less likelihood. Positive z-scores are associated with odds ratios greater than 1.0 and negative z-scores with odds ratios less than 1.0.

C. Staying in the Chemical Sciences

All students were asked the likelihood that they would remain in the chemical sciences in the future. The majority of the students indicated that it was either extremely (41%) or very likely (34%) that they would stay in the chemical sciences after finishing their degree. About a fifth (19%) said that it was only moderately likely, and relatively few indicated that they were unlikely to do so. Table 6-7 reports correlations of the likelihood of staying in the field with the variables included in the multivariate models. Students who were more advanced in their program, women, those who were U.S. citizens or permanent residents, who had experienced more severe impacts from the pandemic, or who were in institutions that had instituted more COVID-related restrictions or were more highly ranked were significantly less likely to believe they would stay in the field.

Table 6-8 reports the results of the mixed model regression. The model fit statistics in the bottom panel indicate that the best fitting model included both the individual and university-level variables. The fixed effects in the top panel indicate that students were significantly less likely to plan to stay in the field if they were more advanced in their program, if they were U.S. citizens or permanent residents, if they had experienced more severe personal impacts of the pandemic, and if they were enrolled in higher ranked schools that more often participated in equity-related programs. Associations with gender and institutional COVID-related restrictions, which were observed in the bivariate analysis, disappeared when other variables were controlled.

7. Students' Educational Plans and the Impact of COVID

All students were asked about the likelihood that they would finish their degree and if they planned to pursue further studies. In addition, students who were beyond their first year of graduate work were asked if their commitment to finishing their degree had changed in the last two years.

A. Completing the Degree

Half of the Masters' students and almost three-fifths of the doctoral students (58%) indicated that they definitely planned to complete their degree. Table 7-1 reports the bivariate correlations of definite plans to complete the degree with variables included in the multivariate analyses. Results differed markedly between Masters and doctoral students. Masters' students were significantly less likely to plan to complete if they had experienced a greater personal impact or were in higher ranked departments. Doctoral students were significantly more likely to definitely plan to complete if further along in program and in counties that had experienced greater impact of the pandemic but less likely to do so if they had experienced more severe personal impacts from the pandemic. Given the different patterns of correlations, the data were analyzed separately by level of program.

Table 7-2 reports results of the logistic regression of definitely planning to complete on the model variables for Masters' students.¹⁸ The full model included all of the model variables and the reduced model includes only those found in the full model to be related to the dependent variable at a probability level less than 0.10. The association of plans to complete with departmental rank found in the bivariate analysis disappeared when other variables were controlled, but the strong association with personal impacts remained, with Masters' students who had experienced more severe personal impacts of the pandemic less likely to expect to finish their degree. In addition, there was a trend ($p < .10$) for those who were married or partnered to be less likely to expect to finish.

With the doctoral students, preliminary analysis using mixed models indicated no variation between universities or counties, so simple logistic regression was used, employing the same series of models as in other analyses. Table 7-3 summarizes the results. Net of other variables, PhD students were significantly more likely to definitely plan to complete if further along in their program and in a county that experienced higher toll from COVID but less likely to do so if they had experienced a greater personal impact of the pandemic.

B. Changing Commitment to the Degree

When students in their second year or later of graduate work were asked if their commitment to finishing their degree had altered over the last two years, a little more than half (55%) indicated there had been no change, a fifth (19%) indicated that they had become more committed to finishing, and a quarter (26%) reported that they had become less committed. Table 7-4 reports the correlations of the model variables with reporting less commitment. Results indicate that students were more likely to report declining commitment if they had experienced greater personal impact of the pandemic and, to a lesser extent if they were U.S. citizens or permanent residents or women. Mixed model logistic regressions indicated no variation between universities or counties in responses, so simple logistic regressions were used. The results are summarized in Table 7-5 and are similar to those in the bivariate analysis, with students' personal impact of the pandemic being the most important factor predictor of a lessened commitment to finishing the degree.

C. Further study

PhD students were asked if they planned to pursue post-doctoral studies and Masters' students were asked if they planned to enter a doctoral program after completing their degrees. Table 7-6 reports the correlations of students' plans for further study with the model variables. Results indicate that Masters' students were significantly less likely to plan to pursue a doctoral degree if they were married or partnered, a U.S. citizen or permanent resident, or identified as LGBTQ. Doctoral students were significantly less likely to plan a post-doc if they

¹⁸ Mixed models were not used in the analyses of Masters' students given the relatively small size of the sample of students and the small number of students relative to universities.

were more advanced in their program, a woman, a U.S. citizen or permanent resident, or in a higher ranked department.

Table 7-7 summarizes the results of the multivariate analysis of doctoral students' plans to pursue a post-doc. The mixed model analysis indicated that the random variances associated with both county and university equaled zero, so a simple regression was used. Results indicate that, net of other model variables, students who were more advanced in their programs, women, and U.S. citizens or permanent residents were significantly less likely to plan a postdoc. The association with departmental rank observed in the bivariate results disappeared when other variables were controlled.

8. Over-Time Analyses: Comparing Data from 2013, 2019, and 2022

The sections below summarize comparisons of the 2022 post-COVID data with data obtained from ACS-sponsored surveys of graduate students in 2013 and 2019. Data were available regarding students' plans to stay in the chemical sciences after graduation, their field of specialization, their preferred sector of employment, the likelihood that they would finish their degree, and plans to pursue further study. As described in the section on methodology, the analysis was designed to allow comparisons of students' plans across years (the main effects associated with time) and the extent to which changes over time varied across characteristics of students and their departments (the interaction effects of the independent variables with time).

A. Staying in chemical sciences

Table 8-1 compares students' intent to stay in the chemical sciences across the three years and suggests that there was relatively little change over time. Table 8-2 reports the correlations of intent to stay with the variables included in the over-time multivariate analyses. The results indicate that women, students at or beyond the middle of their program, U.S. citizens and those in higher ranked departments were less likely to plan to stay in the field.

Table 8-3 reports the model fit statistics for the mixed model regressions of likelihood of staying in the field on survey year, individual characteristics, and department rank. The results indicate that there were significant differences between universities, which remained when all independent variables and interactions were added (Models 3 and 4). The best fitting model was Model 4, which included only the interaction effects that were significant in Model 3. Table 8-4 reports the fixed effects associated with Models 1, Model 2, and Model 4 and indicates that the differences over time varied by degree program, students' year in their graduate work, and whether or not the students were U.S. citizens or permanent residents. Independently, across all years and when other variables were controlled, women were significantly less likely than men to indicate they would stay in the field.

Table 8-5 provides descriptive data to help interpretation of the interaction effects, giving the average values of the dependent measure within each year by degree level, year in

the program, and citizenship. The results indicate slightly different patterns across time associated with these variables. In 2019 Masters' students were more likely than PhD students to plan to stay in the field, but the pattern was the opposite and differences were smaller in magnitude in 2013 and 2022. While first year students and U.S. Citizens were more likely to plan to stay in the field in all years, the differences were greater in 2022 than in earlier years.

B. Area of Specialty

Table 8-6 reports the percentage of students choosing the most common fields of study in 2013, 2019 and 2022. There was a significant increase over time in those choosing analytical, chemical biology, and materials chemistry. Table 8-7 gives the pair-wise correlations of field of interest and the independent variables used in the multivariate analyses. Because the sample was relatively large, a number of the correlations were statistically significant, but almost all were quite small. Of the 63 correlations only one exceeded .10 in magnitude. In other words, there was little evidence that, when looking across all years, students' field of interest was associated with individual or departmental characteristics included in the models.

Table 8-8 reports the model fit statistics associated with the mixed logistic regression models for these fields including year, students' individual characteristics and departmental rank as independent variables. Table 8-9 reports the fixed effects, given as odds ratios to help facilitate interpretations; and Table 8-10 gives descriptive results associated with interaction effects that were significant in the models. The results indicate a significantly significant increased interest in analytical and chemical biology in the 2022 data. For analytical chemistry, there was a trend ($p < .10$) for a slightly greater increase for women. The analysis for chemical biology indicated that the increased interest was significantly smaller for U.S. citizens and permanent residents than for students from other countries.

C. Sector of Employment

Table 8-11 summarizes changes over time in the sector in which students planned to seek employment. In 2022 students were significantly less likely than those in 2019 to express interest in academe, nonprofits, or the entrepreneurial sector, but significantly more likely to express interest in industry. Comparable data were only available for 2019 and 2022 and, because so few students expressed interest in the non-profit or entrepreneurial sectors in 2022, the multivariate analyses were limited to examining interest in academe, government and industry. Table 8-12 reports bivariate correlations of interest in these sectors with the variables included in the multivariate analyses. Less than half of the associations were statistically significant and they were all small in magnitude.

Table 8-13 reports model fit statistics for the mixed model logistic regressions of sector of interest on year, students' individual characteristics, departmental rank and interactions of these variables with year. The best fitting model for the academic sector included only the independent variables, while the best fitting models for government and industry included interaction effects. Table 8-14 reports the associated odds ratios and z-scores associated with

the models. Paralleling the bivariate analyses, the results indicate that students were significantly less likely to plan to enter academe in 2022 than in 2019. When other variables were controlled, the significance of the difference over time was enhanced. In addition, and independently of time, women, students beyond the first year of their program, and U.S. citizens or permanent residents were significantly less likely to plan to enter academe. Results regarding the government sector indicated significantly different patterns of change over time for women and students mid-way through their graduate career. Compared to 2019, men in 2022 expressed somewhat more interest in the governmental sector, while there was a very slight decline for women. In addition, compared to 2019 students mid-way through their graduate program in 2022 indicated more interest in the governmental sector while those at the beginning and end of their programs expressed less interest. Students were significantly more likely to plan to enter industry in 2022 than in 2019. However, the change over time was significantly larger for students in departments ranked in the top 50 in terms of federal funding than for students in other schools (See Table 8-15.) Independently of departmental rank and time, students at the end of their graduate program were also significantly more likely to plan to enter industry, while U.S. citizens or permanent residents were less likely to plan to do so.

D. Finishing the Degree

Table 8-16 reports the percentage of Masters' and PhD students who indicated that they definitely planned to complete their degree in 2013, 2019 and 2022. For both program levels the decline over time was statistically significant. The decline for Masters' students occurred between 2019 and 2022, while the decline for PhD students was similar in the two time periods. Given these different patterns over time, bivariate and multivariate analyses were conducted separately for Masters and PhD students.

Table 8-17 reports correlations of the intent to complete the degree with the model variables. For both groups students in the higher ranked departments were significantly less likely to definitely plan to finish their degrees, while those in the middle years of their graduate program were significantly more likely to do so. Different results appeared between the two groups in associations with other variables in the model. For Masters' students those at the end of their program were significantly less likely to definitely plan to complete, while among doctoral students those in the final years were significantly more likely to hold those plans. In addition, among doctoral students, women and U.S. citizens were significantly less likely to plan to finish while those who identified as URM were significantly more likely to do so.

Table 8-18 summarizes results of the mixed model logistic regression of definitely planning to complete on the model variables for masters students. The results parallel those found in the bivariate analysis, with a significant decline in intent to complete in 2022 and, independently, a higher probability of intending to complete for those mid-program. No interactions were significant. The random effects (in the bottom panel) indicate that differences between universities remained significant, even when the explanatory variables were added to the model.

Table 8-19 summarizes results of the mixed model logistic regression of definitely planning to complete on the model variables for doctoral students. The patterns observed in the bivariate analysis remained and, in addition, there were significant interactions of the change to 2022 with year in the program and the department's rank in terms of funding. As shown in Table 8-20 the change over time was significantly greater for students in lower-ranked schools and those in the middle years of their graduate program. The net result is that differences in the probability of completion between schools of different ranks and students at different points in their program diminished over time. Finally, paralleling the result with Masters' students, the random effect associated with university was significant across all models, indicating that the differences between universities in intent to finish was not explained by model variables.

E. Further study

Doctoral students were asked if they planned to pursue a post-doc after finishing their degree, and masters' students were asked if they planned to pursue a PhD. Table 8-21, which summarizes the responses to these questions over time, reveals different patterns for doctoral and masters students. Over time the percentage of doctoral students planning a post-doc steadily declined. In contrast, the percentage of Masters' students planning to pursue a doctorate increased.

Table 8-22 reports the bivariate correlations of the measures of future plans with the variables used in the multivariate models. For Masters' students the increase from 2012 to 2019 was statistically significant, while the change to 2022 was not. Women, those at the end of their program, and those in higher ranked departments were significantly less likely to plan a PhD. Among doctoral students, the decline over time was significant for both comparisons over time. Women, U.S. citizens or permanent residents, and those in higher ranked departments were significantly less likely to plan a postdoc, while those who identified as URM were more likely to do so.

Table 8-23 reports results of the logistic regression of Masters' students plans to seek a PhD on year and the model variables. Model fit statistics indicated that including interaction effects did not significantly improve model fit and that, while there were significant differences between universities at baseline and when only time was included in the models (Model 1), the differences were much smaller and statistically insignificant when the model variables were added (Model 2). Changes over time were only marginally significant; and, independent of time, women and students at the middle or end of their graduate program were significantly less likely to plan to enter a PhD program.

Table 8-24 summarizes results of the mixed model analysis of doctoral students' plans to pursue a post-doc. The best fitting model included interactions of time with the dummy variable associated with students at the end of their graduate program. Examination of descriptive statistics (Table 8-25) indicates that, over time, there was little change in first year students' plan to pursue a postdoc and the decline was greatest for students in their final years.

Independently of these interactions, women and U.S. citizens and permanent residents were significantly less likely to plan a post-doc while those who identified as URM were significantly more likely to do so.

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Table 1-1

Correlations Among Department-Level Variables, Student and Coordinator Levels of Analysis

<i>Graduate Student Data</i>				
<u>Variables</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
1. Rank in Research Funding	1.00			
2. GRE not required	.57***	1.00		
3. Participated in CIMER Project	.54***	.34***	1.00	
4. Participated in Bridge program	.30***	.16***	.20***	1.00
<i>Graduate Coordinator Data</i>				
<u>Variables</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
1. Rank in Research Funding	1.00			
2. GRE not required	0.56*	1.00		
3. Participated in CIMER Project	0.51*	0.51*	1.00	
4. Participated in Bridge program	0.40*	0.12	0.21	1.00

Note: Based on Student Level of Analysis, n=925, coordinator level of analysis, n=34. Rank measure ranged from 0 to 100 with 100 indicating the highest rank and 0 indicating departments not ranked in the top 100. *=p<.05, **=p<.01, ***=p<.001

Table 1-2

Correlations Among County-Level Variables

<u>Variables</u>	<u>Covid Deaths % All Deaths</u>	<u>SVI</u>	<u>CVAC</u>	<u>% Vaccin.</u>
Social Vulnerability Index (SVI)	0.55	----		
Vaccine Coverage Index (CVAC)	0.43	0.61	----	
% Adults Vaccinated	-0.34	-0.40	-0.53	----
% Non-Hispanic White	-0.45	-0.63	-0.46	0.11

Note: Based on Student Level of Analysis, n = 870. All coefficients significant at p<.001. Correlations at the coordinator level of analysis were very similar.

Table 1-3

Correlations to Test Possible Bias of Methodological Decisions for PhD & Masters Students

<u>Variable</u>	<u>PhD Student</u>	<u>Source Coord.</u>	<u>Source ACS</u>	<u>Return Date</u>	<u>In Multivar. Analysis</u>	<u>Had Coord. Data</u>
Source Coordinator	.11*	1.00				
Source ACS	-0.03	-.78***	1.00			
Return Date	-.10**	-.32***	0.00	1.00		
In Mult. Analysis	.07*	0.01	0.03	-0.07	1.00	
Had Coordinator Data	.14**	.22***	-.14***	-.14***	0.04	1.00
Personal Impact of Pan.	-0.03	-0.01	0.00	-0.03	-0.02	-0.01
Neg. Imp During Pan.	-0.04	-0.02	-0.01	-0.08	0.04	-0.01
Pos. Imp During Pan.	-0.01	0.00	0.00	-0.01	-0.02	0.00
Neg Impact Continuing	-.12**	0.01	-0.05	0.03	-.11***	-0.06
Pos. Impact Continuing	-0.05	0.02	-0.06	-0.03	-0.02	-0.03
Impact on Future Career	-0.03	0.01	0.00	-0.04	-0.03	0.06
Career Plans Changed	-0.02	0.07	-0.05	-0.05	-0.05	0.01
Commitment to Field	0.05	-0.06	0.05	-0.05	.10**	-0.05
Less Com. to Degree	-0.04	-0.01	-0.01	-0.01	-0.07	0.06
Year in Program	.12***	-.32***	.25***	.10**	-0.03	-0.01
Female	0.00	-0.04	0.00	0.06	-0.03	-0.09
LGBTQ	0.04	0.06	-0.02	-0.07	-.16***	-0.01
US Cit./Perm. Resident	0.04	0.02	0.04	-.09*	.08*	0.05
URM	-0.13	-.16***	0.04	.12**	-0.04	-0.06
Married/Partnered	0.07	-0.05	0.08	-0.02	0.07	0.00
Large Public School	0.04	.09**	-0.04	-.16***	0.01	.16***
Univ. COVID Policies	-0.03	.11**	-.08*	-.09**	-0.07	.14***
Dept. Rank Equity Scale	.22***	.26***	-.13***	-.12***	.17***	.24***
County Vuln. Scale	-0.09	-.25***	.22***	.22***	-0.01	-.11***

Note: *=p<.05, **=p<.01, ***=p<.001, sample size ranged from 627 to 925.

Table 1-4

Correlations of Components of the Departmental Scale and Dependent Variables

<u>Dependent Variables</u>	<u>Higher Rank</u>	<u>Bridge participant</u>	<u>Mentoring Program</u>	<u>GRE Not Required</u>
Personal Impact of Pan.	-0.11***	-0.04	-0.08*	-0.02
Neg. Impact During Pan.	.11**	.08*	0.07	0.04
Pos. Impact During Pan.	-.09*	-0.04	-0.06	-0.04
Neg Impact Continuing	-.07*	-0.01	-.11***	-.07*
Pos. Impact Continuing	-0.06	0.00	-0.05	-0.02
Impact on Future Career	.10***	0.03	0.06	.07*
Career Plans Changed	-0.01	0.02	0.02	-0.06
Commitment to Field	-.08*	-0.02	-0.05	-.08*
Less Committed to Degree	0.03	0.03	0.02	-0.03

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. N varied from 661 to 925 depending upon the dependent variable.

Table 2-1

Demographic Characteristics of Student Respondents

<u>Characteristic</u>	<u>Percent</u>	<u>Total N</u>
Identify as female	60%	713
Identify as LBGTQ	21%	719
US Citizen or Permanent Resident	67%	747
Identify as Non-Hispanic White Heritage	57%	722
Identify as Under-Represented Minority	19%	722
Married or Partnered	37%	732
Have children	5%	742

Notes: Data for PhD and Masters students combined. Ninety-two percent of the students were in PhD programs.

Table 2-2

Demographic Characteristics of Students, 2013, 2019, and 2022, Descriptive and Inferential Statistics

<i>Descriptive Results and F-Ratios</i>				
<u>Variable</u>	<u>2013</u>	<u>2019</u>	<u>2022</u>	<u>F</u>
Women	49%	55%	60%	18.22***
URM	10%	13%	19%	18.78***
PhD	94%	92%	92%	4.63*
US Cit./Resident	77%	79%	67%	22.03***
Rank (Average)	49.0	47.0	50.0	2.11
<i>Scheffe Probabilities</i>				
<u>Variable</u>	<u>2013-2019</u>	<u>2013-2022</u>	<u>2019-2022</u>	
Women	<.001	<.001	<.001	
URM	0.05	<.001	<.001	
PhD	0.02	0.10	0.96	
US Cit./Resident	0.25	<.001	<.001	
Rank	0.22	0.90	0.27	

Note: Rank was measured as 100 = the top-ranked department and 0 = unranked schools. In all years the standard deviation for the measure of rank was 35. All other variables were dummy variables with the category listed in the label coded "1." *=p<.05, **=p<.01, ***=p<.001.

Table 2-3

Year in Graduate Program by Year of Survey

<u>Program Year</u>	<u>2013</u>	<u>2019</u>	<u>2022</u>	<u>Total</u>
First Year	20%	30%	18%	24%
Mid Program	58%	57%	50%	57%
End of Program	22%	13%	33%	20%
Total (N)	2,544	2,506	760	5,810
Chi-square = 219.68, p<.001				

Note: For Masters' students the end of program group includes students in year 3 or later, for doctoral students the end of program category includes students in year 5 or later. There are at least two possible reasons for the markedly smaller sample size in 2022. One involves a general trend in responses to internet-based surveys, with smaller response rates in more recent years (see, for example, Sheehan, Kim Bartel, E-mail Survey Response Rates: A Review, *Journal of Computer-Mediated Communication*, Volume 6, Issue 2, 1 January 2001, JCMC621, <https://doi.org/10.1111/j.1083-6101.2001.tb00117.x>). Another possible reason could involve an increased number of surveys sent by the ACS, contributing to respondent "overload," perhaps especially relating to communications from the Society.

Table 2-4

University Characteristics and COVID-Related Policies – Department Characteristics

<u>Variable</u>	<u>Statistic</u>	<u>N</u>
Public, rather than Private	76%	858
In large or medium-sized city	75%	858
More than 20,000 students	74%	858
Outside the U.S.	5%	925
% Masks required	85%	796
% Vaccines required	53%	841
% Mandatory testing	58%	841
Number of COVID-Related Requirements		
None	9%	839
One	16%	
Two	48%	
Three	26%	
GRE Not Required or Optional	58%	925
Participated in Bridge Program	13%	925
Participated in CIMERS	79%	925
Rank in Funding		925
Top 10	6%	
11 to 25	29%	
26 to 50	15%	
51 to 100	25%	
Not ranked	25%	

Note: Unit of analysis is students. Students in schools outside the US or unknown placed in the unranked category in measure of rank in funding.

Table 2-5

Contextual Variables Related to County in Which University is Located

<u>Variable</u>	<u>Statistic</u>
Social Vulnerability High or Very High	25%
Vaccine Hesitancy, low or very low	64%
COVID Deaths/100,000	
Mean	225.6
SD	85.5
Range	.90 to 580
COVID Deaths as % of all Deaths	
Mean	20%
SD	5.8
Range	9.3 to 39.4
% Adults fully vaccinated	
Mean	58%
SD	12%
Range	15% to 75%
% Non-Hispanic White	
Mean	64%
SD	16%
Range	13% to 94%

Note: Student level of analysis, n=870. Data only available for students in U.S. schools.

Table 2-6

University and Departmental Policies, Reports of Graduate Program Coordinators

<u>Policy</u>	<u>Percent</u>
Social distancing	95%
Masks indoors	92%
Reduced lab hours	82%
Closed campus	74%
Required vaccinations	82%
Required COVID-19 testing	71%
Remote Learning	95%
Additional Policies in Department	45%

N=38. Thirteen coordinators described additional departmental policies. Six mentioned changing admission, course, and/or graduate requirements; three described the use of alternatives to in-person learning; and three mentioned changes in administrative procedures.

Table 2-8

Correlations Among Independent Variables Used in Bivariate and Multivariate Models, Means, and Standard Deviations

Variables	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
1 Years prog.	1.00									
2 Female	0.03	1.00								
3 LBGTQ	-0.01	0.10**	1.00							
4 US Cit	0.11**	0.14***	0.14***	1.00						
5 URM	-0.04	0.00	-0.01	-0.11**	1.00					
6 Mar/Part	0.16***	-0.02	0.00	-0.01	-0.01	1.00				
7 Large,Public	0.04	0.02	0.07	0.10**	-0.04	-0.03	1.00			
8 Univ. Pol.	0.03	0.01	0.02	0.13***	-0.11**	-0.05	-0.08*	1.00		
9 Dept. Context	-0.01	0.05	0.09*	0.20***	-0.15***	0.02	0.39***	0.31***	1.00	
10 County Vuln.	0.06	-0.04	-0.03	-0.09	0.12**	0.04	-0.13**	-0.30***	-0.45***	1.00
Mean	3.48	0.60	0.18	0.69	0.18	0.38	0.66	1.87	0.09	0.01
SD	1.63	0.49	0.39	0.46	0.38	0.49	0.47	0.89	0.69	0.77

Note – limited to students with valid responses to each of these variables. N=595. *= $p < .05$, **= $p < .01$, ***= $p < .001$.

Table 3-1

Negative Personal Effects Experienced During the Pandemic and Current Status

<u>Effect</u>	<u>Experienced</u>	<u>Current Status of Concerns</u>		
		<u>Diminished</u>	<u>The Same</u>	<u>Increased</u>
Mental health issues	78%	26%	33%	41%
Increased financial concerns	51%	13%	25%	62%
Problems with physical health	32%	28%	27%	45%
Increased care-taking Responsibilities	27%	34%	29%	36%

Total Number of Issues: Mean = 1.93, SD=1.05, Range = 0 to 4

Scale Score of Severity of Personal Impact, Mean = 4.2, SD=2.9, Range: 0 to 12

Note: N=818. Percentages for continuing concerns calculated only for those who indicated an issue had been a problem. On the scale score of severity of personal impact a value of 12 indicated a respondent had experienced all areas and each had increased

Table 3-2

Correlations of Summative Measure of Personal Impact of Pandemic with Model Variables

<u>Independent Variables</u>	<u>Correlations</u>
Year in Program	0.04
Identified as female	0.06
Identified as LGBTQ	.09*
U.S. Citizen/Permanent Resident	-.09*
Identified as URM	.16***
Married or Partnered	0.02
Large Public Institution	0.06
Covid-Related Restrictions	-.09*
Department Rank/Equity Scale	-0.07
County Vulnerability	0.05

Note: N=595, *=p<.05, **=p<.01, ***=p<.001. Analysis limited to students with data on all of the independent variables.

Table 3-3

Model Fit Statistics, Mixed Model Regression of Severity of Personal Impacts of Pandemic on Individual, University-Related, and Geographic Locale-Related Variables, by Model

<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>
-2 Log Likelihood	2949.81	2921.31	2915.13	2915.12
Change in -2 LL		28.50***	6.19	0.01
Degrees of freedom with change		6	3	1
County-Level Variance Estimate	0.13	0.09	0.00	0.00
County-Level Variance S.E.	0.22	0.19	0.00	0.00
Change County-Level Variance (PPE)		0.34	1.00	
Residual Variance Estimate	8.21***	7.86***	7.86***	7.86***
Residual S.E.	0.51	0.48	0.46	0.46
Change Residual Variance (PPE)		0.04	0.00	0.00

Note: In the baseline model the variance estimate associated with universities/departments was zero, so only the measure of county was used as a random effect in subsequent models. Model 1 added individual level variables, Model 2 added university/department level variables, and Model 3 added the measure of county-level context. N=595 students, in 113 counties, 1 to 45 students per county, average 5.3. *= $p < .05$, **= $p < .01$, ***= $p < .001$.

Table 3-4

Fixed Effects, Mixed Model Regression of Severity of Personal Impact of Pandemic on Individual Characteristics, Department and Location Variables

	<u>Model 1</u>		<u>Model 2</u>		<u>Model 3</u>	
<u>Ind. Variable</u>	<u>b</u>	<u>S.E.</u>	<u>b</u>	<u>S.E.</u>	<u>b</u>	<u>S.E.</u>
Year in Program	0.09	0.07	0.08	0.07	0.08	0.07
Identified as female	0.34	0.24	0.35	0.24	0.35	0.24
Identified as LGBTQ	.75**	0.30	.74**	0.30	.75**	0.30
U.S. Citizen/Perm. Res.	-.62*	0.26	-.56*	0.26	-.56*	0.26
Identified as URM	1.12***	0.30	1.06***	0.30	1.06***	0.30
Married or Partnered	0.10	0.24	0.12	0.24	0.12	0.24
Large public school	-----	-----	.51	0.27	.51	0.27
COVID-Rel. Rest.	-----	-----	-0.13	0.14	-0.13	0.14
Dept Rank/Policy Scale	-----	-----	-0.25	0.20	-0.25	0.21
County Vulnerability	-----	-----	-----	-----	0.00	0.17
Constant	3.70***	0.35	3.60***	0.47	3.60***	0.48

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$.

Table 3-5

Reasons Students Took a Break from their Graduate Program

<u>Reason</u>	<u>%</u>
Mental health	30%
Physical health	29%
COVID-related restrictions	25%
Financial concerns	23%
Care-taking duties	20%
Quality of education	14%
Other, such as family and work opportunities	6%

N=102 (13% of all the returning students). Students could mark more than one reason. The question was phrased, "Why did you take a break? Please mark all that apply." Students were also allowed to indicate other responses and the tally of those answers are included in the table.

Table 3-6

Reasons Students Delayed their Graduate Program

<u>Reason</u>	<u>Percent</u>
Quality of graduate education during the pandemic	47%
Academic preparation	43%
Financing graduate education	42%
Respondent's mental health (e.g. depression, anxiety)	42%
Respondent's physical health	34%
Physical health of friends or family	29%
Other	16%

N=77. Students could check more than one reason. The question was phrased, "There are many reasons why students may have decided to delay graduate school during the pandemic. Which of the following concerns affected your decision to delay graduate school? Please check all that apply."

Table 4-1

Impacts of the Pandemic on the Quality of Graduate Education, Student Reports

<u>Impact</u>	<u>Negative</u>	<u>Positive</u>	<u>Difference</u>
Research (lab) experiences	80%	5%	75%
Interactions with other students	79%	5%	74%
Interactions with other faculty	58%	3%	55%
Classroom instruction	57%	7%	50%
Interactions with research advisor	50%	13%	37%
Career preparation	41%	9%	32%
Financial support	24%	10%	13%
Other	6%	11%	-6%
None	2%	52%	-50%

Note: The question was phrased, "Over the last two years were there areas in which the quality of your graduate education was NEGATIVELY (POSITIVELY) affected by the pandemic? Please mark all that apply." N=757 for negative effects and N=750 for positive effects. The question was not asked of first year students.

Table 4-2

Correlations of Number of Perceived Negative and Positive Impacts of the Pandemic on the Quality of Graduate Education, with Model Variables

<u>Independent Variables</u>	<u>Negative Impacts</u>	<u>Positive Impacts</u>
Year in Program	.17***	-0.01
Identified as female	0.00	0.00
Identified as LGBTQ	0.08	0.06
U.S. Citizen/Permanent Resident	.19***	0.01
Identified as URM	-0.01	0.05
Married or Partnered	-0.03	0.08
Personal Impact	.32***	-0.07
Large Public Institution	0.01	0.02
More COVID-Related Restrictions	0.05	0.00
Depart Rank/Policy Scale	.14**	-0.07
County Vulnerability	-0.01	0.06

Note: N=595, *=p<.05, **=p<.01, ***=p<.001. Analysis was limited to students with data on all the independent variables.

Table 4-3

Model Fit Statistics, Mixed Model Regressions of Number of Negative and Number of Positive Impacts of Pandemic on Quality of Education, by Model (Students in Year Two or Later)

<i>Number of Negative Impacts</i>				
<u>Statistic</u>	<u>Baseline</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>
-2 Log Likelihood	1905.34	1808.70	1798.93	1796.39
Change in -2 LL	-----	96.64***	9.77**	2.54
Degrees of freedom with change	-----	7	3	1
University/Dept. Variance Estimate	.21*	.20*	0.14	0.15
University/Dept. Variance S.E.	0.11	0.10	0.09	0.09
Ch. University Level Variance (PPE)	-----	0.12	0.08	0.02
Residual Variance Estimate	2.54***	2.08***	2.07***	2.06***
Residual S.E.	0.18	0.14	0.14	0.14
Change Residual Variance (PPE)	-----	0.18	0.00	0.01
<i>Number of Positive Impacts</i>				
<u>Statistic</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>
-2 Log Likelihood	1270.30	1260.77	1255.32	1255.11
Change in -2 LL	-----	9.54	5.45	0.21
Degrees of freedom with change	-----	7	3	1
County-Level Variance Estimate	0.03	0.03	0.01	0.00
County-Level Variance S.E.	0.03	0.03	0.03	0.00
Change County-Level Variance (PPE)	-----	0.02	-0.01	-0.01
Residual Variance Estimate	.73***	.72***	.73***	.73***
Residual S.E.	0.05	0.05	0.05	0.05
Change Residual Variance (PPE)	-----	0.02	-0.01	-0.01

Note: In the baseline model for the analysis of negative impacts the variance between counties was zero, while in the baseline model for the analysis of positive impacts the variance between universities was zero. Thus, only university was used as a random effect in the analysis of negative impacts and only county was used as a random variable in the analysis of positive impacts. The question for negative impacts was phrased, "Over the last two years were there areas in which the quality of your graduate education was NEGATIVELY affected by the pandemic? Please mark all that apply." Conversely, the question for positive impacts was phrased, "Over the last two years were there areas in which the quality of your graduate education was POSITIVELY affected by the pandemic? Please mark all that apply. For the analysis of negative impacts, N=497 students, in 123 universities, 1 to 42 students per university, average = 4.0. For the analysis of positive impacts, N = 497 students in 111 counties, 1 to 42 students per county, average = 4.5.

Table 4-4

Fixed Effects, Mixed Model Regression of Number of Negative and Positive Impacts of Pandemic on Graduate Program During the Pandemic on Individual Characteristics, Department and Location Variables, Student Views

<i>Number of Negative Impacts</i>						
	<u>Model 1</u>		<u>Model 2</u>		<u>Model 3</u>	
<u>Ind. Variable</u>	<u>Coef.</u>	<u>S.E.</u>	<u>Coef.</u>	<u>S.E.</u>	<u>Coef.</u>	<u>S.E.</u>
Year in Program	.21***	0.05	.21***	0.05	.21***	0.05
Identified as female	-0.12	0.14	-0.13	0.14	-0.12	0.14
Identified as LGBTQ	0.04	0.18	0.03	0.17	0.02	0.17
U.S. Citizen/Perm. Res.	.63***	0.16	.61***	0.16	.59***	0.16
Identified as URM	-0.05	0.18	-0.01	0.18	-0.02	0.18
Married or Partnered	-.23a	0.14	-.25a	0.14	-.26a	0.14
Personal Impact COVID	.20***	0.02	.20***	0.02	.20***	0.02
Large public school	----	----	-.41*	0.19	-.41*	0.19
COVID-Rel. Restrictions	----	----	0.02	0.10	0.06	0.10
Dept Rank/Policy Scale	----	----	.38**	0.14	.43**	0.15
County Vulnerability	----	----	----	----	0.19	0.12
Constant	1.97***	0.27	2.22***	0.35	2.17***	0.35

<i>Number of Positive Impacts</i>						
	<u>Model 1</u>		<u>Model 2</u>		<u>Model 3</u>	
<u>Ind. Variable</u>	<u>Coef.</u>	<u>S.E.</u>	<u>Coef.</u>	<u>S.E.</u>	<u>Coef.</u>	<u>S.E.</u>
Year in Program	-0.01	0.03	-0.02	0.03	-0.02	0.03
Identified as female	0.00	0.08	0.00	0.08	0.00	0.08
Identified as LGBTQ	0.14	0.10	0.16	0.10	0.16	0.10
U.S. Citizen/Perm. Res.	0.01	0.09	0.02	0.09	0.02	0.09
Identified as URM	0.15	0.10	0.13	0.10	0.12	0.10
Married or Partnered	.14a	0.08	.16*	0.08	.16*	0.08
Personal Impact COVID	-.03a	0.01	-.03*	0.01	-.03*	0.01
Large public school	----	----	.16a	0.10	.17a	0.09
COVID-Rel. Restrictions	----	----	0.04	0.05	0.05	0.05
Dept Rank/Policy Scale	----	----	-.16a	0.07	-.16*	0.07
County Vulnerability	----	----	----	----	0.03	0.06
Constant	.67***	0.16	.50**	0.19	.50***	0.19

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. See Table 4-3 for question wording and sample size.

Table 4-5

Negative Impacts on Graduate Students in the Past Two Years, Coordinator Reports

<u>Impacts</u>	<u>%</u>
Interactions with peers	100%
Mental health	89%
Interactions with faculty	79%
Timely progress through the program	76%
Interactions with professionals in the field	76%
Quality of the learning experience	74%
Financial well-being	55%
Commitment to the chemical sciences	24%
Understanding of possible careers	21%
Other	13%

Note: N=38. Participants could mark more than one reason. The question was phrased, "The pandemic affected graduate students in the chemical sciences in a variety of ways. In the list below please indicate ways in which, during the last two years (academic years 2020-2021 and 2021-2022), students in your program were NEGATIVELY affected by the pandemic. (Please mark all that apply.)"

Table 4-6

Positive Impacts on Graduate Students in the Past Two Years, Coordinator Reports

<u>Impacts</u>	<u>%</u>
Commitment to the chemical sciences	31%
Other	31%
Understanding of possible careers	25%
Quality of the learning experience	19%
Interactions with faculty	13%
Interactions with professionals in the field	13%
Timely progress through the program	6%
Financial well-being	6%
Interactions with peers	0%
Mental health	0%

Note: N=16. Participants could mark more than one reason. The question was phrased, "Please indicate ways in which, during the last two years, students in your program were POSITIVELY affected by the pandemic. (Please mark all that apply.)"

Table 4-7

Coordinators' Reports of Ways the Pandemic Negatively Affected Their Graduate Programs

<u>Area of impact</u>	<u>%</u>
Student morale	86%
Ability to network in their department	84%
Ability to network outside their department	84%
Quality of lab experience	73%
Timely completion	68%
Number of graduate students	62%
Faculty morale	59%
Quality of graduate students	51%
Research resources	43%
Ability to discover professional opportunities	43%
Quality of instruction	41%
Retention of students	38%
Financial issues	32%
Financial support	30%
Teaching resources	27%
Student funding	24%
Other	5%

Note: N=37. Participants could mark more than one reason. The question was phrased, "Are there ways in which the pandemic had a NEGATIVE impact on your GRADUATE PROGRAM? Please mark all that apply."

Table 5-1

Ways students continue to be negatively affected by the pandemic, Coordinators' Report

<u>Impacts</u>	<u>%</u>
Mental health	86%
Timely progress through the program	60%
Financial well-being	60%
Interactions with professionals in the field	43%
Quality of the learning experience	23%
Interactions with peers	23%
Interactions with faculty	20%
Commitment to the chemical sciences	20%
Understanding of possible careers	6%
Other	11%

N=35. Participants could mark more than one reason. The question was phrased as: "Please indicate ways in which students in your program CONTINUE to be NEGATIVELY affected by the experience of the pandemic. (Please mark all that apply.)"

Table 5-2

Concerns over long-term outcomes for program, Coordinators' Views

<u>Impacts</u>	<u>%</u>
Mental health of students	90%
Lower levels of academic preparation	87%
Uneven sizes of graduate cohorts	60%
Diminished number of graduate applicants	43%
Increased difficulties in funding students	40%
Faculty morale	37%
Diminished opportunities for networking	33%
Increased number of graduate applicants	7%
Other	3%

N=30. The question was worded, "Which of the following long-term outcomes do you anticipate for your program?" It was only asked of those who answered "yes" or "maybe" to the question: "Thinking about the future, do you think that the COVID-19 pandemic will continue to impact your department's graduate program in the years to come?"

Table 5-3

Correlations of Coordinators' Reported Impacts of Pandemic with Department Characteristics

<u>Outcomes</u>	<u>Top 50 rank</u>	<u>Bridge participant</u>	<u>Mentoring program</u>	<u>GRE not required</u>	<u>Large Public University</u>
Neg. impact during pandemic on students	0.20	0.26	0.20	0.00	0.41***
Neg impacts continuing on students	0.08	0.26	0.30	0.08	0.32
Pos. impact during pandemic on students	-0.06	-0.10	0.12	0.14	-0.07
Pos. impacts continuing on students	-0.02	-0.02	-0.02	0.03	-0.21
Neg. impacts during pandemic on program	-0.10	0.40*	0.24	-0.06	0.46***
Neg. impacts continuing on program	0.00	0.17	0.32	-0.05	0.28

N=34, * p<0.05, ***=p<.001

Table 5-4

Graduate Students' Perceptions of Potential Future Negative Impact of Pandemic on Graduate Program, by Program Year

<u>Area of Impact</u>	<u>New Students</u>	<u>Returning Students</u>	<u>Total</u>	<u>t-ratio</u>	<u>Effect Size</u>
Classroom instruction	47%	23%	27%	6.14***	0.54
Research (lab) experiences	55%	27%	32%	6.76***	0.59
Career preparation	37%	28%	30%	2.27*	0.20
Interactions with research advisor ^a	-----	18%	18%	-----	-----
Interactions with other faculty ^a	-----	28%	28%	-----	-----
Interactions with faculty ^b	52%	-----	52%	-----	-----
Interactions with other students	57%	32%	36%	6.05***	0.53
Financial support	31%	19%	21%	3.39***	0.30
Other	1%	4%	3%	1.54	-0.14
None ^a	-----	29%	29%	-----	-----
Faculty relations (combined)	52%	33%	36%	4.41***	0.39
Total score	2.81	1.66	1.86	8.37***	0.96

Note: Responses based on 877 students, 150 in their first year and 727 returning. The question was worded, "When you think about the coming years of your graduate program, are there areas in which the quality of your graduate education might be NEGATIVELY affected by policies and procedures adopted because of the pandemic? Please mark all that apply." Effect size is Cohen's d. The "combined" faculty measure indicates whether students marked any of the faculty related choices. The total score is the total number of items marked, using the combined faculty measure.

a: Asked only of returning students

b: Asked only of first year students

Table 5-5

Graduate Students' Perceptions of Potential Future Positive Impact of Pandemic on Graduate Program, by Program Year

<u>Area of Impact</u>	<u>New Students</u>	<u>Returning Students</u>	<u>Total</u>	<u>t-ratio</u>	<u>Effect Size</u>
Classroom instruction	39%	19%	22%	5.37***	0.48
Research (lab) experiences	23%	12%	14%	3.88***	0.35
Career preparation	23%	11%	14%	3.95***	0.35
Interactions with research advisor ^a	----	16%	16%	----	----
Interactions with other faculty ^a	----	9%	9%	----	----
Interactions with faculty ^b	23%	----	23%	----	----
Interactions with other students	19%	9%	11%	3.52***	0.32
Financial support	17%	6%	8%	4.36***	0.39
Other	5%	6%	6%	0.33	-0.03
None ^a	----	48%	48%	----	----
Faculty relations (combined)	23%	19%	20%	1.20	11%
Total score	1.50	0.83	0.94	6.41***	0.43

Note: Responses based on 858 students, 149 in their first year and 709 returning. Question was worded, "When you think about the coming years of your graduate program, are there areas in which the quality of your graduate education might be POSITIVELY affected by policies and procedures adopted because of the pandemic? Please mark all that apply." Effect size is Cohen's d. The "combined" faculty measure indicates whether students marked any of the faculty related choices. The total score is the total number of items marked using the combined faculty measure.

a: Asked only of returning students

b: Asked only of first year students

Table 5-6

Correlations of Number of Perceived Negative and Positive Future Impacts of the Pandemic on the Quality of Graduate Education, with Model Variables

<u>Independent Variables</u>	<u>Negative Impacts</u>	<u>Positive Impacts</u>
Year in Program	-.20***	-.18***
Identified as female	-0.04	-0.04
Identified as LGBTQ	.09*	-0.06
U.S. Citizen/Permanent Resident	-.10**	-0.05
Identified as URM	.09**	0.07
Married or Partnered	-0.03	-0.05
Personal Impact	.25***	0.03
Large Public Institution	0.02	-0.03
More Covid-Related Restrictions	-0.02	-0.04
Depart Rank/Policy Scale	-.10**	-0.04
County Vulnerability	0.00	0.01

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. N=595, limited to students with data on all of the independent variables

Table 5-7

Model Fit Statistics, Mixed Model Regressions of Number of Negative and Number of Positive Impacts of Pandemic on Future Quality of Education, by Model

<i>Number of Negative Future Impacts</i>				
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>
-2 Log Likelihood	2207.66	2144.96	2141.90	2139.68
Change in -2 LL		62.70***	3.06	2.22
Degrees of freedom with change	-----	7	3	1
University/Dept. Variance Estimate	0.07	0.03	0.03	0.02
University/Dept. Variance S.E.	0.06	0.05	0.05	0.04
Change University Level Variance (PRE)		0.57	-0.07	0.35
Residual Variance Estimate	2.34***	2.13***	2.11***	2.11***
Residual S.E.	0.14	0.13	0.13	0.13
Change Residual Variance (PRE)		0.02	-0.01	-0.01
<i>Number of Positive Future Impacts</i>				
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>
-2 Log Likelihood	1899.58	1871.32	1870.32	1869.75
Change in -2 LL		28.26***	1.00	0.57
Degrees of freedom with change	-----	7	3	1
University/Dept. Variance Estimate	0.02	0.00	0.00	0.00
University/Dept. Variance S.E.	0.04	0.00	0.00	0.00
Change University Level Variance (PRE)		1.00	-----	-----
Residual Variance Estimate	1.41***	1.36***	1.36***	1.36***
Residual S.E.	0.09	0.08	0.08	0.08
Change Residual Variance (PRE)		0.02	-0.01	-0.01

Note: *=p<.05, **=p<.01, ***=p<.001. In the baseline models the variance between counties was zero. Thus, only university was used as a random effect. N=595 students in 125 universities. There were 1 to 45 students per university, mean 4.8.

Table 5-8

Fixed Effects, Mixed Model Regressions of Number of Negative and Positive Future Impacts of Pandemic on Graduate Program, Student Views

<i>Number of Negative Effects</i>						
<u>Ind. Variable</u>	<u>Model 1</u>		<u>Model 2</u>		<u>Model 3</u>	
	<u>b</u>	<u>s.e.</u>	<u>b</u>	<u>s.e.</u>	<u>B</u>	<u>s.e.</u>
Year in Program	-.17***	0.04	-.17***	0.04	-.17***	0.04
Identified as female	-0.14	0.12	-0.13	0.12	-0.14	0.12
Identified as LGBTQ	0.10	0.16	0.11	0.16	0.12	0.16
U.S. Citizen/Perm. Res.	-0.11	0.14	-0.10	0.14	-0.10	0.14
Identified as URM	0.24	0.16	0.22	0.16	0.23	0.16
Married or Partnered	-0.10	0.13	-0.09	0.13	-0.08	0.13
Personal Impact COVID	.12***	0.02	.12***	0.02	.13***	0.02
Large public school	----	----	0.02	0.15	0.02	0.15
Covid-Related Restrictions	----	----	0.09	0.08	0.07	0.08
Dept Rank/Policy Scale	----	----	-0.17	0.11	-.21a	0.12
County Vulnerability	----	----	----	----	-0.14	0.09
Constant	1.96***	0.20	1.77***	0.27	1.81***	0.27
<i>Number of Positive Effects</i>						
<u>Ind. Variable</u>	<u>Model 1</u>		<u>Model 2</u>		<u>Model 3</u>	
	<u>b</u>	<u>s.e.</u>	<u>b</u>	<u>s.e.</u>	<u>b</u>	<u>s.e.</u>
Year in Program	-.12***	0.03	-.13***	0.03	-.13***	0.03
Identified as female	-0.03	0.10	-0.03	0.10	-0.03	0.10
Identified as LGBTQ	-0.13	0.13	-0.13	0.13	-0.13	0.13
U.S. Citizen/Perm. Res.	0.00	0.11	0.01	0.11	0.01	0.11
Identified as URM	.26*	0.13	.25*	0.13	.25*	0.13
Married or Partnered	-0.10	0.10	-0.11	0.10	-0.11	0.10
Personal Impact COVID	0.02	0.02	0.02	0.02	0.02	0.02
Large public school			-0.07	0.11	-0.07	0.11
Covid-Related Restrictions			-0.05	0.06	-0.05	0.06
Dept Rank/Policy Scale			0.02	0.08	0.05	0.09
County Vulnerability					0.05	0.07
Constant	1.33***	0.16	1.46	0.21	1.45***	0.21

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. N=595 students in 125 universities, 1 to 45 students per university, average of 4.8.

Table 6-1

Correlations of Model Variables with Expected Negative Impact of Pandemic on Careers

<u>Independent Variables</u>	<u>Correlations</u>
Year in Program	.17***
Identified as female	.11**
Identified as LGBTQ	.07
U.S. Citizen/Permanent Resident	0.03
Identified as URM	-.09*
Married or Partnered	0.07
Personal Impact	.09*
Large Public Institution	.07a
More Covid-Related Restrictions	.11**
Depart Rank/Policy Scale	.11**
County Vulnerability	-0.12

Note: *=p<.05, **=p<.01, ***=p<.001. N=595.

Table 6-2

Mixed Model Regression of Perceived Future Negative Impact of Pandemic on Career on Model Variables

<i>Fixed Effects</i>						
	<u>Model 1</u>		<u>Model 2</u>		<u>Model 3</u>	
<u>Ind. Variable</u>	<u>b</u>	<u>s.e.</u>	<u>b</u>	<u>s.e.</u>	<u>b</u>	<u>s.e.</u>
Year in Program	.09***	0.02	.09***	0.02	.09***	0.02
Identified as female	.19**	0.07	.18**	0.07	.18***	0.07
Identified as LGBTQ	0.13	0.09	0.12	0.09	0.12	0.09
U.S. Citizen/Perm. Res.	-0.03	0.08	-0.07	0.08	-0.06	0.08
Identified as URM	-.22*	0.09	-.18*	0.09	-.18	0.09
Married or Partnered	0.07	0.07	0.08	0.07	0.08	0.07
Personal Imp. COVID	.03*	0.01	.03*	0.01	.03*	0.01
Large public school	----	----	0.08	0.09	0.08	0.09
COVID-Rel. Restr.	----	----	.10*	0.05	.08a	0.05
Dept Rank/Policy Scale	----	----	0.08	0.07	0.04	0.07
County Vulnerability	----	----	----	----	-.09a	0.05
Constant	3.03***	0.12	2.81***	0.16	2.84***	0.16
<i>Model Fit Statistics</i>						
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>		
-2 Log Likelihood	1560.94	1524.77	1514.48	1512.13		
Change in -2 LL		36.17***	10.28**	2.35		
Degrees of freedom with change		7	3	1		
University-Level Variance Estimate	0.04	0.02	0.02	0.00		
University-Level Variance S.E.	0.03	0.03	0.02	0.02		
Change University-Level Variance (PRE)		0.47	0.14	0.74		
Residual Variance Estimate	0.77**	.74***	.73***	.74***		
Residual S.E.	0.05	0.05	0.05	0.05		
Change Residual Variance (PRE)		0.04	0.01	-0.01		

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. N=595, 125 universities, 1-45 students per university, average=4.8. In the baseline model the variance between counties was zero. Thus, only university was used as a random effect

Table 6-3

Students' Open-Ended Comments Regarding Impact of the Pandemic

<u>Categories</u>	<u>N</u>	<u>% of All Comments</u>
Negative Comments		
Financial	65	25%
Social interactions, isolation	53	21%
Lost productive, academic progress	93	36%
Mental Health	107	42%
Physical health	22	9%
Caretaking responsibilities	8	3%
Family issues	15	6%
Professional, career areas	44	17%
Daily routines, livelihood	30	12%
View of field and career	12	5%
Non-Negative		
No negative effects (stated)	4	2%
Positive effect	20	8%
Other or vague	26	10%

Note: Comments could be coded into more than one category. Of the 255 respondents who gave comments, 19 gave only comments coded as positive, 31 gave comments coded as both positive and negative, and 205 gave only negative comments.

Table 6-4

Correlations of Comments Regarding Impact of Pandemic with Quantitative Measure of Impact and Model Variables, by Sample

<u>Independent Variable</u>	<u>Total Sample</u>		<u>Reduced Sample</u>
	<u>Gave a Comment</u>	<u>Negative Comment</u>	<u>Negative Comment</u>
Impact on Career	0.05	.07*	.14*
Year in Program	.06*	.08*	0.11
Identified as female	0.02	0.02	0.00
Identified as LGBTQ	0.05	0.06	0.07
U.S. Citizen/Perm. Res.	0.01	0.02	0.07
Identified as URM	0.05	0.06	0.07
Married or Partnered	0.03	0.04	0.06
Personal Impact COVID	.10**	.11**	0.08
Large public school	-0.05	-0.04	0.02
COVID-Rel. Restrictions	-0.05	-0.01	0.17
Dept Rank/Policy Scale	-.08**	-.07*	0.06
County Vulnerability	.10**	.08*	-0.08

Note: Reduced sample included only the 255 students who gave comments. N for the total sample was 595, restricted to those who had data on all of the independent variables. *= $p < .05$, **= $p < .01$, ***= $p < .001$

Table 6-5

Correlations of Model Variables with Having Changed Career Plans Because of the Pandemic, Returning Students Only

<u>Independent Variables</u>	<u>Correlation</u>
Year in Program	0.06
Identified as female	0.07
Identified as LGBTQ	0.07
U.S. Citizen/Permanent Resident	0.04
Identified as URM	0.04
Married or Partnered	.09*
Personal Impact	.15***
Large Public Institution	-0.05
More COVID-Related Restrictions	0.01
Depart Rank/Policy Scale	0.02
County Vulnerability	0.03

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. N=497

Table 6-6

Logistic Mixed Model Regression of Changed Career Plans Because of Pandemic on Independent Variables

<i>Fixed Effects</i>						
<u>Independent Variables</u>	<u>Model 1</u>		<u>Model 2</u>		<u>Model 3</u>	
	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>
Year in Program	1.08	1.09	1.09	1.17	1.08	1.09
Identified as female	1.27	1.22	1.26	1.21	1.27	1.24
Identified as LGBTQ	1.25	0.91	1.24	0.90	1.24	0.87
U.S. Citizen/Perm. Res.	1.17	0.73	1.17	0.73	1.16	0.69
Identified as URM	1.12	0.44	1.14	0.53	1.13	0.49
Married or Partnered	1.40a	1.8	1.36	1.61	1.35	1.59
Personal Impact COVID	1.10**	2.97	1.11**	3.17	1.11***	3.19
Large public school	-----	-----	.69	-1.65	.69	-1.66
COVID-Rel. Restrictions	-----	-----	1.00	-0.02	1.02	0.13
Dept Rank/Policy Scale	-----	-----	1.21	1.18	1.27	1.41
County Vulnerability	-----	-----	-----	-----	1.13	0.88
Constant	.28***	-3.37	.34*	-2.35	.34*	-2.38
<i>Model Fit Statistics</i>						
-2 Log Likelihood	668.37		665.09		664.33	
Change in -2 LL	19.49**		3.27		0.77	
Variance Constant	0.10		0.00		0.00	
S.E. Constant	1.01		0.43		0.41	
PRE Constant Variance	0.53		1		---	

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. Question asked only of students in 2nd year or later of graduate program. N=497, 123 universities 1 to 42 per university, average = 4. At baseline, only the random effects for universities was greater than zero. At baseline, -2 LL = 687.86; variance estimate was .20, s.e. was .40. OR refers to odds ratio.

Table 6-7

Correlations of Model Variables with Likelihood of Staying in the Chemical Sciences

<u>Independent Variables</u>	<u>Correlation</u>
Year in Program	-.16***
Identified as female	-.09*
Identified as LGBTQ	-0.02
U.S. Citizen/Permanent Resident	-.06***
Identified as URM	0.04
Married or Partnered	0.01
Personal Impact	-.08*
Large Public Institution	0.01
More Covid-Related Restrictions	-.08*
Depart Rank/Policy Scale	-.10**
County Vulnerability	-0.001

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. N=595.

Table 6-8

Mixed Model Regression of Likelihood of Staying in the Chemical Sciences on Model Variables

<i>Fixed Effects</i>						
<u>Independent Variables</u>	<u>Model 1</u>		<u>Model 2</u>		<u>Model 3</u>	
	<u>b</u>	<u>s.e.</u>	<u>b</u>	<u>s.e.</u>	<u>B</u>	<u>s.e.</u>
Year in Program	-.08***	0.02	-.08***	0.02	-.08***	0.02
Identified as female	-0.11	0.07	-0.10	0.07	-0.11	0.07
Identified as LGBTQ	0.03	0.09	0.04	0.09	0.04	0.09
U.S. Citizen/Perm. Res.	-.28***	0.08	-.25***	0.08	-.25***	0.08
Identified as URM	0.08	0.09	0.05	0.09	0.06	0.09
Married or Partnered	0.06	0.07	0.06	0.07	0.07	0.07
Personal Impact COVID	-.03*	0.01	-.03*	0.01	-.03**	0.01
Large public school	-----	-----	0.13	0.09	0.06	0.09
COVID-Rel. Restrictions	-----	-----	-0.03	0.04	0.07	0.05
Dept Rank/Policy Scale	-----	-----	-.14*	0.06	-.17**	0.07
County Vulnerability	-----	-----			-0.08	0.05
Constant	3.78***	0.12	3.74***	0.15	3.76***	0.15
<i>Model Fit Statistics</i>						
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>		
-2 Log Likelihood	1,533	1,495	1,488	1,486		
Change in -2 LL		38.18***	6.87*	2.15		
DF with change	-----	7	3	1		
University-Level Var.	0.01	0.02	0.01	0.01		
University-Level S.E.	0.02	0.02	0.01	0.01		
PRE Change Univ. Var.	-----	-0.56	0.53	0.00		
Residual Var.	.76***	.71***	.71***	.70***		
Residual S.E.	0.05	0.04	0.04	0.04		
PRE Change Res. Var.		0.07	0.00	0.00		

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. N=595, 125 schools, 1-45 per school, average 4.7. In the baseline model the variance between counties was zero. Thus, only university was used as a random effect. Higher values of the dependent variable indicate students were more likely to believe they would stay in the chemical sciences.

Table 7-1

Correlations of Definite Plans to Complete Degree with Year and Model Variables, Over-Time Analysis, by Degree Level

<u>Variable</u>	<u>Masters Students</u>	<u>Doctoral Students</u>	<u>Total Group</u>
Year in Program	-0.18	.16***	.13***
Identified as female	0.07	-0.01	0.00
Identified as LGBTQ	-0.15	0.01	0.00
U.S. Citizen/Perm. Res.	0.09	-0.06	-0.05
Identified as URM	0.03	0.02	0.02
Married or Partnered	-0.29	0.07	0.05
Personal Impact COVID	-.46**	-0.06	-.09*
Large public school	-0.11	-0.05	-0.06
Covid-Related Restrictions	-0.13	-0.02	-0.03
Dept Rank/Policy Scale	-.36*	-0.05	-0.07
County Vulnerability	0.07	.11**	.11**

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. N=595 for the total group, 43 for Masters students and 552 for Doctoral students.

Table 7-2

Logistic Regression of Definite Plan to Complete Degree on Model Variables, Masters Students

<u>Independent Variable</u>	<u>Model 1</u>		<u>Reduced</u>	
	<u>Odds Ratio</u>	<u>Z-score</u>	<u>Odds Ratio</u>	<u>Z-score</u>
Year in Program	0.66	-1.40	-----	-----
Identified as female	2.57	0.99	-----	-----
Identified as LGBTQ	0.90	-0.07	-----	-----
U.S. Citizen/Perm. Res.	5.11	1.49	-----	-----
Identified as URM	1.42	0.37	-----	-----
Married or Partnered	.13a	-1.75	.22	-1.73
Personal Impact COVID	.65*	-2.40	.72**	-2.68
Large public school	0.54	-0.54	-----	-----
Covid-Related Restrictions	1.70	0.84	-----	-----
Dept Rank/Policy Scale	0.37	-1.12	-----	-----
County Vulnerability	1.46	0.52	-----	-----
Constant	3.69	0.63	10.3**	3.14
Pseudo R ²	.39*		.22**	

Note: a= $p < .10$, *= $p < .05$, **= $p < .01$, ***= $p < .001$; N=43

Table 7-3

Logistic Regression of Definite Plans to Finish Degree on Model Variables, PhD Students

<i>Fixed Effects</i>						
	<u>Model 1</u>		<u>Model 2</u>		<u>Model 3</u>	
<u>Ind. Variable</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>
Year in Program	1.25***	3.89	1.26***	3.93	1.25***	3.83
Identified as female	1.00	0.01	1.00	0.00	1.00	0.02
Identified as LGBTQ	1.22	0.84	1.24	0.92	1.24	0.91
U.S. Citizen/Perm. Res.	.66*	-2.07	0.69	-1.79	0.68	-1.85
Identified as URM	1.12	0.47	1.09	0.35	1.05	0.21
Married or Partnered	1.24	1.15	1.22	1.09	1.21	1.02
Personal Impact COVID	.94*	-2.01	.94*	-1.98	.94*	-1.99
Large public school	-----	-----	0.81	-0.96	0.81	-0.97
Covid-Related Restrictions	-----	-----	0.96	-0.36	1.00	0.02
Dept Rank/Policy Scale	-----	-----	0.95	-0.35	1.09	0.48
County Vulnerability	-----	-----	-----	-----	1.34*	2.15
Constant	1.02	0.08	1.22	0.52	1.17	0.4
<i>Model Fit Statistics</i>						
-2 Log Likelihood	719.52		717.76		713.04	
Change in -2 LL	24.20**		1.76		4.72*	

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$; N=552. Random effects models showed no variation between universities or counties in the dependent measure. Logistic regression was used because the dependent variable is a dichotomy. At baseline -2LL=743.72.

Table 7-4
*Correlations of Lessened Commitment to Finishing Degree with Model Variables,
 Returning Students Only*

<u>Independent Variables</u>	<u>Correlations</u>
Year in Program	0.05
Identified as female	.08a
Identified as LGBTQ	0.06
U.S. Citizen/Permanent Resident	.09*
Identified as URM	0.02
Married or Partnered	0.06
Personal Impact	.15***
Large Public Institution	0.04
More Covid-Related Restrictions	-0.01
Depart Rank/Policy Scale	0.04
County Vulnerability	0.06

Note: *=p<.05, **=p<.01, ***=p<.001. N=497. Analysis limited to students with data on all model variables. Question only asked of students in the 2nd year or later of graduate school.

Table 7-5

Logistic Regression of Lessened Commitment to Finishing Degree on Model Variables

<i>Fixed Effects</i>						
	<u>Model 1</u>		<u>Model 2</u>		<u>Model 3</u>	
<u>Ind. Variable</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>
Year in Program	1.06	0.68	1.06	0.73	1.05	0.62
Identified as female	1.35	1.31	1.36	1.33	1.37	1.38
Identified as LGBTQ	1.14	0.47	1.12	0.43	1.11	0.40
U.S. Citizen/Perm. Res.	1.65a	1.91	1.59a	1.75	1.56	1.68
Identified as URM	1.04	0.14	1.07	0.22	1.04	0.14
Married or Partnered	1.34	1.33	1.33	1.30	1.32	1.25
Personal Impact COVID	1.13***	3.34	1.13***	3.32	1.13***	3.34
Large public school	-----	-----	1.08	0.28	1.08	0.28
COVID-Rel. Restrictions	-----	-----	0.97	-0.20	1.02	0.11
Dept Rank/Policy Scale	-----	-----	1.12	0.58	1.26	1.14
County Vulnerability	-----	-----	-----	-----	1.29a	1.63
Constant	.08***	-5.79	.07***	-4.76	.07***	-4.82
Pseudo-R squared	.04**		.04*		.04**	
<i>Model Fit Statistics</i>						
-2 Log Likelihood	549.43		528.29		527.58	
Change in -2 LL	21.14**		0.71		2.64	

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. N=497. Mixed models analyses indicated no variation between universities or counties, so a simple logistic regression was used. At baseline, -2LL=549.43.

Table 7-6

Correlations of Future Educational Plans with Model Variables, by Degree Level

<u>Independent Variable</u>	<u>Plan Post-Doc (Doctoral Students)</u>	<u>Plan PhD (Masters Students)</u>
Year in Program	-.12**	-0.09
Identified as female	-.11**	-0.27
Identified as LGBTQ	-0.01	-.29**
U.S. Citizen/Perm. Res.	-.16***	-.32*
Identified as URM	0.01	0.12
Married or Partnered	-0.03	-.35*
Personal Impact COVID	0.001	-0.03
Large public school	-0.05	0.01
Covid-Related Restrictions	-0.01	0.01
Dept Rank/Policy Scale	-.09*	-0.07
County Vulnerability	0.02	0.08

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. N=552 doctoral students, 37 Masters students.
Dependent variable coded so that 1 = no, 2=not sure, and 3=yes.

Table 7-7

Regression of Doctoral Students' Plans to Pursue a Post-Doc on Model Variables

<u>Independent Variable</u>	<u>Model 1</u>		<u>Model 2</u>		<u>Model 3</u>	
	<u>B</u>	<u>s.e.</u>	<u>b</u>	<u>s.e.</u>	<u>B</u>	<u>s.e.</u>
Year in Program	-.05*	0.02	-.05**	0.02	-.05*	0.02
Identified as female	-.14*	0.07	-.13*	0.07	-.13*	0.07
Identified as LGBTQ	0.04	0.09	0.04	0.09	0.04	0.09
U.S. Citizen/Perm. Res.	-.25***	0.07	-.23**	0.08	-.23**	0.08
Identified as URM	-0.03	0.09	-0.03	0.09	-0.03	0.09
Married or Partnered	-0.03	0.07	-0.02	0.07	-0.02	0.07
Personal Impact COVID	0.00	0.01	0.00	0.01	0.00	0.01
Large public school	-----	-----	0.01	0.08	0.01	0.08
Covid-Related Restrictions	-----	-----	0.03	0.04	0.02	0.04
Dept Rank/Policy Scale	-----	-----	-0.08	0.06	-0.09	0.06
County Vulnerability	-----	-----	-----	-----	-0.02	0.05
Constant	2.33	0.11	2.28***	0.14	2.28***	0.14
Adjusted R Squared	.03**		.03**		.03**	

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. N=552. Mixed model analyses indicated that the random variances for both universities and counties were zero, so a simple regression was used.

Table 8-1

Percentage Distribution of Likelihood of Remaining in Chemical Sciences 2013, 2019, and 2022

	2013	2019	2022	Total
Slightly or Less	5%	6%	6%	6%
Moderate	17%	17%	19%	17%
Very Likely	39%	36%	34%	37%
Extremely Likely	39%	40%	41%	40%
Total %	100	100	100	100
Total N	2,543	2,206	757	5,506

Table 8-2

Correlations of Intent to Stay in the Chemical Sciences with Model Variables, Over-Time Analysis

<u>Independent Variables</u>	<u>Correlation</u>
Year 2019	-0.01
Year 2022	0.01
Women	-.05***
URM	0.01
Mid Program	-.05***
End of Program	-.05***
PhD	-0.01
U.S. Citizen	-.07***
Rank Higher	-.12***

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$. N=4,977. Analysis limited to students with data on all independent variables included in the multivariate analysis. The comparison category for the dummy variables for years was 2013.

Table 8-3

Model Fit Statistics for Mixed Model Regressions of Stay in Field on Year and Individual and Departmental Characteristics

<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>
-2 Log Likelihood	12830.8	12829.9	12703.8	13264.3	12669.2
Change in -2 LL		0.96	126.01***	-560.44	34.61***
Degrees of freedom with change	-----	2.00	7.00	14.00	5.00
University/Dept. Variance Estimate	.025***	.025***	.011**	.011**	.011**
University/Dept. Variance S.E.	0.01	0.01	0.00	0.00	0.00
Change University Level Variance (PRE)	-----	0.00	0.58	-0.07	-0.04
Residual Variance Estimate	.75***	.75***	.74***	.74***	.74***
Residual S.E.	0.75	0.75	0.74	0.74	0.74
Change Residual Variance (PRE)	-----	0.00	0.01	0.01	0.01

Note: Model 1 included only the two dummy variables for year. Model 2 added individual characteristics and departmental rank, Model 3 added the interactions of these variables with the two dummy variables for year, and Model 4, reduced the model to only include interactions that were significant in Model 3. For calculations of model fit and the PRE measures, Model 4 was compared to Model 2. n=4,977 students; 280 departments, 1 to 179 students per department, average = 17.8. ***=p<.001, **=p<.01, *=p<.05.

Table 8-4

Fixed Effects, for Mixed Model Regressions of Stay in Field on Year and Individual and Departmental Characteristics by Model

<u>Ind. Variables</u>	<u>Model 1</u>		<u>Model 2</u>		<u>Model 4</u>	
	<u>b</u>	<u>s.e.</u>	<u>b</u>	<u>s.e.</u>	<u>B</u>	<u>s.e.</u>
Year 2019	0.00	0.03	-0.02	0.03	.18a	0.10
Year 2022	0.03	0.04	0.04	0.04	.34***	0.10
Women	-----	-----	-.09***	0.02	-.09***	0.02
URM	-----	-----	0.01	0.04	0.00	0.04
Mid Program	-----	-----	-.22***	0.03	-.28***	0.04
End of Program	-----	-----	-.28***	0.04	-.27***	0.04
PhD	-----	-----	.13*	0.05	.26***	0.06
U.S. Citizen	-----	-----	-.10***	0.03	-.07*	0.03
Rank Higher	-----	-----	-.003***	0.00	-.003***	0.00
2019*PhD	-----	-----	-----	-----	-.34***	0.10
2019*Mid Prog.	-----	-----	-----	-----	.20***	0.06
2023*Mid Prog.	-----	-----	-----	-----	-.21*	0.10
2023*End Prog.	-----	-----	-----	-----	-.22*	0.11
2023*U.S. Cit.	-----	-----	-----	-----	-.19*	0.08
Constant	3.14***	0.02	3.44***	0.06	3.24***	0.07

Note: Higher values on the dependent variable indicate a greater likelihood of staying in the chemical sciences.

***=p<.001, **=p<.01, *=p<.05. Details on model and sample size are in Table 8-3.

Table 8-5

Average Values of Likelihood of Staying in the Chemical Sciences by Year with Degree Level, Program Year, and U.S. Citizenship

<u>Variables</u>	<u>2013</u>	<u>2019</u>	<u>2022</u>
Degree Level			
Masters	3.0	3.3	3.0
PhD	3.1	3.1	3.1
Program Level			
First Year	3.3	3.2	3.5
Mid-Program	3.1	3.1	3.0
End of Program	3.1	2.9	3.0
Citizenship			
U.S. Citizen or Permanent Resident	3.2	3.2	3.3
Other	3.1	3.1	3.0

Note: The dependent variable could vary from 1 to 4 with a code of 4 indicating students were extremely likely to stay in the chemical sciences. For Masters students "mid program" indicates at year 2 of their program and end of program was beyond the 2nd year. For PhD Students end of program was defined as year 5 or later. See Table 8-3 for further details on sample.

Table 8-6

Primary Field of Study by Year

<u>Field</u>	<u>2013</u>	<u>2019</u>	<u>2022</u>	<u>Chi-Sq.</u>	<u>Prob.</u>
Analytical	9%	11%	14%	17.8	<.001
Biochemistry	8%	9%	7%	3.93	0.14
Chemical Biology	5%	6%	9%	20.45	<.001
Inorganic	12%	12%	9%	5.72	0.06
Materials Chemistry	9%	9%	12%	6.67	0.04
Organic	15%	15%	15%	0.01	0.99
Physical Chemistry	7%	9%	8%	11.56	0.003

Note: The question was phrased, "What is your primary field of study?" Fields that were chosen by fewer than 6% of the students omitted. Chi-square values calculated within each field. Degrees of freedom equal 2 for each comparison. N=5970.

Table 8-7

Correlations of Field of Study with Year and Model Variables, Over-Time Analysis

	<u>Analytical</u>	<u>BioChem.</u>	<u>Chem.</u> <u>Biol.</u>	<u>Inorganic</u>	<u>Materials</u>	<u>Organic</u>	<u>Phys.</u> <u>Chem.</u>
Year 2019	0.02	0.02	0.02	0.01	0.00	0.00	.04***
Year 2022	.04***	-0.02	.05***	-0.03	0.03	0.00	0.00
Women	.06***	.04**	0.01	0.00	-0.01	-.05***	0.00
URM	0.00	0.00	0.00	-0.03	0.00	0.02	-.03**
Mid Program	-0.02	-.05***	-0.02	0.00	0.02	0.01	0.03
End of Prog.	-0.02	0.01	0.01	-0.01	-0.01	0.00	0.01
PhD	-.03*	-0.03	.04***	.04*	.04***	0.02	.04***
U.S. Citizen	.03*	0.01	0.02	.04**	-0.02	-0.01	0.01
Rank Higher	-.04**	-.06***	.13***	0.02	.05***	0.02	.08***

Note: *=p<.05, **=p<.01, ***=p<.001

Table 8-8

Model Fit Statistics for Mixed Model Logistic Regressions of Choice of Field on Year and Individual and Departmental Characteristics

<i>Analytical Chemistry</i>					
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>
-2 Log Likelihood	3,117	3,102	3,066	3,047	3,058
Change in -2 LL	-----	15.01***	36.68***	18.38	8.05*
Degrees of freedom with change	-----	2	7	14	2
University/Dept. Variance Estimate	.94***	.94***	.92***	.93***	.92***
University/Dept. Variance S.E.	0.10	0.10	0.10	0.10	0.10
Change University Level Variance (PRE)	-----	0.00	0.03	-0.01	-0.01
<i>Chemical Biology</i>					
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>
-2 Log Likelihood	2131.7	2117.1	2070.4	2056.6	2064.6
Change in -2 LL	-----	14.54***	46.79***	13.77	5.75
Degrees of freedom with change	-----	2	7	14	2
University/Dept. Variance Estimate	1.02***	1.02***	.80***	.80***	.81***
University/Dept. Variance S.E.	0.13	0.13	0.13	0.13	0.13
Change University Level Variance (PRE)	-----	0.00	0.22	0.00	-0.01
<i>Inorganic</i>					
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>
-2 Log Likelihood	3456.0	3452.4	3437.3	3418.3	3431.7
Change in -2 LL	-----	3.58	15.10*	18.99	5.66
Degrees of freedom with change	-----	2	7	14	2
University/Dept. Variance Estimate	.52***	.51***	.52***	.52***	.52***
University/Dept. Variance S.E.	0.07	0.07	0.08	0.08	0.08
Change University Level Variance (PRE)	-----	0.01	-0.01	-0.01	0.00

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<i>Materials Chemistry</i>				
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>
-2 Log Likelihood	3,115	3109.7172	3094.6926	3086.7
Change in -2 LL	-----	5.15	15.02*	7.95
Degrees of freedom with change	-----	2	7	14
University/Dept. Variance Estimate	.57***	.57***	.56***	.56***
University/Dept. Variance S.E.	0.08	0.08	0.09	0.09
Change University Level Variance (PRE)		0.00	0.02	0.00
<i>Physical Chemistry</i>				
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>
-2 Log Likelihood	2667.1	2660.8	2623.4	2607.7
Change in -2 LL	-----	6.28*	37.39***	15.73
Degrees of freedom with change	-----	2	7	14
University/Dept. Variance Estimate	.68***	.66***	.61***	.60***
University/Dept. Variance S.E.	0.09	0.09	0.10	0.10
Change University Level Variance (PRE)	-----	0.02	0.08	0.01

Note: Model 1 included only the two dummy variables for year. Model 2 added individual characteristics and departmental rank, Model 3 added the interactions of these variables with the two dummy variables for year, and Model 4, reduced the model to only include interactions that were significant in Model 3. For calculations of model fit and the PRE measures, Model 4 was compared to Model 2. n=4,977 students; 280 departments, 1 to 179 students per department, average = 17.8. ***=p<.001, **=p<.01, *=p<.05.

Table 8-9

Fixed Effects, Mixed Model Regressions of Field of Interest on Year, Individual and Departmental Characteristics, Final Models

<i>Analytical</i>						
	<u>Model 1</u>		<u>Model 2</u>		<u>Model 4</u>	
<u>Ind. Variable</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>
Year 2019	1.29**	2.25	1.20	1.57	0.54	-1.54
Year 2022	1.74***	3.79	1.86***	4.15	1.32	1.14
Women	-----	-----	1.37**	3.07	1.25*	2.04
URM	-----	-----	0.86	-0.93	0.87	-0.91
Mid Program	-----	-----	.75*	-2.33	.75*	-2.33
End of Program	-----	-----	.57***	-3.56	.56***	-3.61
PhD	-----	-----	0.98	-0.12	0.73	-1.36
U.S. Citizen	-----	-----	1.40***	2.57	1.41**	2.6
Rank Higher	-----	-----	1.00	-1.77	0.99	-1.91
2019*PhD	-----	-----	-----	-----	2.36*	2.11
2022*Women	-----	-----	-----	-----	1.68	1.83
Constant	.07***	-23.03	.07***	-10.31	.10***	-8.24
<i>Chemical Biology</i>						
	<u>Model 1</u>		<u>Model 2</u>		<u>Model 4</u>	
<u>Ind. Variable</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>
Year 2019	1.59***	3.24	1.61***	3.32	1.59***	3.23
Year 2022	1.77**	3.12	1.76**	3.05	2.76**	3.11
Women	-----	-----	1.05	0.40	1.05	0.39
URM	-----	-----	1.10	0.50	1.08	0.4
Mid Program	-----	-----	0.77	-1.65	0.78	-1.56
End of Program	-----	-----	0.98	-0.11	0.91	-0.43
PhD	-----	-----	1.37	0.91	1.42	0.99
U.S. Citizen	-----	-----	0.93	-0.46	1.13	0.65
Rank Higher	-----	-----	1.02***	6.19	1.02***	6.2
2022*End Program	-----	-----	-----	-----	1.44	1.05
2022*U.S. Citizen	-----	-----	-----	-----	.45*	-2.25
Constant	.02***	-21.51	.01***	-11.33	.01***	-11.36

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<i>Inorganic</i>						
	<u>Model 1</u>		<u>Model 2</u>		<u>Model 4</u>	
<u>Ind. Variable</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>
Year 2019	0.96	-0.43	0.96	-0.39	0.97	-0.32
Year 2022	0.75	-1.85	0.80	-1.44	1.53	1.41
Women	-----	-----	0.97	-0.32	0.97	-0.29
URM	-----	-----	0.76	-1.74	0.76	-1.75
Mid Program	-----	-----	0.94	-0.52	1.03	0.24
End of Program	-----	-----	0.98	-0.17	1.06	0.4
PhD	-----	-----	1.60*	2.09	1.59*	2.09
U.S. Citizen	-----	-----	1.36**	2.57	1.38**	2.68
Rank Higher	-----	-----	1.00	-0.23	1.00	-0.28
2022*Mid Program	-----	-----	-----	-----	.42*	-2.39
2022*End Program	-----	-----	-----	-----	0.48	-1.84
Constant	.12***	-26.42	.07***	-10.55	.06***	-10.74
<i>Materials Chemistry</i>						
	<u>Model 1</u>		<u>Model 2</u>			
<u>Ind. Variable</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>		
Year 2019	1.15	1.27	1.19	1.53		
Year 2022	1.39*	2.22	1.40*	2.24		
Women	-----	-----	0.91	-1.00		
URM	-----	-----	0.99	-0.03		
Mid Program	-----	-----	1.16	1.14		
End of Program	-----	-----	1.12	0.69		
PhD	-----	-----	1.77*	2.17		
U.S. Citizen	-----	-----	0.83	-1.61		
Rank Higher	-----	-----	1.00	1.33		
Constant	.08***	-26.56	.05***	-10.54		

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<i>Physical Chemistry</i>				
<u>Ind. Variable</u>	<u>Model 1</u>		<u>Model 2</u>	
	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>
Year 2019	1.35**	2.51	1.46**	3.1
Year 2022	1.14	0.75	1.17	0.91
Women	.06***	-25.97	1.01	0.06
URM	-----	-----	0.66	-2.16
Mid Program	-----	-----	1.78***	3.6
End of Program	-----	-----	1.93***	3.53
PhD	-----	-----	1.37	1.08
U.S. Citizen	-----	-----	1.00	-0.02
Rank Higher	-----	-----	1.01**	2.96
Constant			.02***	-11.56

Note: For materials and physical chemistry none of the interaction effects were statistically significant. Interaction effects were included in the models if they were significant in Model 3. *=p<.05, **=p<.01, ***=p<.001. See Table 8-8 for details on sample size.

Table 8-10

Percent of Students Indicating Interest in a Field, by Variables with Significant Interactions in Multivariate Analyses

<i>Analytic Chemistry</i>			
<u>Variable</u>	<u>Year</u>		
<u>Gender</u>	<u>2013</u>	<u>2019</u>	<u>2022</u>
Men	8%	8%	9%
Women	9%	12%	17%
<u>Level of Study</u>			
Masters	14%	12%	16%
PhD	8%	11%	13%
<i>Chemical Biology</i>			
<u>Variable</u>	<u>Year</u>		
<u>Citizenship</u>	<u>2013</u>	<u>2019</u>	<u>2022</u>
Non US	3%	5%	9%
U.S.	5%	7%	8%
<u>Year in Program</u>			
First year	5%	7%	5%
Mid Program	4%	6%	9%
End Program	5%	7%	11%
<i>Inorganic</i>			
<u>Variable</u>	<u>Year</u>		
<u>Year in Program</u>	<u>2013</u>	<u>2019</u>	<u>2022</u>
First year	11%	13%	13%
Mid Program	12%	12%	8%
End Program	13%	9%	8%

Note: See Table 8-8 for details on sample size.

Table 8-11

Sector of Interest by Year

<u>Year</u>	<u>Academe</u>	<u>Government</u>	<u>Industry</u>	<u>Nonprofit</u>	<u>Entrepren.</u>
2019	38%	12%	41%	4%	5%
2022	30%	12%	53%	1%	1%
Total	45%	29%	48%	6%	9%
Chi Square	16.04	0.28	31.34	21.98	18.92
Probability	<.001	0.6	<.001	<.001	<.001

Note: The question was phrased, "When thinking about the future, which of the following career sectors is of most interest to you?" Comparable data were not available for 2012. Chi-squares calculated for each sector, degrees of freedom=1. N=2,438.

Table 8-12

Correlations of Preferred Sector of Employment with Year and Model Variables

	<u>Academe</u>	<u>Government</u>	<u>Industry</u>
Year 2022	-.08***	0.01	.12***
Women	-.08***	.06**	0.04
URM	0.00	0.03	-0.02
Mid Program	-0.03	0.04	-0.02
End of Program	-.06**	0.03	.06**
PhD	0.01	0.02	-0.02
U.S. Citizen	-.09***	.14***	-.05**
Rank Higher	0.00	0.02	-.04*

Note: Analysis limited to 2019 and 2022. *= $p < .05$, **= $p < .01$, ***= $p < .001$. N=2,438

Table 8-13

Model Fit Statistics for Mixed Model Logistic Regressions of Sector of Interest on Year and Individual and Departmental Characteristics

<i>Academe</i>					
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	
-2 Log Likelihood	3,134	3,120	3,067	3,059	
Change in -2 LL		14.40***	52.69***	7.97	
Degrees of freedom with change	-----	1	7	7	
University/Dept. Variance Estimate	0.32***	0.32***	0.32***	0.32***	
University/Dept. Variance S.E.	0.07	0.07	0.07	0.07	
Change University Level Variance (PRE)		0.01	-0.02	0.01	
<i>Government</i>					
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>
-2 Log Likelihood	1786	1786	1704	1689	1692
Change in -2 LL		0.14	81.11***	15.31*	12.15**
Degrees of freedom with change		1	7	7	2
University/Dept. Variance Estimate	.55***	.55***	.53***	.52***	.53***
University/Dept. Variance S.E.	0.10	0.10	0.11	0.11	0.11
Change University Level Variance (PRE)		0.00	0.03	0.01	0.01
<i>Industry</i>					
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>
-2 Log Likelihood	3346.7	3313.7	3295.7	3284.3	3289.4
Change in -2 LL		33.00***	17.96*	11.39	6.35*
Degrees of freedom with change		1	7	7	1
University/Dept. Variance Estimate	.27***	.27***	.28***	.25***	.25***
University/Dept. Variance S.E.	0.08	0.08	0.08	0.08	0.08
Change University Level Variance (PRE)		0.01	-0.03	0.10	0.09

Note: Model 1 included only the two dummy variables for year. Model 2 added individual characteristics and departmental rank, Model 3 added the interactions of these variables with the two dummy variables for year, and Model 4, reduced the model to only include interactions that were significant in Model 3. For calculations of model fit and the PRE measures, Model 4 was compared to Model 2. n=4,977 students; 280 departments, 1 to 179 students per department, average = 17.8. ***=p<.001, **=p<.01, *=p<.05.

Table 8-14

Fixed Effects, Mixed Model Regressions of Sector of Interest on Year, Individual and Departmental Characteristics

Academe						
	Model 1		Model 2			
Ind. Variable	OR	Z	OR	Z		
Year 2022	.68***	-3.75	.68***	-3.54		
Women	----	----	.73***	-3.48		
URM	----	----	1.00	0.01		
Mid Program	----	----	.69***	-3.47		
End of Program	----	----	.61***	-3.55		
PhD	----	----	1.19	0.97		
U.S. Citizen	----	----	.62***	-4.48		
Rank Higher	----	----	1.00	0.74		
Constant	.57***	-9.54	1.05	0.25		
Government						
	Model 1		Model 2		Model 4	
Ind. Variable	OR	Z	OR	Z	OR	Z
Year 2022	1.06	0.38	1.11	0.69	0.92	-0.26
Women	----	----	1.38*	2.36	1.64**	3.06
URM	----	----	1.50*	2.29	1.58*	2.41
Mid Program	----	----	1.70**	3.00	1.44*	1.97
End of Program	----	----	1.83**	2.82	2.24***	3.6
PhD	----	----	1.17	0.57	1.15	0.51
U.S. Citizen	----	----	4.58***	6.41	4.67***	6.46
Rank Higher	----	----	1.00	-0.03	1.00	-0.03
2022*Women	----	----	----	----	.56*	-1.96
2022*Mid Prog.	----	----	----	----	2.49**	2.95
Constant	.12***	-21.32	.01***	-11.24	.04***	-11.1

Table 8-14, Page
2

<i>Industry</i>						
<u>Ind. Variable</u>	<u>Model 1</u>		<u>Model 2</u>		<u>Model 4</u>	
	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>
Year 2022	1.72***	5.71	1.62***	4.86	1.14	0.79
Women	-----	-----	1.17	1.83	1.17	1.84
URM	-----	-----	0.79	-1.91	0.80	-1.8
Mid Program	-----	-----	1.06	0.58	1.07	0.63
End of Program	-----	-----	1.29	1.92	1.30*	2.00
PhD	-----	-----	0.89	-0.68	0.92	-0.48
U.S. Citizen	-----	-----	0.82	-1.91	.81*	-2.01
Rank Higher	-----	-----	1.00	-1.86	.995**	-2.83
2022*Rank	-----	-----	-----	-----	1.01**	2.53
Constant	.70***	-6.46	0.90	-0.55	0.96	-0.23

Note: No interaction effects were significant for the analysis of the academic sector. *=p<.05, **=p<.01, ***=p<.001. See Table 8-13 for details on sample size.

Table 8-15

Percent Students Preferring Government and Industrial Sector by Associations with Significant Interactions

<i>Percent Preferring Government</i>			
<u>Variable</u>	<u>Year</u>		<u>Change 2019 to 2022</u>
<u>Gender</u>	<u>2019</u>	<u>2022</u>	
Men	9%	12%	3%
Women	14%	13%	-1%
<u>Progress through Program</u>			
First year	10%	6%	-4%
Mid-Program	12%	16%	4%
End of Program	15%	11%	-4%
<i>Percent Preferring Industry</i>			
<u>Variable</u>	<u>Year</u>		<u>Change 2019 to 2022</u>
<u>Department Rank</u>	<u>2019</u>	<u>2022</u>	
Below top 50	43%	51%	9%
Top 50	40%	54%	14%

Table 8-16

Percent of Students Definitely Planning to Complete Degree by Year and Degree Level

<u>Year</u>	<u>Masters Students</u>	<u>Doctoral Students</u>
2013	86%	77%
2019	86%	68%
2022	51%	58%
chi-square	44.00	102.16
prob.	<.001	<.001

Degrees of freedom for chi-square = 2. N= 4,629 PhD students and 338 Masters students.

Table 8-17

Correlations of Definite Plans to Complete Degree with Year and Model Variables, Over-Time Analysis, by Degree Level

	<u>Masters Students</u>	<u>Doctoral Students</u>	<u>Total Group</u>
Year 2019	.13**	-.05***	-0.04
Year 2022	-.32**	-.10***	-0.12***
Women	0.03	-.06***	-0.05***
URM	-0.03	.03*	0.03*
Mid Program	.16***	.09***	.08***
End of Program	-.17***	.12***	.10***
PhD	-----	-----	-.06***
U.S. Citizen	0.06	-.11***	-.10***
Rank Higher	-.11*	-.06***	-.08***

Note: * = $p < .05$, ** = $p < .01$, *** = $p < .001$

Table 8-18

Mixed Model Logistic Regression of Definitely Finishing Degree on Year and Individual and Departmental Characteristics, Masters' Students

<i>Fixed Effects</i>				
<u>Ind. Variable</u>	<u>Model 1</u> <u>Odds Ratios</u>	<u>Z</u>	<u>Model 2</u> <u>Odds Ratios</u>	<u>Z</u>
Year 2019	1.59	0.99	1.19	0.37
Year 2022	.12***	-3.80	.13***	-3.49
Women	-----	-----	1.35	0.75
URM	-----	-----	1.66	0.99
Mid Program	-----	-----	3.47*	2.00
End of Program	-----	-----	0.63	-0.99
U.S. Citizen	-----	-----	0.72	-0.57
Rank Higher	-----	-----	0.99	-1.07
Constant	10.94***	5.46	13.43***	3.45
<i>Model Fit Statistics</i>				
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>
-2 Log Likelihood	302	276	265	251
Change in -2 LL		26.58***	10.41	14.36
Degrees of freedom with change	-----	1	6	12
University/Dept. Variance Estimate	1.44***	1.50***	1.43***	1.61***
University/Dept. Variance S.E.	0.40	0.49	0.46	0.56
Change University Level Variance (PRE)		-0.04	0.04	-0.12

Note: N=338, 166 universities, 1 to 12 students per university, average = 2. * = $p < .05$, ** = $p < .01$, *** = $p < .001$

Table 8-19

Mixed Model Logistic Regression of Definitely Finishing Degree on Year and Individual and Departmental Characteristics, Doctoral Students

<i>Fixed Effects</i>						
	<u>Model 1</u>		<u>Model 2</u>		<u>Model 4</u>	
<u>Ind. Variable</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>
Year 2019	.69***	-5.04	.79***	-3.18	.79**	-3.05
Year 2022	.45***	-8.23	.37***	-9.69	.56*	-2.16
Women	-----	-----	.84**	-2.51	.84**	-2.46
URM	-----	-----	1.35**	2.7	1.37**	2.82
Mid Program	-----	-----	2.61***	11.73	2.99***	12.56
End Program	-----	-----	4.44***	13.18	4.91***	12.44
U.S. Citizen	-----	-----	.55***	-6.62	.55***	-6.59
Rank Higher	-----	-----	.997**	-2.69	.996***	-3.65
2022*Mid Pr.	-----	-----	-----	-----	.33***	-4.41
2022*End Pr.	-----	-----	-----	-----	.42**	-2.96
2022*Rank	-----	-----	-----	-----	1.01**	3.07
Constant	3.35***	22.53	2.77***	8.47	2.71***	7.92
<i>Model Fit Statistics and Random Effects</i>						
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>	
-2 LL	5,530	5,459	5,159	5,121	5130	
Ch. In -2 LL		71.299***	299.87***	37.95***	29.00***	
Df		2	6	12	3	
Uni. Var	.27***	.19***	.15***	.15**	.16**	
Uni. S.E.	0.05	0.06	0.07	0.07	0.07	
Ch. Uni Var.		0.29	0.23	-0.06	-0.07	

Note: n=4639 students, 239 schools, 1 to 177 per school, average = 19.4 * = p < .05, ** = p < .01, *** = p < .001

Table 8-20

Percent PhD Students Definitely Planning to Complete Degree by Department Rank and Year in Program

<u>Variable</u>	<u>Year</u>			
<u>Dept. Rank</u>	<u>2013</u>	<u>2019</u>	<u>2022</u>	<u>Ch. 2013-2022</u>
Not Top 50	80%	70%	57%	-23%
Top 50	73%	66%	59%	-15%
<u>Year in program</u>				
1st year	57%	48%	52%	-5%
Mid Program	78%	74%	53%	-25%
End Program	86%	82%	70%	-17%

Table 8-21

Future Educational Plans, by Degree Level and Year

<i>Doctoral Students Plans for a Post-Doc</i>			
<u>Response</u>	<u>2013</u>	<u>2019</u>	<u>2022</u>
No	20%	27%	34%
Not sure	41%	40%	38%
Yes	40%	33%	27%
<i>Masters' Students' Plans for a PhD</i>			
<u>Response</u>	<u>2013</u>	<u>2019</u>	<u>2022</u>
No	28%	29%	30%
Not sure	42%	29%	24%
Yes	30%	43%	46%

Note: N=5,486 doctoral students and 407 Masters students. Questions were worded, "Do you plan to do a postdoctoral position upon completion of your Ph.D?" and "Do you plan to continue in a Ph.D. program upon completion of your Master's degree?"

Table 8-22

Correlations of Plans for Future Study with Year and Model Variables, Over-Time Analysis, by Degree Level

	<u>Masters Students</u>	<u>Doctoral Students</u>
Year 2019	.10*	-.05***
Year 2022	0.05	-.09***
Women	-.22***	-.10***
URM	0.08	.03*
Mid Program	-0.05	-0.02
End of Program	-.12**	-0.02
U.S. Citizen	-0.07	-.16***
Rank Higher	-.11*	-.05***

Note: The measure of Masters' students plans to pursue a PhD was coded 0=no and 1=yes; the measure of PhD students' plans to pursue a post-doc was coded 1=no, 2=maybe, and 3=yes. *= $p < .05$, **= $p < .01$, ***= $p < .001$

Table 8-23

Mixed Model Logistic Regressions of Plans to Seek a PhD on Year and Model Variables

<i>Fixed Effects</i>				
<u>Ind. Variable</u>	<u>Model 1</u>		<u>Model 2</u>	
	<u>OR</u>	<u>Z</u>	<u>OR</u>	<u>Z</u>
Year 2019	1.60	1.72	1.57	1.62
Year 2022	2.12	1.73	1.53	0.92
Women	-----	-----	.39***	-3.60
URM	-----	-----	1.49	1.22
Mid Program	-----	-----	.50*	-2.09
End of Program	-----	-----	.37**	-2.73
U.S. Citizen	-----	-----	.35**	-3.12
Rank Higher	-----	-----	1.00	-0.46
Constant	.40***	-4.50	2.39*	2.12
<i>Model Fit Statistics and Random Effects</i>				
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>
-2 Log Likelihood	410.52	405.97	372.48	366.70
Change in -2 LL	-----	4.55	33.49***	5.78
DF with change	-----	2.00	6.00	12.00
University-Level Var.	.70**	.64**	0.26	0.34
University-Level S.E.	0.27	0.27	0.62	0.59
PRE Change Univ. Var.		0.08	0.59	-0.28

Note: N=316, students, 157 universities, 1 to 11 students per university, average = 2.0. ***=p<.001, **=p<.01, *=p<.05.

Table 8-24

Mixed Model Regressions of Seeking a Post-Doc on Model Variables, Over-Time Analysis, PhD Students

<i>Fixed Effects</i>						
	<u>Model 1</u>		<u>Model 2</u>		<u>Model 4</u>	
<u>Ind. Variable</u>	<u>B</u>	<u>s.e.</u>	<u>b</u>	<u>s.e.</u>	<u>B</u>	<u>s.e.</u>
Year 2019	-.18***	0.02	-.17***	0.02	-.13***	0.03
Year 2022	-.28***	0.03	-.29***	0.03	-.24***	0.04
Women	-----	-----	-.12***	0.02	-.12***	0.02
URM	-----	-----	.07*	0.03	.07*	0.03
Mid Program	-----	-----	-.11***	0.03	-.10***	0.03
End of Program	-----	-----	-.11***	0.04	-0.01	0.04
U.S. Citizen	-----	-----	-.28***	0.03	-.28***	0.03
Rank Higher	-----	-----	0.00	0.00	0.00	0.00
2019*End of Program	-----	-----	-----	-----	-.24***	0.07
2022*End of Program	-----	-----	-----	-----	-.20**	0.07
Constant	2.21***	0.02	2.58***	0.04	2.55***	0.04
<i>Model Fit Statistics and Random Effects</i>						
<u>Statistic</u>	<u>Baseline</u>	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>	
-2 Log Likelihood	11068	10582	10404	10379	10388	
Change in -2 LL		486.13**	177.83**	24.70**	17.00***	
		*	*			
DF with change		2	6	12	2	
University-Level Var.	.014***	.012***	.010***	.011***	.011***	
University-Level S.E.	0.004	0.004	0.004	0.004	0.004	
PRE Change U Var.		0.16	0.09	-0.08	-0.05	
Residual Var.	.57***	.56***	.54***	.54***	.54***	
Residual S.E.	0.01	0.01	0.01	0.01	0.01	
PRE Change Res. Var.		0.02	0.04	0.01	0.00	

Note: Higher values on the dependent variable indicate a greater likelihood of seeking a post-doctoral position.
 ***=p<.001, **=p<.01, *=p<.05. N=4,639 students in 239 universities, 1 to 177 students per university, average = 19.4.

Table 8-25

Percent of Doctoral Students Definitely Planning to Pursue a Post-Doc by Year and Year in Graduate Program

<u>Year in Program</u>	<u>2013</u>	<u>2019</u>	<u>2023</u>
First Year	36%	33%	35%
Years 2-4	38%	32%	25%
Beyond the 4th Year	47%	29%	28%

Appendix A –Surveys and Letters

COVID-19 and Chemistry Graduate Students

Start of Block: Block 1 - intro and yr in program

Q1.1

Thank you for helping the American Chemical Society (ACS) learn about how the COVID-19 pandemic impacted graduate students. The questions that follow ask how the pandemic affected your graduate school experiences and ways in which the ACS might help in the future. To help understand differences in these experiences we also ask a few questions about your career plans and background. Please remember that all your responses will be anonymous.

Q1.2 In general, what impact do you think the COVID-19 pandemic will have on your career in the chemical sciences in the years to come?

- ☐ Very positive impact (1)
 - ☐ Some positive impact (2)
 - ☐ No impact (3)
 - ☐ Some negative impact (4)
 - ☐ Very negative impact (5)
-

Q1.3 When did you first enter your current degree program?

- ☐ 2022-2023 (this year) (1)
- ☐ 2021-2022 (2)
- ☐ 2020-2021 (3)
- ☐ 2019-2020 (4)
- ☐ 2018-2019 (5)
- ☐ 2017-2018 (6)
- ☐ Earlier than fall 2017 (7)

End of Block: Block 1 - intro and yr in program

Start of Block: Block 2 - pandemic effects yr 2 pl

t

Q2.1

First, some questions about how the pandemic has affected your graduate education.

Q2.2 During the last two years did you pause your graduate education at any point?

- ☐ No (1)
 - ☐ Yes (2)
-

Page Break

Display This Question:

If During the last two years did you pause your graduate education at any point? = Yes

Q2.3 How long was the break?

- ☐ Less than one academic year (1)
 - ☐ An entire academic year (2)
 - ☐ More than one academic year (3)
 - ☐ Other, please specify: (4) _____
-

Display This Question:

If During the last two years did you pause your graduate education at any point? = Yes

Q2.4 Why did you take the break? Please mark all that apply.

- ☐ Physical health (1)
 - ☐ Mental health (2)
 - ☐ Financial concerns (3)
 - ☐ Quality of education (4)
 - ☐ Care-taking duties (5)
 - ☐ Other (6) _____
-

Q2.5 Over the last two years were there areas in which the quality of your graduate education was NEGATIVELY affected by the pandemic? Please mark all that apply.

- ☐ Classroom instruction (1)
 - ☐ Research (lab) experiences (2)
 - ☐ Career preparation (3)
 - ☐ Interactions with research advisor (9)
 - ☐ Interactions with other faculty (4)
 - ☐ Interactions with other students (5)
 - ☐ Financial support (6)
 - ☐ Other, please explain (7)
-
- ☐ There were no negative effects (8)

Q2.6 Over the last two years were there areas in which the quality of your graduate education was POSITIVELY affected by the pandemic? Please mark all that apply.

- ☐ Classroom instruction (1)
 - ☐ Research (lab) experiences (2)
 - ☐ Career preparation (3)
 - ☐ Interactions with research advisor (9)
 - ☐ Interactions with other faculty (4)
 - ☐ Interactions with other students (5)
 - ☐ Financial support (6)
 - ☐ Other, please explain (7)
-
- ☐ There were no positive effects (8)

Q2.7 Now, consider the future. When you think about the coming years of your graduate program, are there areas in which the quality of your graduate education might be NEGATIVELY affected by POLICIES AND PROCEDURES adopted because of the pandemic? Please mark all that

apply.

- ☐ Classroom instruction (1)
 - ☐ Research (lab) experiences (2)
 - ☐ Career preparation (3)
 - ☐ Interactions with research advisor (9)
 - ☐ Interactions with other faculty (4)
 - ☐ Interactions with other students (5)
 - ☐ Financial support (6)
 - ☐ Other, please explain (7)
-
- ☐ None (8)

Q2.8 When you think about the coming years of your graduate program, are there areas in which the quality of your graduate education might be POSITIVELY affected by POLICIES AND

PROCEDURES adopted because of the pandemic? Please mark all that apply.

- ☐ Classroom instruction (1)
- ☐ Research (lab) experiences (2)
- ☐ Career preparation (3)
- ☐ Interactions with research advisor (9)
- ☐ Interactions with other faculty (4)
- ☐ Interactions with other students (5)
- ☐ Financial support (6)
- ☐ Other, please explain (7)

☐ None (8)

Q2.9 Feel free to elaborate on policies and procedures that you believe may have a lasting impact on your graduate program and why you hold these views.

Page Break

Q2.10

Now, a few questions on how the pandemic affected you personally.

Q2.11 Many people reported negative personal experiences during the pandemic over the last two years. Did you experience any of the following? Please mark all that apply.

- ☐ Increased care-taking responsibilities (1)
 - ☐ Problems with your physical health (2)
 - ☐ Mental health issues (e.g. depression, anxiety, loneliness) (3)
 - ☐ Increased financial concerns (4)
 - ☐ Other, please explain (5)
-

Display This Question:

If Many people reported negative personal experiences during the pandemic over the last two years. D... = Increased care-taking responsibilities

Q2.12 Has the increased level of care-taking diminished, stayed the same, or increased further since the pandemic started two years ago?

- ☐ Diminished to pre-pandemic levels (1)
 - ☐ Stayed the same (2)
 - ☐ Increased (3)
-

Display This Question:

If Many people reported negative personal experiences during the pandemic over the last two years. D... = Problems with your physical health

Q2.13 Have the problems with your physical health diminished, stayed the same, or increased since the pandemic started two years ago?

- ☐ Diminished to pre-pandemic levels (1)
- ☐ Stayed the same (2)
- ☐ Increased (3)

Display This Question:

If Many people reported negative personal experiences during the pandemic over the last two years. D... = Mental health issues (e.g. depression, anxiety, loneliness)

Q2.14 Have the problems with your mental health diminished, stayed the same, or increased since the pandemic started two years ago?

- ☐ Diminished to pre-pandemic levels (1)
- ☐ Stayed the same (2)
- ☐ Increased (3)

Display This Question:

If Many people reported negative personal experiences during the pandemic over the last two years. D... = Increased financial concerns

Q2.15 Have the financial issues diminished, stayed the same, or increased?

- ☐ Diminished to pre-pandemic levels (1)
 - ☐ Stayed the same (2)
 - ☐ Increased (3)
-

Display This Question:

If Many people reported negative personal experiences during the pandemic over the last two years. D... = Increased care-taking responsibilities

Or Many people reported negative personal experiences during the pandemic over the last two years. D... = Problems with your physical health

Or Many people reported negative personal experiences during the pandemic over the last two years. D... = Mental health issues (e.g. depression, anxiety, loneliness)

Or Many people reported negative personal experiences during the pandemic over the last two years. D... = Increased financial concerns

Or Many people reported negative personal experiences during the pandemic over the last two years. D... = Other, please explain

Q2.16

Feel free to use the space below to expand upon how the pandemic affected you personally and how this might impact your future in the chemical sciences.

Q2.17 Over the last two years, did your commitment to finishing your degree change in any way?

- ☐ I became MORE committed to finishing my degree (1)
- ☐ There was NO change in my commitment (2)
- ☐ Yes, I became LESS committed to finishing my degree (3)

Display This Question:

If Over the last two years, did your commitment to finishing your degree change in any way? = I became MORE committed to finishing my degree

Or Over the last two years, did your commitment to finishing your degree change in any way? = Yes, I became LESS committed to finishing my degree

Q105 Please explain why your commitment changed.

Q2.18 Over the last two years, did your future career plans change in any way (e.g. field of interest, career aspirations, etc.)?

☐ No (1)

☐ Yes (2)

Display This Question:

If Over the last two years, did your future career plans change in any way (e.g. field of interest,... = Yes

Q2.19 Please explain how your plans changed.

Q2.20 Now, a few questions about ways that universities, the ACS, and other professional organizations might help graduate students.

Q2.21 The list below includes suggestions for ways to help graduate students address issues resulting from the pandemic. Please indicate policies that your UNIVERSITY could adopt to help you complete your degree and launch your career in the chemical sciences. Mark any that

apply.

- ☐ Additional funding opportunities (1)
 - ☐ Mental health services (2)
 - ☐ Career-related experiences (3)
 - ☐ Special "catch-up" instructional programs to compensate for missed lab or other instructional experiences (4)
 - ☐ Opportunities to interact with other graduate students regarding common issues and concerns (5)
 - ☐ Help with job placement (6)
 - ☐ Opportunities to interact with professionals in the field (7)
 - ☐ Funding for travel to conferences (8)
 - ☐ Workshops related to publishing (9)
-

Q2.22 From the list below please indicate policies or programs that FUNDING AGENCIES could adopt to help you complete your degree and launch your career in the chemical sciences. Mark

any that apply.

- ☐ Additional funding opportunities (1)
 - ☐ Mental health services (2)
 - ☐ Career-related experiences (3)
 - ☐ Special "catch-up" instructional programs to compensate for missed lab or other instructional experiences (4)
 - ☐ Opportunities to interact with other graduate students regarding common issues and concerns (5)
 - ☐ Help with job placement (6)
 - ☐ Opportunities to interact with professionals in the field (7)
 - ☐ Funding for travel to conferences (8)
 - ☐ Workshops related to publishing (9)
-

Q2.23 From the list below please indicate policies or programs that the ACS or other professional groups could adopt to help you complete your degree and launch your career in

the chemical sciences. Mark any that apply.

- ☐ Additional funding opportunities (1)
 - ☐ Mental health services (2)
 - ☐ Career-related experiences (3)
 - ☐ Special "catch-up" instructional programs to compensate for missed lab or other instructional experiences (4)
 - ☐ Opportunities to interact with other graduate students regarding common issues and concerns (5)
 - ☐ Help with job placement (6)
 - ☐ Opportunities to interact with professionals in the field (7)
 - ☐ Funding for travel to conferences (8)
 - ☐ Workshops related to publishing (9)
-

Q2.24

Are there other policies or programs that might help graduate students in the chemical sciences recover from the impact of the pandemic on their careers? Please explain.

Q2.25 Now, a few questions about your career plans.

Q2.26 What is your current degree program?

- ☐ Master's student in the chemical sciences, including chemistry and chemical engineering (1)
- ☐ Doctoral student in the chemical sciences, including chemistry and chemical engineering (2)
- ☐ Other, please explain (3) _____

Display This Question:

If What is your current degree program? = Master's student in the chemical sciences, including chemistry and chemical engineering

Q2.27 Do you plan to continue in a Ph.D. program upon completion of your Master's degree?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)

Display This Question:

If What is your current degree program? = Doctoral student in the chemical sciences, including chemistry and chemical engineering

Q2.28 Do you plan to do a postdoctoral position upon completion of your Ph.D?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)
-

Q2.29 What is your primary field of study? (Please mark only one)

- ☐ Agricultural/food chemistry (1)
 - ☐ Analytical chemistry (2)
 - ☐ Biochemistry (3)
 - ☐ Chemical biology (4)
 - ☐ Chemical education (5)
 - ☐ Chemical engineering (6)
 - ☐ Chemical toxicology (7)
 - ☐ Colloid and surface chemistry (8)
 - ☐ Computational chemistry (9)
 - ☐ Electrochemistry (10)
 - ☐ Environmental chemistry (11)
 - ☐ General chemistry (12)
 - ☐ Geochemistry (13)
 - ☐ Inorganic chemistry (14)
 - ☐ Materials chemistry (15)
 - ☐ Medicinal/pharmaceutical chemistry (16)
 - ☐ Nuclear chemistry (17)
 - ☐ Organic chemistry (18)
 - ☐ Physical chemistry (19)
 - ☐ Theoretical chemistry (20)
 - ☐ Other, please explain (21) _____
 - ☐ Not yet determined (22)
-

Q2.30 Looking ahead, how likely is it that you will complete your degree program?

- ☐ Extremely likely (1)
 - ☐ Very likely (2)
 - ☐ Somewhat likely (3)
 - ☐ Slightly likely (4)
 - ☐ Not at all likely (5)
-

Q2.31 When thinking about the future, which of the following career sectors is of most interest to you?

- ☐ Academia (teaching and/or research) (1)
 - ☐ Industry, manufacturing (2)
 - ☐ Industry, non-manufacturing (7)
 - ☐ Government (3)
 - ☐ Self-Employed (4)
 - ☐ Non-profit (5)
 - ☐ Other (6) _____
-

Q2.32 Looking ahead, how likely is it that you will stay in the chemical sciences after you graduate?

- ☐ Extremely likely (1)
 - ☐ Very likely (2)
 - ☐ Somewhat likely (3)
 - ☐ Slightly likely (4)
 - ☐ Not at all likely (5)
-

Q2.33 Finally, a few questions to provide background information.

Q2.34 What is your gender identity?

- ☐ Female (1)
 - ☐ Male (2)
 - ☐ Non-binary / third gender (3)
 - ☐ Prefer to self describe (4) _____
 - ☐ Prefer not to say (5)
-

Q2.35 Do you identify as LGBTQ?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Prefer not to share (9)

Q2.36

What is your citizenship or visa status? (Mark one)

- ☐ U.S. native (1)
 - ☐ U.S. naturalized (2)
 - ☐ U.S. permanent resident (3)
 - ☐ J-1 visa (4)
 - ☐ F-1 visa (5)
 - ☐ H1-B visa (6)
 - ☐ Other (7) _____
 - ☐ Prefer not to say (8)
-

Q2.37 Are you of Hispanic, Latino or Spanish descent?

- ☐ Yes (1)
 - ☐ No (2)
 - ☐ Prefer not to say (3)
-

Q2.38 What is your racial background? Mark all that apply

- ☐ White (1)
 - ☐ Black/African (2)
 - ☐ Black/African American (8)
 - ☐ American Indian, Alaska Native, First Nations, Aboriginal Australian or other indigenous group (3)
 - ☐ Caribbean (4)
 - ☐ East Asian (5)
 - ☐ Middle Eastern/North African (9)
 - ☐ Native Hawaiian or Other Pacific Islander (10)
 - ☐ Southern Asian (11)
 - ☐ Self-describe (7) _____
 - ☐ Prefer not to answer (6)
-

Q2.39 Are you single, partnered, or married?

- ☐ Single (1)
 - ☐ Partnered/married (2)
 - ☐ Prefer not to say (3)
-

Q2.40 How many children do you have?

- ☐ Zero (1)
- ☐ One (2)
- ☐ Two (3)
- ☐ Three or more (4)
- ☐ Prefer not to say (5)

Display This Question:

If How many children do you have? = One

Or How many children do you have? = Two

Or How many children do you have? = Three or more

Q2.41 What is the age of your youngest child?

- ☐ Infant (less than 12 months) (1)
- ☐ Toddler (1 to 3 years) (2)
- ☐ Pre-schooler (4 to 5 years old) (3)
- ☐ Elementary school age (6 to 11) (4)
- ☐ 12 years old or older (5)
- ☐ Prefer not to say (6)

Q2.42

Please add any additional thoughts you may have on how the ACS can help you handle any challenges you face as a result of the COVID-19 pandemic.

Q2.43 Thank you for completing this survey. Your answers will be very useful in developing policies to better help graduate students in the chemical sciences. If you would like to enter the drawing for [whatever prizes have] please click on this link. Using this separate link ensures that your survey responses are not associated with your name. [link will be added later]

End of Block: Block 2 - pandemic effects yr 2 pl

Start of Block: Block 3 - 1st yrs

Q3.1 When did you receive your last degree?

- ☐ 2022 (This year) (1)
 - ☐ 2021 (2)
 - ☐ 2020 (3)
 - ☐ 2019 (4)
 - ☐ before 2019 (5)
-

Q3.2 Did the COVID-19 pandemic affect your decision regarding when to start graduate school?

- ☐ No (1)
 - ☐ Maybe (2)
 - ☐ Yes (3)
-

Display This Question:

*If Did the COVID-19 pandemic affect your decision regarding when to start graduate school?
= Maybe*

*Or Did the COVID-19 pandemic affect your decision regarding when to start graduate
school? = Yes*

Q3.3 There are many reasons why students may have decided to delay graduate school during the pandemic. Which of the following concerns affected your decision to delay graduate

school? Please check all that apply.

- ☐ Quality of graduate education during the pandemic (1)
 - ☐ Financing your graduate education (2)
 - ☐ Your academic preparation (3)
 - ☐ Physical health of friends or family (4)
 - ☐ Your physical health (5)
 - ☐ Your mental health (e.g. depression, anxiety) (6)
 - ☐ Other, please explain (7)
-
- ☐ None of the above (10)

Page Break

Q3.4

Now some questions about the potential impact of the pandemic on graduate education in the chemical sciences.

Q3.5 When you think about the coming years of your graduate program, are there areas in which the quality of your graduate education might be **NEGATIVELY** affected by policies and procedures adopted because of the pandemic? Please mark all that apply.

- ☐ Classroom instruction (1)
 - ☐ Research (lab) experiences (2)
 - ☐ Career preparation (3)
 - ☐ Interactions with faculty (4)
 - ☐ Interactions with other students (5)
 - ☐ Financial support (6)
 - ☐ Other, please explain (7)
-

Q3.6 When you think about the coming years of your graduate program, are there areas in which the quality of your graduate education might be **POSITIVELY** affected by policies and

procedures adopted because of the pandemic? Please mark all that apply.

- ☐ Classroom instruction (1)
 - ☐ Research (lab) experiences (2)
 - ☐ Career preparation (3)
 - ☐ Interactions with faculty (4)
 - ☐ Interactions with other students (5)
 - ☐ Financial support (6)
 - ☐ Other, please explain (7)
-

Q3.7 Feel free to elaborate on policies and procedures that you believe may have a lasting impact on your graduate program and why you hold these views.

Page Break

Q3.8

Now, a few questions on how the pandemic affected you personally.

Q3.9 Many people reported negative experiences during the pandemic of the last two years. Did you experience any of the following? Please mark all that apply.

- ☐ Increased care-taking responsibilities (1)
 - ☐ Problems with your physical health (2)
 - ☐ Mental health issues (e.g. depression, anxiety, loneliness) (3)
 - ☐ Increased financial concerns (4)
 - ☐ Other, please explain (5)
-

Display This Question:

*If Many people reported negative experiences during the pandemic of the last two years.
Did you experience... = Increased care-taking responsibilities*

Q3.10 Has the increased level of care-taking diminished, stayed the same, or increased since the pandemic started two years ago?

- ☐ Diminished to pre-pandemic levels (1)
 - ☐ Stayed the same (2)
 - ☐ Increased (3)
-

Display This Question:

*If Many people reported negative experiences during the pandemic of the last two years.
Did you experience... = Problems with your physical health*

Q3.11 Have the problems with your physical health diminished, stayed the same, or increased since the pandemic started two years ago?

- ☐ Diminished to pre-pandemic levels (1)
- ☐ Stayed the same (2)
- ☐ Increased (3)

Display This Question:

*If Many people reported negative experiences during the pandemic of the last two years.
Did you expe... = Mental health issues (e.g. depression, anxiety, loneliness)*

Q3.12 Have the problems with mental health diminished, stayed the same, or increased since the pandemic started two years ago?

- ☐ Diminished to pre-pandemic levels (1)
- ☐ Stayed the same (2)
- ☐ Increased (3)

Display This Question:

*If Many people reported negative experiences during the pandemic of the last two years.
Did you expe... = Increased financial concerns*

Q3.13 Have the financial issues diminished, stayed the same, or increased since the pandemic started two years ago?

- ☐ Diminished to pre-pandemic levels (1)
 - ☐ Stayed the same (2)
 - ☐ Increased (3)
-

Display This Question:

*If Many people reported negative experiences during the pandemic of the last two years.
Did you experience... = Increased care-taking responsibilities*

*Or Many people reported negative experiences during the pandemic of the last two years.
Did you experience... = Problems with your physical health*

*Or Many people reported negative experiences during the pandemic of the last two years.
Did you experience... = Mental health issues (e.g. depression, anxiety, loneliness)*

*Or Many people reported negative experiences during the pandemic of the last two years.
Did you experience... = Increased financial concerns*

*Or Many people reported negative experiences during the pandemic of the last two years.
Did you experience... = Other, please explain*

Q3.14

Feel free to expand upon how the pandemic affected you personally and how this might impact your future in the chemical sciences.

Q3.15 Now, a few questions about ways that universities, the ACS, and other professional organizations might help graduate students.

Q3.16 The list below includes suggestions for ways to help graduate students address issues resulting from the pandemic. Please indicate policies that your UNIVERSITY could adopt to help you complete your degree and launch your career in the chemical sciences. Mark any that

apply.

- ☐ Additional funding opportunities (1)
 - ☐ Mental health services (2)
 - ☐ Career-related experiences (3)
 - ☐ Special "catch-up" instructional programs to compensate for missed lab or other instructional experiences (4)
 - ☐ Opportunities to interact with other graduate students regarding common issues and concerns (5)
 - ☐ Help with job placement (6)
 - ☐ Opportunities to interact with professionals in the field (7)
 - ☐ Funding for travel to conferences (8)
 - ☐ Workshops related to publishing (9)
-

Q3.17 From the list below, please indicate policies or programs that FUNDING AGENCIES could adopt to help you complete your degree and launch your career in the chemical sciences. Mark

any that apply.

- ☐ Additional funding opportunities (1)
 - ☐ Mental health services (2)
 - ☐ Career-related experiences (3)
 - ☐ Special "catch-up" instructional programs to compensate for missed lab or other instructional experiences (4)
 - ☐ Opportunities to interact with other graduate students regarding common issues and concerns (5)
 - ☐ Help with job placement (6)
 - ☐ Opportunities to interact with professionals in the field (7)
 - ☐ Funding for travel to conferences (8)
 - ☐ Workshops related to publishing (9)
-

Q3.18 From the list below, please indicate policies or programs that the ACS could adopt to help you complete your degree and launch your career in the chemical sciences. Mark any that

apply.

- ☐ Additional funding opportunities (1)
 - ☐ Mental health services (2)
 - ☐ Career-related experiences (3)
 - ☐ Special "catch-up" instructional programs to compensate for missed lab or other instructional experiences (4)
 - ☐ Opportunities to interact with other graduate students regarding common issues and concerns (5)
 - ☐ Help with job placement (6)
 - ☐ Opportunities to interact with professionals in the field (7)
 - ☐ Funding for travel to conferences (8)
 - ☐ Workshops related to publishing (9)
-

Q3.19

Are there other policies or programs that might help graduate students in the chemical sciences recover from the impact of the pandemic on their careers? Please explain.

Q3.20 Now, a few questions about your career plans.

Q3.21 What is your current degree program?

- ☐ Master's student in the chemical sciences, including chemistry and chemical engineering (1)
- ☐ Doctoral student in the chemical sciences, including chemistry and chemical engineering (2)
- ☐ Other, please explain (3) _____

Display This Question:

If What is your current degree program? = Master's student in the chemical sciences, including chemistry and chemical engineering

Q3.22 Do you plan to continue in a Ph.D. program upon completion of your Master's degree?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)

Display This Question:

If What is your current degree program? = Doctoral student in the chemical sciences, including chemistry and chemical engineering

Q3.23 Do you plan to do a postdoctoral position upon completion of your Ph.D?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)
-

Q3.24 What is your primary field of study? (Please mark only one)

- ☐ Agricultural/food chemistry (1)
 - ☐ Analytical chemistry (2)
 - ☐ Biochemistry (3)
 - ☐ Chemical biology (4)
 - ☐ Chemical education (5)
 - ☐ Chemical engineering (6)
 - ☐ Chemical toxicology (7)
 - ☐ Colloid and surface chemistry (8)
 - ☐ Computational chemistry (9)
 - ☐ Electrochemistry (10)
 - ☐ Environmental chemistry (11)
 - ☐ General chemistry (12)
 - ☐ Geochemistry (13)
 - ☐ Inorganic chemistry (14)
 - ☐ Materials chemistry (15)
 - ☐ Medicinal/pharmaceutical chemistry (16)
 - ☐ Nuclear chemistry (17)
 - ☐ Organic chemistry (18)
 - ☐ Physical chemistry (19)
 - ☐ Theoretical chemistry (20)
 - ☐ Other, please explain (21) _____
 - ☐ Not yet determined (22)
-

Q3.25 Looking ahead, how likely is it that you will complete your degree program?

- ☐ Extremely likely (1)
 - ☐ Very likely (2)
 - ☐ Somewhat likely (3)
 - ☐ Slightly likely (4)
 - ☐ Not at all likely (5)
-

Q3.26 When thinking about the future, which of the following career sectors is of most interest to you?

- ☐ Academia (teaching and/or research) (1)
 - ☐ Industry, manufacturing (2)
 - ☐ Industry, non-manufacturing (7)
 - ☐ Government (3)
 - ☐ Self-Employed (4)
 - ☐ Non-profit (5)
 - ☐ Other (6) _____
-

Q3.27 Looking ahead, how likely is it that you will stay in the chemical sciences after you graduate?

- ☐ Extremely likely (1)
 - ☐ Very likely (2)
 - ☐ Somewhat likely (3)
 - ☐ Slightly likely (4)
 - ☐ Not at all likely (5)
-

Q3.28 Finally, a few questions to provide background information.

Q3.29 What is your gender identity?

- ☐ Female (1)
 - ☐ Male (2)
 - ☐ Non-binary / third gender (3)
 - ☐ Prefer to self describe (4) _____
 - ☐ Prefer not to say (5)
-

Q3.30 Do you identify as LGBTQ or not?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Prefer not to share (9)

Q3.31

What is your citizenship or visa status? (Mark one)

- ☐ U.S. native (1)
 - ☐ U.S. naturalized (2)
 - ☐ U.S. permanent resident (3)
 - ☐ J-1 visa (4)
 - ☐ F-1 visa (5)
 - ☐ H1-B visa (6)
 - ☐ Other (7) _____
 - ☐ Prefer not to say (8)
-

Q3.32 Are you of Hispanic, Latino or Spanish descent?

- ☐ Yes (1)
 - ☐ No (2)
 - ☐ Prefer not to say (3)
-

Q3.33 What is your racial background? Mark all that apply

- ☐ White (1)
 - ☐ Black/African (2)
 - ☐ Black/African American (8)
 - ☐ American Indian, Alaska Native, First Nations, Aboriginal Australian or other indigenous group (3)
 - ☐ Caribbean (4)
 - ☐ East Asian (5)
 - ☐ Middle Eastern/North African (9)
 - ☐ Native Hawaiian or Other Pacific Islander (10)
 - ☐ Southern Asian (11)
 - ☐ Self-describe (7) _____
 - ☐ Prefer not to answer (6)
-

Q3.34 Are you single, partnered, or married?

- ☐ Single (1)
 - ☐ Partnered/married (2)
 - ☐ Prefer not to say (3)
-

Q3.35 How many children do you have?

- ☐ Zero (1)
- ☐ One (2)
- ☐ Two (3)
- ☐ Three or more (4)
- ☐ Prefer not to say (5)

Display This Question:

If How many children do you have? = One

Or How many children do you have? = Two

Or How many children do you have? = Three or more

Q3.36 What is the age of your youngest child?

- ☐ Infant (less than 12 months) (1)
- ☐ Toddler (1 to 3 years) (2)
- ☐ Pre-schooler (4 to 5 years old) (3)
- ☐ Elementary school age (6 to 11) (4)
- ☐ 12 years old or older (5)
- ☐ Prefer not to say (6)

Q3.37

Please add any additional thoughts you may have on how the ACS can help you handle any challenges you face as a result of the COVID-19 pandemic.

Q3.38 Thank you for completing this survey. Your answers will be very useful in developing policies to better help graduate students in the chemical sciences. If you would like to enter the drawing for [whatever prizes have] please click on this link. Using this separate link ensures that your survey responses are not associated with your name. [link will be added later]

End of Block: Block 3 - 1st yrs

Survey for Graduate Program Coordinators

Start of Block: Default Question Block

Q1.1

Thank you for helping the American Chemical Society (ACS) and COACH support graduate programs in the chemical sciences. The questions that follow ask about how the pandemic affected your graduate program and students and how the ACS might help. There are also a few questions about your department.

,

End of Block: Default Question Block

Start of Block: Block 2 - effect on students

Q2.1

First, some questions about how the pandemic affected students in your program.



Q2.2 The pandemic affected graduate students in the chemical sciences in a variety of ways. In the list below please indicate ways in which, during the last two years (academic years 2020-2021 and 2021-2022), students in your program were NEGATIVELY affected by the pandemic.

(Please mark all that apply.)

- ☐ Quality of the learning experience (1)
 - ☐ Timely progress through the program (2)
 - ☐ Interactions with faculty (3)
 - ☐ Interactions with peers (4)
 - ☐ Interactions with professionals in the field (5)
 - ☐ Understanding of possible careers (6)
 - ☐ Commitment to the chemical sciences (7)
 - ☐ Financial well-being (8)
 - ☐ Mental health (e.g. loneliness, depression, anxiety) (9)
 - ☐ Other, please explain (10)
-



Q2.3 Please indicate ways in which students in your program CONTINUE to be NEGATIVELY affected by the experience of the pandemic. (Please mark all that apply.)

- ☐ Quality of the learning experience (1)
 - ☐ Timely progress through the program (2)
 - ☐ Interactions with faculty (3)
 - ☐ Interactions with peers (4)
 - ☐ Interactions with professionals in the field (5)
 - ☐ Understanding of possible careers (6)
 - ☐ Commitment to the chemical sciences (7)
 - ☐ Financial well-being (8)
 - ☐ Mental health (e.g. loneliness, depression, anxiety) (9)
 - ☐ Other, please explain (10)
-



Q2.4 Please indicate ways in which, during the last two years, students in your program were POSITIVELY affected by the pandemic. (Please mark all that apply.)

- ☐ Quality of the learning experience (1)
 - ☐ Timely progress through the program (2)
 - ☐ Interactions with faculty (3)
 - ☐ Interactions with peers (4)
 - ☐ Interactions with professionals in the field (5)
 - ☐ Understanding of possible careers (6)
 - ☐ Commitment to the chemical sciences (7)
 - ☐ Financial well-being (8)
 - ☐ Mental health (9)
 - ☐ Other, please explain (10)
-



Q2.5 Please indicate ways in which students in your program CONTINUE to be POSITIVELY affected by the experience of the pandemic. (Please mark all that apply.)

- ☐ Quality of the learning experience (1)
 - ☐ Timely progress through the program (2)
 - ☐ Interactions with faculty (3)
 - ☐ Interactions with peers (4)
 - ☐ Interactions with professionals in the field (5)
 - ☐ Understanding of possible careers (6)
 - ☐ Commitment to the chemical sciences (7)
 - ☐ Financial well-being (8)
 - ☐ Mental health (9)
 - ☐ Other, please explain (10)
-

Page Break



Q2.6 The list below includes suggestions for ways in which ACS might help graduate students and graduate programs address issues resulting from the pandemic. Please indicate ways that would benefit your department or your students.

- ☐ Funding for students to attend professional conferences (1)
 - ☐ Mental health services for students (2)
 - ☐ Greater opportunities for career-related experiences (e.g. internships, mentorships, etc.) for graduate students (3)
 - ☐ Greater opportunities for career-related experiences for undergraduate students (4)
 - ☐ Greater opportunities for career-related experiences for high school students (5)
 - ☐ Opportunities for graduate coordinators to interact with other coordinators regarding common issues and concerns (6)
 - ☐ Special "catch-up" instructional programs to compensate for missed lab or other instructional experiences (7)
 - ☐ Other (8)
-

End of Block: Block 2 - effect on students

Start of Block: Block 3 - effects on program

Q3.1 Now some questions about the effect of the pandemic on your graduate PROGRAM.



Q3.2 Are there ways in which the pandemic had a NEGATIVE impact on your GRADUATE PROGRAM? Please mark all that apply

- ☐ Student morale (1)
 - ☐ Student funding (2)
 - ☐ Teaching resources (3)
 - ☐ Research resources (4)
 - ☐ Faculty morale (5)
 - ☐ Number of graduate students (6)
 - ☐ Quality of graduate students (7)
 - ☐ Financial support (8)
 - ☐ Quality of instruction (9)
 - ☐ Quality of lab experience (10)
 - ☐ Retention of students (11)
 - ☐ Rate of timely completion (12)
 - ☐ Ability of students to network with others in department (13)
 - ☐ Ability to network with those outside the department (14)
 - ☐ Ability to discover more about professional/career opportunities (15)
 - ☐ Financial issues (e.g. lowered revenue from tuition....) (16)
 - ☐ Other (17)
-



Q3.3 Thinking about the future, do you think that the COVID-19 pandemic will continue to impact your department's graduate program in the years to come?

- ☐ Yes (1)
- ☐ Maybe (2)
- ☐ No (3)

Display This Question:

If Thinking about the future, do you think that the COVID-19 pandemic will continue to impact your d... = Yes

Or Thinking about the future, do you think that the COVID-19 pandemic will continue to impact your d... = Maybe



Q3.4 Which of the following long-term outcomes do you anticipate for your program?

- ☐ Uneven sizes of graduate cohorts (1)
 - ☐ Lower levels of academic preparation (2)
 - ☐ Diminished number of graduate applicants (3)
 - ☐ Increased number of graduate applicants (4)
 - ☐ Mental health issues of students (5)
 - ☐ Faculty morale (6)
 - ☐ Increased difficulties in funding students (7)
 - ☐ Diminished opportunities for networking (8)
 - ☐ Other (9)
-

Display This Question:

If Thinking about the future, do you think that the COVID-19 pandemic will continue to impact your d... = No

Q3.5 Please explain why you believe there will not be a lasting impact on your program.

End of Block: Block 3 - effects on program

Start of Block: Block 4 - university/department response

Q4.1 Now some questions about how your university and department responded to the pandemic.



Q4.2 Colleges and universities around the country adopted a number of different policies related to instruction, student interactions, and research procedures. Which of the following did your campus adopt? Please check all that apply.

- ☐ Social distancing (1)
 - ☐ Masks Indoors (2)
 - ☐ Reduced lab hours (3)
 - ☐ Closed campus (4)
 - ☐ Required vaccinations (5)
 - ☐ Required COVID-19 testing (6)
 - ☐ Remote learning (7)
 - ☐ Other, please specify (8)
-



Q4.3 During the pandemic of the last two years did your DEPARTMENT introduce additional changes in policies or procedures related to your graduate program?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If During the pandemic of the last two years did your DEPARTMENT introduce additional changes in pol... = Yes

Q4.4 Please describe the additional changes introduced in your department.

Page Break

End of Block: Block 4 - university/department response

Start of Block: Block 5 background on department and coordinator

Q5.1 Finally, a few questions about your department.

Q5.2 What is the name of your institution?

▼ Akron, The University of (1) ... None of the above (193)

Display This Question:

If What is the name of your institution? = None of the above

Q5.3 If your institution is not listed in the previous question, please enter its name here.



Q5.4 What degrees does your graduate program offer? Please mark all that apply

- ☐ A terminal Masters degree, for students planning to seek employment or PhD elsewhere (1)
 - ☐ A Masters degree as part of progression through the doctoral program (2)
 - ☐ Doctoral degree (3)
 - ☐ Certificate programs (4)
 - ☐ Other (5)
-

Display This Question:

If What degrees does your graduate program offer? Please mark all that apply = A terminal Masters degree, for students planning to seek employment or PhD elsewhere



Q5.5 Approximately how many students receive a terminal Masters degree each year?

- ☐ 1 to 19 (1)
- ☐ 20 to 39 (2)
- ☐ 40 to 59 (3)
- ☐ 60 or more (4)

Display This Question:

If What degrees does your graduate program offer? Please mark all that apply = A Masters degree as part of progression through the doctoral program



Q5.6 Each year, approximately how many students in your program receive a Masters degree preliminary to their doctoral degree in your program?

- ☐ 1 to 19 (1)
- ☐ 20 to 39 (2)
- ☐ 40 to 59 (3)
- ☐ 60 or more (4)

Display This Question:

If What degrees does your graduate program offer? Please mark all that apply = Doctoral degree



Q5.7 Each year, approximately how many students in your program receive a doctoral degree?

- ☐ 1 to 19 (1)
- ☐ 20 to 39 (2)
- ☐ 40 to 59 (3)
- ☐ 60 or more (4)

Display This Question:

If What degrees does your graduate program offer? Please mark all that apply = Certificate programs



Q5.8 Each year, approximately how many students finish your department's certificate program?

- ☐ 1 to 19 (1)
- ☐ 20 to 39 (2)
- ☐ 40 to 59 (3)
- ☐ 60 or more (4)



Q5.9 What is your position within your graduate program? Please check all that apply.

- ☐ Tenure-track faculty member (1)
 - ☐ Non-tenure-track faculty member (2)
 - ☐ Administrative staff (3)
 - ☐ Research staff (4)
 - ☐ Graduate coordinator (5)
 - ☐ Department Head (6)
 - ☐ Other (7)
-

Q5.10 Please feel free to add other comments you may have about ways the ACS can help graduate students and programs in the chemical sciences.

End of Block: Block 5 background on department and coordinator

Recruitment Letters sent to Graduate Coordinators and Students via Email

Subject: Tell ACS how to help graduate programs recover from impact of COVID-19

Dear Graduate Coordinator,

The American Chemical Society (ACS) is committed to promoting the success of graduate programs in the Chemical Sciences. We are asking your help in understanding how the ACS might best help graduate programs recover from the impact of the COVID-19 pandemic. We hope that you will complete a short internet-based survey regarding the impact of the pandemic on your students and department and thoughts on how ACS might help in the future. In pretests, most people have completed the survey in less than 10 minutes. Here is a link to the survey: <https://tinyurl.com/cooracs>.

We also ask that you forward the letter at the end of this message (and also in the attachment) to all graduate students in your department. It has a link to a separate survey for graduate students, which asks about their experiences during the pandemic and ways that the ACS could help in the future.

The surveys were developed in a collaborative process of ACS and researchers at COACH, a center based at the University of Oregon, which is devoted to enhancing the careers of chemical scientists.

Of course, completing the survey is totally voluntary. Your name and those of your students will not be retained or reported, and you may simply skip any questions you do not care to answer. We ask for the name of your university so that we can check the way in which factors such as community COVID rates and university policies might be related to issues that departments have encountered. But when we analyze data, your university name will be removed and will not be included in reports.

If you have questions about this research project, feel free to contact either of us. If you have questions about research compliance services at the University of Oregon, you may contact the University of Oregon's Office of Research Compliance (researchcompliance@uoregon.edu), phone 541-346-2510.

Thank you for helping us learn more about how the ACS can help your students by completing the survey and forwarding the letter below, with a separate survey link, to your students. You can access your survey by following this link: <https://tinyurl.com/cooracs>

Sincerely,

Joerg Schlatterer, Ph.D.
Assistant Director, Education
American Chemical Society
J_schlatterer@acs.org

Jean Stockard, Ph.D.
Professor Emerita, University of Oregon
Co-Interim Director, COACH
jeans@uoregon.edu

Please forward the message below to all of your graduate students

--

Subject: Help promote graduate student success post-pandemic

Dear Chemical Sciences Graduate Student,

The American Chemical Society (ACS) is committed to promoting the success of graduate students in the Chemical Sciences. We are asking your help in understanding how the ACS might best help graduate programs and students in the aftermath of the COVID-19 pandemic. We hope that you will complete a short internet-based survey (tinyurl.com/gracscov) regarding the impact of the pandemic on your graduate work and future plans. We also ask your thoughts on how ACS might help graduate students and include a few questions about you and your graduate studies. The survey was developed collaboratively by the ACS and researchers at COACH, which is based at the University of Oregon and devoted to enhancing the careers of chemical scientists. Pretests show that most people complete the survey in less than 10 minutes.

Of course, completing the survey is totally voluntary. We do not ask for your name, and you may skip any questions you do not care to answer. Responses will be initially linked to an identifier for your university so that we can check the way in which factors such as community COVID rates and university policies might be related to issues that students have encountered. But when we analyze data, the name of your university will be removed and will not be included in reports. As a token of our appreciation for your help, at the end of the survey you may enter your name into a random drawing for \$1,000 in travel support to an ACS Meeting or one of ten \$100 gift certificates. The link for entering the drawing is designed to be totally separate from your survey responses.

If you have questions about this research project, feel free to contact either Joerg at ACS or Jean at COACH. If you have questions about research compliance services at the University of Oregon, you may contact the University of Oregon's Office of Research Compliance (researchcompliance@uoregon.edu), phone 541-346-2510. If you belong to the ACS you may have already received a link to the survey. If you completed the form using that link, there is no need to do so again.

Thank you very much for helping us learn more about how the ACS can help graduate students in the chemical sciences. You can access the survey by following this link: tinyurl.com/gracscov.

Appendix B Students' Open-Ended Responses

This appendix includes all of the open-ended comments made by students, categorized as explained in the methodological section of the report. Each section includes a summary table of the percentage distribution of the coded categories and the comments placed in each category.

B.1 Negative Experiences During the Pandemic

Open-ended responses to the question, “Many people reported negative experiences during the pandemic of the last two years. Did you experience any of the following? Please mark all that apply.” were coded into 9 categories. One response was edited to remove profanity. Many of these responses were multifaceted and coded into multiple categories.

Table B-1
*Percentage Distribution of Students' Open-ended Responses
Regarding Negative Experiences During the Pandemic*

<u>Categories</u>	<u>Percent</u>
Negative familial impacts	8%
Negative academic/career progress	7%
No Negative impact reported	3%
Negative physical health	3%
Negative mental health / stressors	10%
Negative social/ isolation	5%
Loss of productivity	7%
Negative impact on routine/livelihood	7%
Other	5%

1a. Negative Familial Impacts

- Family issues, differences of opinions leading to stress
- Family loss
- loss of family members/grieving
- My father passed away in July 2020 which effected my families and my financial stability which I cannot put in words.
- We had 16 (sixteen) family members and friends die of COVID. Not sure how long it will take for hearts to heal.
- Decrease in concentration in research due to family members health
- Increased stress in general. I have asthma as well as family with health concerns so worrying about health was a big change.
- Loss of several family members, multiple covid cases under one roof, long lasting physical impacts related to senses and neurology

1b. Negative Academic / Career Progress

- Decrease in productivity due to constantly drained extrovert-batteries. Dramatically decreased retention of online course material due to visual impairments, leading to excessive study time causing MORE eye strain and further decreases in social time, leading to an empty life of studying endlessly through agonizing eye pain and feeling near-comatose from lack of free/fun/social time.
- delay on graduation
- Distraction and not being able to carry out research and other self-development skill acquisition.
- Research/career progress concerns
- Since my work was purely experimental, I was not able to carry out my research.
- Unreasonable expectations from PI during pandemic
- Restricted laboratory/research experience that would have been greatly beneficial for starting graduate school.

1c. No Negative Impact Reported

- I had no negative impact.
- It helped me to get to know myself better. It was positive for me
- None

1d. Negative Physical Health

- Being immunocompromised without mask mandates means that I have had to adopt an incredibly grueling schedule to complete my research safely (isolated) while maintaining a 'normal' day to day schedule to complete meetings/classes/etc. Already having a number of chronic health conditions, being forced to work this way has exacerbated many of them very negatively impacting my physical health and mental/emotional health short- and long-term.
- Decrease in productivity due to constantly drained extrovert-batteries. Dramatically decreased retention of online course material due to visual impairments, leading to excessive study time causing MORE eye strain and further decreases in social time, leading to an empty life of studying endlessly through agonizing eye pain and feeling near-comatose from lack of free/fun/social time.
- Loss of several family members, multiple covid cases under one roof, long lasting physical impacts related to senses and neurology

1e. Negative Mental Health / Stressors

- Academic bullying
- Being immunocompromised without mask mandates means that I have had to adopt an incredibly grueling schedule to complete my research safely (isolated) while maintaining a 'normal' day to day schedule to complete meetings/classes/etc. Already having a number of chronic health conditions, being forced to work this way has exacerbated many of them very negatively impacting my physical health and mental/emotional health short- and long-term.

- Decrease in productivity due to constantly drained extrovert-batteries. Dramatically decreased retention of online course material due to visual impairments, leading to excessive study time causing MORE eye strain and further decreases in social time, leading to an empty life of studying endlessly through agonizing eye pain and feeling near-comatose from lack of free/fun/social time.
- Family issues, differences of opinions leading to stress
- Family loss
- My father passed away in July 2020 which effected my families and my financial stability which I cannot put in words.
- Stress with abiding by pandemic policies should has remembering to bring a mask, take my temperature.
- We had 16 (sixteen) family members and friends die of COVID. Not sure how long it will take for hearts to heal.
- Increased stress in general. I have asthma as well as family with health concerns so worrying about health was a big change.
- Loss of several family members, multiple covid cases under one roof, long lasting physical impacts related to senses and neurology

1f. Negative Social/Isolation

- Academic bullying
- Being immunocompromised without mask mandates means that I have had to adopt an incredibly grueling schedule to complete my research safely (isolated) while maintaining a 'normal' day to day schedule to complete meetings/classes/etc. Already having a number of chronic health conditions, being forced to work this way has exacerbated many of them very negatively impacting my physical health and mental/emotional health short- and long-term.
- Decrease in productivity due to constantly drained extrovert-batteries. Dramatically decreased retention of online course material due to visual impairments, leading to excessive study time causing MORE eye strain and further decreases in social time, leading to an empty life of studying endlessly through agonizing eye pain and feeling near-comatose from lack of free/fun/social time.
- Family issues, differences of opinions leading to stress
- Family loss
- My father passed away in July 2020 which effected my families and my financial stability which I cannot put in words.
- Stress with abiding by pandemic policies should has remembering to bring a mask, take my temperature.
- We had 16 (sixteen) family members and friends die of COVID. Not sure how long it will take for hearts to heal.
- Increased stress in general. I have asthma as well as family with health concerns so worrying about health was a big change.
- Loss of several family members, multiple covid cases under one roof, long lasting physical impacts related to senses and neurology

1g. Loss of Productivity

- Decrease in productivity due to constantly drained extrovert-batteries. Dramatically decreased retention of online course material due to visual impairments, leading to excessive study time causing MORE eye strain and further decreases in social time, leading to an empty life of studying endlessly through agonizing eye pain and feeling near-comatose from lack of free/fun/social time.
- Distraction and not being able to carry out research and other self-development skill acquisition.
- Extracurricular organizations needed more effort because we had to change all the existing prep work over and over.
- motivation lacked
- Research/career progress concerns
- Since my work was purely experimental, I was not able to carry out my research.
- Decrease in concentration in research due to family members health

1h. Negative Impact on Routine/Livelihood

- Being immunocompromised without mask mandates means that I have had to adopt an incredibly grueling schedule to complete my research safely (isolated) while maintaining a 'normal' day to day schedule to complete meetings/classes/etc. Already having a number of chronic health conditions, being forced to work this way has exacerbated many of them very negatively impacting my physical health and mental/emotional health short- and long-term.
- Decrease in productivity due to constantly drained extrovert-batteries. Dramatically decreased retention of online course material due to visual impairments, leading to excessive study time causing MORE eye strain and further decreases in social time, leading to an empty life of studying endlessly through agonizing eye pain and feeling near-comatose from lack of free/fun/social time.
- Feeling of isolation in a liberal city and institution where everyone wanted to be unnecessarily cautious for longer than needed.
- Home/Working environment
- Inability to return to home country
- social isolation, missing out on key life events (undergraduate graduation)
- Stress with abiding by pandemic policies should have been remembering to bring a mask, take my temperature.

1i. Other

- harder to access healthcare facilities when symptomatic
- I am BEYOND disgusted with how academia and "scientists" whom I trusted behaved since 2020.
- Moving to a new location during the pandemic severely impacted my search for a rental unit. while the housing boom may have been the direct cause, that itself was caused by the pandemic

- My father passed away in July 2020 which effected my families and my financial stability which I cannot put in words.
- As an international student, I faced serious obstacles in order to travel to the country where I study.

B.2 Negative Impacts on Quality of Education

Open-ended responses to the question, “Over the last two years were there areas in which the quality of your graduate education was NEGATIVELY affected by the pandemic? Please mark all that apply.” were coded into 9 categories. One response was edited to omit revealing data. Many of these responses were multifaceted and coded into multiple categories.

Table B-2

*Percentage Distribution of Students’ Open-Ended Responses
Regarding Negative Impacts on Quality of Education*

<u>Categories</u>	<u>Percent</u>
Negative research experiences	16%
Negative social/isolation	13%
Negative TA experience	13
Loss of productivity	7%
Negative financial	4%
Negative academic impacts	18%
Negative professional development	20%
Negative impacts on health/wellbeing	20%
Other/vague	13%

2a. Negative Research Experiences

- Availability of lab supplies
- Access to common instruments
- My research work. Actually during that time our major instrument was done and the repair people didn’t come on time
- lab closures and lab technique discontinuity
- Participating to research conferences
- Was not able to get access to for 10 months which delayed my graduation.
- Lack of incoming graduate students during 2020-2021 meant senior graduate students had to TA. Taking even more time away from research.

2b. Negative Social/Isolation

- Felt lonely and homesick because I was unable to visit family and significant other
- Academic bullying
- Social Support
- conference, interactions with researchers worldwide
- No in person conferences made it harder to make connections in the field

- Family / support structure isolation

2c. Negative TA Experience

- TAing
- Teaching obligations
- Teaching/grading
- Teaching, as a TA, was also more difficult in some aspects
- Lack of incoming graduate students during 2020-2021 meant senior graduate students had to TA. Taking even more time away from research.
- Teaching responsibilities

2d. Loss of Productivity

- Inability to focus during quarantine and at-home work periods made progress slow
- I had to postpone my admission into graduate program by a year
- I am a visually impaired extrovert. Online classes are FREAKING AGONY.

2e. Negative Financial

- Cost of living
- COVID contributed to a lot of financial stress that the university was unwilling to help with. Graduate students currently live at 69% of the xxx calculated living wage in xxx County.

2f. Negative Academic Impacts

- prospective student visiting days (all virtual, could not visit any school before making a decision)
- I had to postpone my admission into graduate program by a year
- Academic bullying
- Unable to visit graduate campuses and faculty in person prior attending as student
- Writing
- Literally everything. I'm immunocompromised and every aspect of my education, training, and health were impacted by the pandemic and the lack of continued and consistent response to it.
- I am a visually impaired extrovert. Online classes are FREAKING AGONY.
- Online Classrooms make it more difficult for concept grasping and apprehension

2g. Negative Professional Development

- Very few departmental seminars, almost no graduate school events
- Conferences/presentations
- conference, interactions with researchers worldwide
- Conference attendance
- No in person conferences made it harder to make connections in the field
- Conference attendance and travel
- job market, networking opportunities

- Participating to research conferences
- Lack of in-person conferences

2h. Negative Impacts on Health/Wellbeing

- Mental health
- Health impact
- Literally everything. I'm immunocompromised and every aspect of my education, training, and health were impacted by the pandemic and the lack of continued and consistent response to it.
- I was scared, could go out because of that mentally stress
- My mental health severely suffered which caused me to struggle to do basic things I needed to do.
- Mental health leading to lowered productivity
- increase in mental health issues
- Loss of family and a personal health issue
- Health: contracted COVID & resulting complications limited my energy/stamina on a daily basis

2i. Other/Vague

- Conference attendance and travel
- Literally everything. I'm immunocompromised and every aspect of my education, training, and health were impacted by the pandemic and the lack of continued and consistent response to it.
- politics
- The Chinese regime used it to justify their surveillance system
- Loss of family and a personal health issue
- I was unable for a year to travel to the country in which I study due to travel restrictions

B.3. Positive Impacts on Quality of Graduate Education

Open-ended responses to the question, "Over the last two years were there areas in which the quality of your graduate education was POSITIVELY affected by the pandemic? Please mark all that apply." were coded into 11 categories. Many of these responses were multifaceted and coded into multiple categories.

Table C-1

*Percentage Distribution of Students' Open-Ended Responses
Regarding Positive Impacts on Quality of Education*

<u>Categories</u>	<u>Percent</u>
Skill development	9%
Positive academic productivity	12%
Positive academic/personal relationships	8%
More manageable work load	3%
Positive mental health	7%
Positive physical health	6%
Positive research	13%
Remote/online flexibility	44%
Other- personal reflection	3%
Other- relieved academic pressure	3%
Other/ vague	10%

3a. Skill Development

- I learned to be more flexible by teaching online.
- Computer skill improvements when working remote
- Time management
- got time to learn more digital tools
- I had opportunities to use my training to help with a covid testing lab, giving me leadership and analytical skills I did not have before.
- Grant writing
- better time management skills learned
- IT skills improved

3b. Positive Academic Productivity

- Had more time to spend time on literature
- Allowed more time for self-studying
- Mandatory time away from lab forced me to write a paper
- Got to read a lot of work
- Focus on how to adapt to circumstances and my ability to Work from home and digest papers
- Independent study
- Focus - there was not much else to do
- More time to read papers
- More citations on my papers
- Plenty of writing time :)

3c. Positive Academic / Personal Relationships

- Due to the physical distance, I got close emotionally to my family and significant other
- shared solidarity from going through the pandemic together
- The pandemic exposed a toxic culture in my former lab that lead me to quit and find a group that has been a far better fit. I don't know if things would have gotten so bad so fast otherwise, and I might have stayed somewhere that ultimately would have driven me out of the field long term.
- Mentorship experience
- Online seminars meant we interacted with other faculty from around the world
- Interaction with external faculty members because of zoom
- We were forced to collaborate with other researchers, which ended up being very fruitful. This was serendipitous, and probably not common

3d. More Manageable Workload

- Allowed more time for self-studying
- Work life balance, most people I know work fewer hours
- work load was less

3e. Positive Mental Health

- Time to work on mental health
- Mental Health Awareness
- Mental health and overall health is taken more seriously
- less pressure from less in-person interactions
- I went to therapy, so my mental health improved.
- Mental health support is more accessible. Meetings being hybrid are more accessible
- 3f. Positive physical health

3f. Positive Research

- Research outside of lab (computational); faculty admitting they were also struggling
- Gave me some space to reflect on my career goals and about my research project without being overwhelmed by work while out of the lab for long periods.
- Research project focused on COVID-19 detection for a while
- Research Venues
- research progress
- New research projects related to the pandemic were created
- Independent research
- I got to focus on new better projects
- Being kicked off campus forced me to do some computational chemistry which has positively affected my overall research
- We were forced to collaborate with other researchers, which ended up being very fruitful. This was serendipitous, and probably not common
- Have explored theoretical research options

3g. Remote / Online Flexibility

- Enabled work from home improved work/life balance and encouraged rest days
- Ability to attend online conferences which were normally held in person
- I liked working from home
- Accessibility to external resources via zoom
- The normalization of remote/hybrid meetings is the one benefit of the pandemic
- Ease of interacting with professors far away via Zoom
- online events
- Working from home made scheduling more flexible
- Encouraged work from home has continued since reopening, improving work/life balance and encouraging rest days
- Meetings can now be virtual and during the pandemic and working at home was able to take daily walks outside and focus on my health
- being able to take online meetings
- More accessibility for various events
- less pressure from less in-person interactions
- Focus on how to adapt to circumstances and my ability to Work from home and digest papers
- Remote work ability
- Increased flexibility in general (e.g., normalization of doing some work from home)
- Virtual seminars gave me access to more departments and interesting topics.
- ability to work from home
- Time schedule became more flexible
- Better understanding of my work/life balance
- Work from home prospects
- Hybrid work options
- Mental health support is more accessible. Meetings being hybrid are more accessible
- Virtual seminars were easier to attend when busy
- Work/life balance
- Online instruction improved. I saved hundreds of dollars in gas and parking permit fees, and saved about 10-15 hours weekly as had no commute/no parking time (remote leaning)
- Online seminars meant we interacted with other faculty from around the world
- the use of zoom and microsoft teams have been useful
- The online option being available was helpful long term.
- Work space flexibility
- remote work infrastructure
- Use of more virtual platforms, able to attend virtually other conferences that would not been financially feasible otherwise
- Ability to Zoom for calls
- Ability to work from home
- Seminars on zoom

- Increase in hybrid options
- Online mode was a big leap forward and a helpful tool to have access to valuable resources
- online seminars

3h. Other- Personal Reflection

- Gave me some space to reflect on my career goals and about my research project without being overwhelmed by work while out of the lab for long periods.
- Had some time to get to know myself
- General soul searching, different than career preparation

3i. Other- Relieved Academic Pressure

- less pressure from less in-person interactions
- Helped ease me into grad student life
- Our university allowed us to switch from letter grades to P/F at the end of the semester, if needed, which helped me greatly

3j. Other/ Vague

- Research outside of lab (computational); faculty admitting they were also struggling
- Gave me some space to reflect on my career goals and about my research project without being overwhelmed by work while out of the lab for long periods.
- time to regroup and switch project directions more easily
- Focus on how to adapt to circumstances and my ability to Work from home and digest papers
- TA experience
- This is somewhat intangible, but it has taught me ways to cope with big changes in my life.
- New research projects related to the pandemic were created
- I was able to take up online tutoring to better my financial situation
- Work space flexibility

B.4 Negative Impacts on Quality of Education Affected by Pandemic Policies

Open-ended responses to the question, “When you think about the coming years of your graduate program, are there areas in which the quality of your graduate education might be NEGATIVELY affected by policies and procedures adopted because of the pandemic? Please mark all that apply.” were coded into 5 categories. Many of these responses were multifaceted and coded into multiple categories.

Table B-4

Percentage Distribution of Students' Open-ended Responses Regarding Negative Impacts on Quality of Education Affected by Pandemic Policies

<u>Categories</u>	<u>Percent</u>
Negative academic impacts	30%
Negative professional development/ networking impacts	37%
Negative financial impacts	5%
Lack of acknowledgement/flexibility following COVID impacts	19%
Other/vague	22%

4a. Negative Academic Impacts

- Institutions are rushing to return to normal procedures and life before the pandemic, however, they refuse to understand that there are long-term impacts on the economy and health that make it difficult as a student to return to graduate education. In addition, the flexibility that was often given in the midst of the pandemic is now being taken away which is arguably needed even more in a post-pandemic landscape while people are still recuperating.
- exams/defense
- My program decided that remote work was super, they gave my office/desk to a new student who was not enrolled during pandemic. I get to work from home all the time, and as I am doing independent study I never see my peers. I've turned into a hermit! Not great from networking perspective.
- Slower start, so later to publish, so less competitive CV when applying to funding and awards
- longer time in program due to lack of progress during lab shutdown
- Didn't receive any guidance on how expectations to graduate change because of the first two years of the pandemic
- I gave a presentation through Zoom, which may have meant I wasn't forced to practice in-person presentation skills
- As undergraduate students come with no lab (practical) experience, institutional policies and faculty are focused on them, often neglecting postgraduate programs

4b. Negative Professional Development/Networking Impacts

- Networking
- conference virtual changes
- Fewer in-person events, support staff work from home and are not as accessible
- Conferences
- virtual events not being a proper replacement for networking interactions
- My program decided that remote work was super, they gave my office/desk to a new student who was not enrolled during pandemic. I get to work from home all the time, and as I am doing independent study I never see my peers. I've turned into a hermit! Not great from networking perspective.

- Networking external to university; i.e. finding postdoctoral positions in the upcoming year having only begun participating in in-person conferences this year.
- I gave a presentation through Zoom, which may have meant I wasn't forced to practice in-person presentation skills
- Less human interaction likely hurts collaboration (though zoom may offset some)
- I think we've become more accepting of virtual meetings in place of in-person conversations, and I think that continues to hurt networking and collaboration opportunities.

4c. Negative Financial Effects

- Because of pandemic there is huge inflection I'm still struggling with my finances and due this inflection it's more difficult to manage finances
- After pandemic, the financial support for travel has been significantly shrunk. .

4d. Lack of Acknowledgement/Flexibility Following COVID Impacts

- Institutions are rushing to return to normal procedures and life before the pandemic, however, they refuse to understand that there are long-term impacts on the economy and health that make it difficult as a student to return to graduate education. In addition, the flexibility that was often given in the midst of the pandemic is now being taken away which is arguably needed even more in a post-pandemic landscape while people are still recuperating.
- Seeing the lack of care some of my peers put on my and others' health and safety was a serious blow in my trust.
- If we continue to ignore that the pandemic is still an active situation (which is insinuated by this survey being marketed to me as a 'post-pandemic' survey) then literally everything will continue to be negatively impacted for me as a result of that lack of response.
- Didn't receive any guidance on how expectations to graduate change because of the first two years of the pandemic
- Negative impacts from *removal* of COVID policies & seeing how my university & community puts me at increased risk in the name of "normalcy", even as the pandemic continues. Disabled graduate students are being left behind.

4e. Other/Vague

- None? Faculty and students are now much more flexible and thus education is far more flexible (recordings, masks, more electronic accessibility)
- Access to common instruments
- dealing with adverse situations
- The vaccine mandates, besides being a travesty of science, are also a hindrance, since I have no intention of turning my body into a dump for Big Pharma.
- Negative impacts from *removal* of COVID policies & seeing how my university & community puts me at increased risk in the name of "normalcy", even as the pandemic continues. Disabled graduate students are being left behind.

- Psychological aspects

B.5. Positive Impacts on Quality of Education Affected by Pandemic Policies

Open-ended responses to the question, “When you think about the coming years of your graduate program, are there areas in which the quality of your graduate education might be POSITIVELY affected by policies and procedures adopted because of the pandemic? Please mark all that apply.” were coded into 7 categories. Many of these responses were multifaceted and coded into multiple categories.

Table B-5

Percentage Distribution of Students' Open-ended Responses Regarding Positive Impacts on Quality of Education Affected by Pandemic Policies

<u>Categories</u>	<u>Percent</u>
Positive remote learning	15%
Flexibility with schedule	21%
Positive online interactions/networking	31%
Improved safety/health standards	13%
Positive academic outcome	13%
Positive online resources	13%
Other/vague	15%

5a. Positive Remote Learning

- It is possible to attend classes remotely allowing for greater flexibility in dealing with trials of life.
- Remote learning became more developed
- development of technology to improve the class room experience
- Online resources
- The adoption of remote work, remote instruction, and remote meetings
- Available online lectures and classes
- independent learning

5b. Flexibility with Schedule

- It is possible to attend classes remotely allowing for greater flexibility in dealing with trials of life.
- Virtual meetings allowed long-distance interactions and students to manage their schedules more efficiently.
- All the meetings was shifted to online and It continued after the pandemic. Online meetings saves time a lot.
- prioritizing work-life balance
- The adoption of remote work, remote instruction, and remote meetings
- working from home and staying home when you're sick is nice to have.

- I now have the flexibility to hold tutor hours for my TA position remotely over zoom
- I can more easily work from home
- flexibility, working remotely
- Flexibility in when I can work from home

5c. Positive Online Interactions/Networking

- Virtual meetings allowed long-distance interactions and students to manage their schedules more efficiently.
- All the meetings was shifted to online and It continued after the pandemic. Online meetings saves time a lot.
- The adoption of remote work, remote instruction, and remote meetings
- Faculty can attend more meetings (candidacy exams, defense, etc) when they are out of town due to comfort with virtual meetings
- Flexible virtual meetings to collaborate and include committee members on sabbatical
- Online conferences
- accomodations for virtual seminars and interactions
- With Covid came the possibility of attending manyy career networking events in virtual environments. That would stay on for a long time and that is beneficial.
- Conference presentation
- accessibility to seminars, resources, conferences that are now also offered virtually
- Attending meetings
- Zoom access to qolloquium organized by my department
- use of zoom and microsoft teams
- I think interacting virtually is an instrumental way of interaction and discussion.
- Promoting virtual tools facilitates international scientific networking in general

5d. Improved Safety/ Health Standards

- An increase in societal tolerance of chronic conditions and accommodations
- working from home and staying home when you're sick is nice to have.
- not coming to work sick
- Safety during the pandemic. I appreciated the safety precautions because I was able to still perform research without great risk to my health.
- Policies and Procedures kept me and many others healthy and safe
- Better understanding of taking time off when sick

5e. Positive Academic Outcome

- As a biochemist I can see that how companies pay special attention to biosciences
- Graduation requirements (number of required exams, etc.) were reduced
- Computer skills
- I got really good at Zoom. I can easily make backgrounds, screenshare, etc.
- Maybe in terms of writing ability, but hard to gauge how much that came with exposure or time.

- Increase in theoretical research

5f. Positive Online Resources

- Online resources
- There are now many more online career resources
- online workshops and events
- accessibility to seminars, resources, conferences that are now also offered virtually
- use of zoom and microsoft teams
- Promoting virtual tools facilitates international scientific networking in general

5g. Other/Vague

- support
- The shift to digital forms makes it easier to move through bureaucracy
- Accessibility is more understood
- Very few policies and procedures were adopted by the graduate program
- Hybrid defenses
- They are more aware of the issues I tried to warn about in school
- Hybrid is a positive

B.6. Career Plans and Commitment

Open-ended responses to the question, “Please explain why your commitment changed.” were coded into 13 categories. Many of these responses were multifaceted and coded into multiple categories.

Table B-6

Percentage Distribution of Students' Open-ended Responses Explaining Why Commitment Changed

<u>Categories</u>	<u>Percent</u>
Desire or pressure to graduate ASAP/move on	20%
Loss of interest in field	11%
Change in priorities	13%
Pos motivation	14%
Neg motivation	15%
Financial stress/concerns	10%
Lack of support/resources from university	12%
Neg mental health/stress	27%
Neg physical health	2%
Neg productivity	16%
Other- career prospects/ job market	10%
Other- social/isolation	7%
Other/vague/not chemistry related	12%

6a. Desire or Pressure to Graduate ASAP / Move on

- PhD period was dragged during the pandemic and now I want to rap up the things quickly
- I need to finish this to get a job that I make enough to fully support myself.
- more motivation to leave the program as soon as possible
- Lockdown reminded me there's more to life outside of work so I need to graduate
- I need yo get a job with higher salary. Its is more urgent for me now
- While pushing through a global pandemic, I feel that because my mental health and relationships had suffered, I owe it to myself to push all the way through.
- I want to get out as quickly as possible because my situation isn't financially tenable in the long term.
- Already lost a year, really want to increase my progress
- if i donâ€™t get through this mf degree, i will never forgive myself for the time that was wasted in the pandemic
- I want to get out and start my job
- The challenges presented by the pandemic heightened my awareness of my degree timeline and motivated me to work even harder to make up for time lost to the pandemic and strive to graduate on time.
- I saw how many jobs were influenced by the pandemic and further realized the importance of cementing my educational level to enhance my desire for a workplace.
- It was extremely taxing to continue graduate school that I am much less attached and realize that nothing is worth that level of mental health and financial destruction. The pandemic made me realize that I want to finish my degree but I am no committed to giving up anything and everything to finish.
- I want to finish my degree such that I can find a financially stable job.
- I want to graduate soon so I can start an industry career and kind of change my environment
- I just want the degree
- I want to graduate so that I can earn more money and not deal with an administration that fails its students at all levels
- I want out with my degree as soon as possible.
- Want to get out of school quick
- I just want to be done and finished with my degree, so I can leave my graduate program. It has negatively affected me mentally and physically, and I do not want to contribute to academia or professional societies like others do
- I wanted to be done
- I feel a sense of looming pressure that I have to catch up for the time that I had missed in the lab while working remotely at home for ~6 months
- I couldn't wait to be done and be able to move back closer to family.
- I changed graduate programs and want to be the first person to graduate with my degree from my institution

- I need to finish my degree ASAP, so that my financial condition can improve after getting a decent job.
- Uncertainty about future made me want to complete and move on
- Sunken cost fallacy: at this point, I'm 3.5 years in to my degree, and I'm not going to let those years go to waste. I feel that some of my financial problems and overall loneliness/isolation will diminish once I graduate, and increasing my productivity is the best way to achieve that end.
- Honestly the policies in place during the pandemic made me want to quit more than ever. I don't know why I stuck it out. If I could redo it I would have just mastered out in Spring or Summer 2020 to avoid the emotional turmoil my advisor put me through. For whatever reason I just stayed and now I'm just staying strong to get out next spring.
- I am more determined to finish, as I got less chance to work in last 2 years. But, now I have to finish on time to not screw my financials.
- My commitment changed because i now have alot of responsibility meaning i have to graduate and get a job so i can cater for this new responsibilities
- I almost quit during the pandemic, but ultimately decided to stick with it. I promised myself that if I wasn't going to quit then, I had to see it through.
- I felt more pressure about it
- In as much as I'm struggling from the effect of the pandemic, I love my chemical sciences and I just want to graduate so i became more committed so that when opportunities meet my hardwork it will be success. Rather than relaxing and giving up
- Felt I needed to leave grad school as soon as possible.
- I feel like I've lost so much. I deserve this degree and I will have it. However I don't believe I can make it another year.
- I had to double down on my commitment to finish in order to push through this adversity.
- I just want to get it done and over with

6b. Loss of Interest in Field

- I am less sure of my career goals following the pandemic. I still want to complete my degree, but I am seriously considering switching fields, where my chemistry degree will be less important.
- I realized during the height of the pandemic what really mattered to me and had time to contemplate what I wanted for my life and realized that a PhD doesn't align as well as I initially thought
- I don't care as much about it anymore, and I feel burnt out after the pandemic.
- burnout, feeling like I chose the wrong field to study
- I realized I'm deeply unhappy with my degree program and having to deal with the roadblocks associated with COVID feels nearly pointless.
- I still want my degree desperately, but my motivation has just sunk. My faith in academia has been ruined and I no longer feel passionate about my work.

- I enjoyed research less and less, and often thought about leaving my Ph.D. program early with a Master's. I felt like I didn't belong in graduate school and that I wasn't going to succeed, which was highly discouraging.
- The personal struggles I have endured caused by the pandemic have been so draining that I don't have the energy for my degree. I feel burnt out beyond solution. Every time something goes wrong with my research it feels like it will be the straw that breaks the camels back. I know that this is not sustainable mentally and so I am constantly questioning my decision to remain within my program.
- For about a year, I lost interest and had a difficult time staying motivated. However, this past month I found a new spark that I believe will carry me to the finish line.
- Lack of support in academic departments - I had to fight for a lot of accommodations and support. This led me to think less of my institution and thus devalue my degree.
- I was initially interested in pursuing a career in higher ed but the way academia handled the pandemic made me disappointed in the future I could have in academia.
- I am feeling disillusioned and burnt out. I don't feel like achieving the Ph.D. necessarily aligns with my career goals any more, but I am only ~10 months from finishing.
- My planned timeline was changed, so I decided to aim for a different degree.
- I just want to be done and finished with my degree, so I can leave my graduate program. It has negatively affected me mentally and physically, and I do not want to contribute to academia or professional societies like others do
- I found that I am ethically pretty against the structure of our graduate program and seeing how some faculty have treated students and continue to treat students, while being extremely tone-deaf as to their positions of power and comfort in having already finished their degrees has severely disillusioned me from this process.
- The career choice I have (academia) is significantly less attractive as I continue living and struggling in it.
- I started to lose some faith in the academic institution, and even some of companies that I viewed as potential employers. I doubted if I wanted to stay on the track that would, seemingly, ostracize me for my views for the rest of my career.
- Sought job opportunities when access to lab was restricted. I wasn't able to do the work I enjoyed doing
- Passion for continuing science decreased
- The professors don't care or even try to care. No support from faculty. Way behind in research and education. Not financially stable. I think I have like 2 semesters left and I'd rather just quit than continue since I've had such a horrible experience.

6c. Change in Priorities

- I was ready to continue with my PhD, but as things got worse its better for me to leave with my masters with thesis and be alive and healthy then stay in a place so toxic and not worth the mental, physical, financial, and emotional drainage.
- I'm a seventh-year graduate student. I began the program before the pandemic (2016) and have experienced the dramatic shift of the entire program, department, and university. While I enjoy my field, I've simultaneously pondered many days if the stress

of graduate school on top of the worldwide change we all experienced was worth it for how much I personally care for chemistry. I find chemistry interesting, but I was never interested in destroying my mental health for a degree. I was certain the graduate program would challenge me, but I accepted my university's offer due to their more friendly, relaxed nature compared to other chemistry departments. The addition of the pandemic, in my experience, intensified the work, stress, and lifestyle changes ultimately to a point I considered only possible if I had chosen one of those more intense chemistry departments.

- I realized during the height of the pandemic what really mattered to me and had time to contemplate what I wanted for my life and realized that a PhD doesn't align as well as I initially thought
- It didn't feel as important as things like seeing my loved ones and staying healthy. It's no longer my biggest goal in life, it's just another degree that I will work hard to earn, but not ruin myself in the process
- Before I was very much determined to finish, especially on time. Now with how my physical and mental health has impacted my personal and work life, I very much am more focused on taking care of myself instead of focusing on completing my degree on time. If my advisor or committee have a problem at the pace I am working then that's their problem. If it comes down to it, I will drop out if they won't work with me.
- I do not feel the additional time put into my graduate studies has improved my career prospects in anyway and I no longer feel supported by my graduate program. Decreased social interactions with my advisor, peers and committee members has left me often distracted from my commitments.
- The need to prioritize my caring for my brother
- Sometimes it feels less worth the stress. I feel very overwhelmed, and I know that I have limited time alive. Sometimes I think about leaving to reduce my stress and improve my quality of life.
- I realized that there was a lot more that I wanted out of life than to spend all of my time in a research lab with a PI that doesn't respect their students enough to be concerned about their well being during COVID.
- Many close friends dropped out of the program due to the lack of support for grad students. Their mental health was suffering and leaving allowed them to find jobs that allowed for financial stability and more down time to recover. They encouraged me to leave as well, which is something I seriously considered. I'm in my last semester now and reflecting back, I should have dropped. I do not believe the stress has been worth it.
- Just being away from home/those I love during a pandemic made me realize I value family/loved ones over a graduate degree any day.
- Life is short, I realized that a PhD is not the only way to be successful in stem.
- It was extremely taxing to continue graduate school that I am much less attached and realize that nothing is worth that level of mental health and financial destruction. The pandemic made me realize that I want to finish my degree but I am not committed to giving up anything and everything to finish.

- Grad school really sucks and the pandemic helped me see how awful it can really be. I've decided that I'd rather preserve my mental health than finish my PhD if it comes down to a choice between the two.
- Nothing to do with the pandemic, but I was working at a job that didn't stimulate me which then motivated me to return to graduate school
- unsure if higher degree is necessary, or even harmful to future career success
- I realized my priorities better, and learnt what I want in my future career. That has motivated me to move towards my next step
- I had a baby and recognize finishing my degree will allow me to give them a better life.
- I started questioning if I needed the PhD degree.
- I realized that getting a PhD is not worth my mental or physical health. I'm not quitting but I've accepted that I cannot and should not try to put in 14-hour days or work on weekends.
- Change in perspective and priority.
- It wavered some. Due to international travel restrictions, I didn't see my family or fiance for too long. Even when I did, I had some personal health struggles that I needed to address. At some point, I was questioning why I was even here away from all my people, putting my life on hold for a PhD that wasn't even working. I think I would've had an easier time dealing with it if I could travel normally and see my family more frequently (me visiting or them visiting). Covid still impacts visa appointments so my family can still not visit me. The effects are still ongoing
- My commitment changed because i now have alot of responsibility meaning i have to graduate and get a job so i can cater for this new responsibilities
- I think the death toll of COVID and the policies in place with those passing away negatively affected me. I felt and at times feel like I would rather spend the time I'm spending on the PhD with family instead because of the grand human toll of COVID.
- I realized how precious time with my loved ones was and that all of the hours I normally put in lab were hours I may never get to spend with my loved ones again. I definitely have reprioritized spending time with friends and family over academics now.

6d. Positive Motivation

- Being back in person and completing program milestones has made me feel more confident about completing my degree
- I am further along and therefore more focused on the finish line
- I passed my oral qualifying exam during the pandemic.
- I felt refocused on my academic goals and felt as if I had more time and fewer distractions (such as social outings)
- I took a year gap because of the covid, and that benefited my mental health.
- I actually got more committed to getting my degree because, essentially - if I don't get my degree now, why did I bother putting myself through hell in the pandemic? What would I do with the knowledge that things would have been easier if I just gave up? There's also an element of, what else could I do? Employment is still very difficult to

find, and being in a graduate program with financial, educational, and social support is probably a better place to be than being adrift in a tempestuous job market.

- I saw how flexible graduate school could be, so taking more time to finish my degree wouldn't be so bad
- During the pandemic over a period of mourning I experienced a lessen of my commitment to finish my degree, but now my commitment increased back to pre-pandemic levels again
- I saw people with diverse jobs have a hard time when they couldn't go to work or their business suffered, etc. and this motivated me to pursue a career with flexible working circumstances and pursue science that contributes to human health
- The challenges presented by the pandemic heightened my awareness of my degree timeline and motivated me to work even harder to make up for time lost to the pandemic and strive to graduate on time.
- For about a year, I lost interest and had a difficult time staying motivated. However, this past month I found a new spark that I believe will carry me to the finish line.
- I got closer to graduating
- Nothing to do with the pandemic, but I was working at a job that didn't stimulate me which then motivated me to return to graduate school
- Since I hadn't been able to work in lab for a few months, I have become more commitment to finishing up my degree.
- I realized my priorities better, and learnt what I want in my future career. That has motivated me to move towards my next step
- I had a bad experience with my previous advisor and now that I have a new advisor that has improved my experience I am more determined to stay.
- Because I entered a group where I felt like I could actually finished and wasn't being sabotaged by a negative PI who didn't believe in my success.
- I'm way more focused on make sure that I'm a strong candidate for jobs, which fueled my commitment to science.
- I saw the positive effects of research on helping with global problems
- My interest is in pharmaceutical industry which is important, especially now, for the well-being of this world
- Since i lost 1.3 years due to lockdown,. I feel to be more committed in carrying my research work so that i can compleye my phd within give timeline
- I became more committed because I seen other students giving up. They stopped coming to class, stopped coming to study groups, they stopped caring. I did not want to fall into the same entrapment of the pandemic.
- I tend to turn negative things in my life to positive. I decided that I wanted to be more committed to my PhD degree, I was able to write a scientific review during the lockdown, had the time to think about my research/analyze data and went to any virtual conference, symposium and event I could find.
- Because I took advantage of the decreased social interaction to push harder through my program.

- I felt that i needed to push harder to get over my loss during the pandemic and i was more determined to finish in 5 years to improve my financial situation
- In as much as I'm struggling from the effect of the pandemic, I love my chemical sciences and I just want to graduate so i became more committed so that when opportunities meet my hardwork it will be success. Rather than relaxing and giving up

6e. Negative Motivation

- Lost the motivation.
- I'm having a lack of motivation. Sometimes I feel I don't have a good relationship with my PI.
- I don't care as much about it anymore, and I feel burnt out after the pandemic.
- Lab equipment breaking down, resulting in more time spent in the program. A professor quit the program which was discouraging.
- I still want my degree desperately, but my motivation has just sunk. My faith in academia has been ruined and I no longer feel passionate about my work.
- I enjoyed research less and less, and often thought about leaving my Ph.D. program early with a Master's. I felt like I didn't belong in graduate school and that I wasn't going to succeed, which was highly discouraging.
- Effort to reward ratio is negative. Society doesn't value science or teachers neither socially nor economically. Students are unengaged. Over exertion is obliterated
- During the pandemic over a period of mourning I experienced a lessen of my commitment to finish my degree, but now my commitment increased back to pre-pandemic levels again
- Constant roadblocks to running experiments, lack of return on efforts
- First my lab was really caring about health of all the members, so even only being in office or lab spaces was limited due to scheduling. Since I was a just starting student, I needed to be physically be in these spaces to learn about my lab and inspired from anything. It was impossible, and I just gave up to tight up myself.
- Lack of motivation and constantly feeling helpless
- less motivation. degree taking more time it seemed less worthwhile
- The personal struggles I have endured caused by the pandemic have been so draining that I don't have the energy for my degree. I feel burnt out beyond solution. Every time something goes wrong with my research it feels like it will be the straw that breaks the camels back. I know that this is not sustainable mentally and so I am constantly questioning my decision to remain within my program.
- I wasn't able to hear much about the older graduate students who were graduating and getting jobs during COVID due to distancing requirements. I felt like this hindered my career development. Additionally, lab closures slowed things down by a few months. For these reasons, I felt more unsure about my future and this made me feel less motivated to be finishing.
- I failed a few courses and thought science was not for me.
- IT is so draining and probably not really needed
- I was depressed and didn't want to continue

- Although we are not physically as isolated, interactions are fewer and less productive. I feel isolated in my effort to finish- not motivated by anyone other than myself.
- The pandemic occurred during my 3rd to 4th year which is when there's supposed to be that upswing in your research, and instead our lab was shut down for 3 months, and the NMR lab I need for my thesis was closed to students for six. It's delayed me and I'm unmotivated to finish.
- It has been much harder to motivate myself due to missing out on in-person interactions
- I'm tired and the first two years of my degree were really difficult because there was no one around to help.
- Demotivation and discouragement. Anxiety increase.
- My motivation decreased significantly due to depression
- While I am still committed to finishing my degree, there have been increased feelings of wanting to quit or at least pause. I think this stems from having feelings of burnout along with frustration at research problems.
- I wanted the suffering to end, to be honest.
- Less motivation due to decreasing mental health
- It changed because it was as if the plan I wrote down was truncated which resulted to a discouragement.
- I feel like I've lost so much. I deserve this degree and I will have it. However I don't believe I can make it another year.

6f. Financial Stressors

- I was ready to continue with my PhD, but as things got worse it's better for me to leave with my masters with thesis and be alive and healthy than stay in a place so toxic and not worth the mental, physical, financial, and emotional drainage.
- I need to finish this to get a job that I can make enough to fully support myself.
- I need to get a job with higher salary. It's more urgent for me now
- Because the price for withdrawal is too big
- I want to get out as quickly as possible because my situation isn't financially tenable in the long term.
- It was extremely taxing to continue graduate school that I am much less attached and realize that nothing is worth that level of mental health and financial destruction. The pandemic made me realize that I want to finish my degree but I am not committed to giving up anything and everything to finish.
- The work is not worth being paid under minimum wage
- Burn out, low pay now and after graduation
- I need to finish my degree ASAP, so that my financial condition can improve after getting a decent job.
- Because of the financial crisis I am going through.
- Because I need to make more money.
- Sunk cost fallacy: at this point, I'm 3.5 years in to my degree, and I'm not going to let those years go to waste. I feel that some of my financial problems and overall

loneliness/isolation will diminish once I graduate, and increasing my productivity is the best way to achieve that end.

- I am more determined to finish, as I got less chance to work in last 2 years. But, now I have to finish on time to not screw my financials.
- Because of the financial and mental stress
- The professors don't care or even try to care. No support from faculty. Way behind in research and education. Not financially stable. I think I have like 2 semesters left and I'd rather just quit than continue since I've had such a horrible experience.
- I felt that I needed to push harder to get over my loss during the pandemic and I was more determined to finish in 5 years to improve my financial situation
- The pandemic affected the inflow of income and more so the program became a bit distorted and less organized.
- I couldn't get resources from lab and also no financial support. So finishing my Ph. D became hard to me
- Due to financial and family conditions

6g. Lack of Support / Resources From University

- I'm having a lack of motivation. Sometimes I feel I don't have a good relationship with my PI.
- Lab equipment breaking down, resulting in more time spent in the program. A professor quit the program which was discouraging.
- I do not feel the additional time put into my graduate studies has improved my career prospects in anyway and I no longer feel supported by my graduate program. Decreased social interactions with my advisor, peers and committee members has left me often distracted from my commitments.
- Lack of support from the University/department
- Stress. Work environments. Workloads. I realize its standard practice to abuse those employed in academia.
- I realized that there was a lot more that I wanted out of life than to spend all of my time in a research lab with a PI that doesn't respect their students enough to be concerned about their well being during COVID.
- I wanted to escape a bad lab situation that turned my advisor into a toxic, spiteful person
- Constant roadblocks to running experiments, lack of return on efforts
- Feeling lonely and unsupported by my department and school.
- I don't feel supported by my institution
- Many close friends dropped out of the program due to the lack of support for grad students. Their mental health was suffering and leaving allowed them to find jobs that allowed for financial stability and more down time to recover. They encouraged me to leave as well, which is something I seriously considered. I'm in my last semester now and reflecting back, I should have dropped. I do not believe the stress has been worth it.

- It opened my eyes to how unimportant my research and career development are to my advisor. I think in terms of a five-year degree; he thinks in terms of a 40-year career. I'm nothing to him.
- Lack of support in academic departments - I had to fight for a lot of accommodations and support. This led me to think less of my institution and thus devalue my degree.
- I'm tired and the first two years of my degree were really difficult because there was no one around to help.
- I want to graduate so that I can earn more money and not deal with an administration that fails its students at all levels
- I found that I am ethically pretty against the structure of our graduate program and seeing how some faculty have treated students and continue to treat students, while being extremely tone-deaf as to their positions of power and comfort in having already finished their degrees has severely disillusioned me from this process.
- The lack of support from the department and the deep seeded issues caused me to question why I have been putting myself through so much abuse and has me reconsidering if the final Ph.D. degree is worth it.
- I plan to graduate but I am in no way excited about science or performing as high as my PI / department want me to. I am truly disgusted by how selfish for their careers and psychologically manipulative professors have acted in this pandemic.
- Lack of support from university, department, and PI. Haven't seen my committee fac-to-face since 2019.
- I didn't get to go to lab for a long time. My research has stalled and I had very little support. Many of my classmates dropped out of the program.
- The professors don't care or even try to care. No support from faculty. Way behind in research and education. Not financially stable. I think I have like 2 semesters left and I'd rather just quit than continue since I've had such a horrible experience.
- The pandemic affected the inflow of income and more so the program became a bit distorted and less organized.
- I couldn't get resources from lab and also no financial support. So finishing my Ph. D became hard to me

6h. Negative Mental Health / Stress

- I was ready to continue with my PhD, but as things got worse its better for me to leave with my masters with thesis and be alive and healthy then stay in a place so toxic and not worth the mental, physical, financial, and emotional drainage.
- I'm a seventh-year graduate student. I began the program before the pandemic (2016) and have experienced the dramatic shift of the entire program, department, and university. While I enjoy my field, I've simultaneously pondered many days if the stress of graduate school on top of the worldwide change we all experienced was worth it for how much I personally care for chemistry. I find chemistry interesting, but I was never interested in destroying my mental health for a degree. I was certain the graduate program would challenge me, but I accepted my university's offer due to their more friendly, relaxed nature compared to other chemistry departments. The addition of the

pandemic, in my experience, intensified the work, stress, and lifestyle changes ultimately to a point I considered only possible if I had chosen one of those more intense chemistry departments.

- I felt like going back home because of loneliness. The thought of quitting my PhD program was more during the pandemic than before or after
- The pandemic decreased working capabilities, however the requirements for degree completion did not change. Putting increased stress on myself
- I don't care as much about it anymore, and I feel burnt out after the pandemic.
- It didn't feel as important as things like seeing my loved ones and staying healthy. It's no longer my biggest goal in life, it's just another degree that I will work hard to earn, but not ruin myself in the process
- burnout, feeling like I chose the wrong field to study
- Before I was very much determined to finish, especially on time. Now with how my physical and mental health has impacted my personal and work life, I very much am more focused on taking care of myself instead of focusing on completing my degree on time. If my advisor or committee have a problem at the pace I am working then that's their problem. If it comes down to it, I will drop out if they won't work with me.
- During first year, I felt very isolated and was unable to talk to others in my position. I am a person who is very social and enjoys being with others. Since I was unable to do so, my first year of grad school was challenging and I questioned my ability to finish. Now, this is somewhat alleviated.
- Sometimes it feels less worth the stress. I feel very overwhelmed, and I know that I have limited time alive. Sometimes I think about leaving to reduce my stress and improve my quality of life.
- Stress. Work environments. Workloads. I realize it's standard practice to abuse those employed in academia.
- While pushing through a global pandemic, I feel that because my mental health and relationships had suffered, I owe it to myself to push all the way through.
- Research seemed hopeless and there was a lot of pressure.
- Now, I always scared another virus or sth might happen and my education will be delayed
- Effort to reward ratio is negative. Society doesn't value science or teachers neither socially nor economically. Students are unengaged. Over exertion is obliterated
- Changed PhD institutions due to life-threatening mental health concerns
- I wanted to escape a bad lab situation that turned my advisor into a toxic, spiteful person
- Mental exhaustion
- Lack of motivation and constantly feeling helpless
- Feeling lonely and unsupported by my department and school.
- Many close friends dropped out of the program due to the lack of support for grad students. Their mental health was suffering and leaving allowed them to find jobs that allowed for financial stability and more down time to recover. They encouraged me to

leave as well, which is something I seriously considered. I'm in my last semester now and reflecting back, I should have dropped. I do not believe the stress has been worth it.

- COVID made the isolating experience of obtaining a graduate degree even more isolating. Not only were the students burnt out, but so were the faculty.
- The personal struggles I have endured caused by the pandemic have been so draining that I don't have the energy for my degree. I feel burnt out beyond solution. Every time something goes wrong with my research it feels like it will be the straw that breaks the camels back. I know that this is not sustainable mentally and so I am constantly questioning my decision to remain within my program.
- It was extremely taxing to continue graduate school that I am much less attached and realize that nothing is worth that level of mental health and financial destruction. The pandemic made me realize that I want to finish my degree but I am not committed to giving up anything and everything to finish.
- Grad school really sucks and the pandemic helped me see how awful it can really be. I've decided that I'd rather preserve my mental health than finish my PhD if it comes down to a choice between the two.
- I had to allocate time and energy on other issues that resulted from the pandemic.
- IT is so draining and probably not really needed
- I was depressed and didn't want to continue
- I just don't think I am suited for graduate school. The more I stay here, the more miserable I become.
- Mental health reasons
- I am feeling disillusioned and burnt out. I don't feel like achieving the Ph.D. necessarily aligns with my career goals any more, but I am only ~10 months from finishing.
- Burn out, low pay now and after graduation
- Demotivation and discouragement. Anxiety increase.
- I just want to be done and finished with my degree, so I can leave my graduate program. It has negatively affected me mentally and physically, and I do not want to contribute to academia or professional societies like others do
- My motivation decreased significantly due to depression
- While I am still committed to finishing my degree, there have been increased feelings of wanting to quit or at least pause. I think this stems from having feelings of burnout along with frustration at research problems.
- I realized that getting a PhD is not worth my mental or physical health. I'm not quitting but I've accepted that I cannot and should not try to put in 14-hour days or work on weekends.
- The lack of support from the department and the deep seeded issues caused me to question why I have been putting myself through so much abuse and has me reconsidering if the final Ph.D. degree is worth it.
- Mental health
- Sunken cost fallacy: at this point, I'm 3.5 years in to my degree, and I'm not going to let those years go to waste. I feel that some of my financial problems and overall

loneliness/isolation will diminish once I graduate, and increasing my productivity is the best way to achieve that end.

- I think I'm just feeling burned out since the pandemic. I think my momentum (which I felt I had a lot of before) has halted and never recovered
- Honestly the policies in place during the pandemic made me want to quit more than ever. I don't know why I stuck it out. If I could redo it I would have just mastered out in Spring or Summer 2020 to avoid the emotional turmoil my advisor put me through. For whatever reason I just stayed and now I'm just staying strong to get out next spring.
- Since my bachelors' degree I have lived many situations that mentally make me think if I can actually finish my degree and the pandemic depressed me given the time out of the lab. When I came back it was very hard to catch up and still today I am affected because materials do not arrive because companies are behind in production.
- I think I am more burn out because of having to make up the time I lost in the lab (4 months) due to stay at home orders and getting COVID.
- The toll it was taking on my mental health
- Because of the financial and mental stress
- I think the death toll of COVID and the policies in place with those passing away negatively affected me. I felt and at times feel like I would rather spend the time I'm spending on the PhD with family instead because of the grand human toll of COVID.
- Less motivation due to decreasing mental health
- I felt stagnant and unhappy with the lack of progress
- I couldn't concentrate myself to write and read works to develop my research. I tried a treatment with a psychologist, but it didn't work. I was afraid of me and my family getting contaminated again

6i. Negative Physical Health

- I was ready to continue with my PhD, but as things got worse it's better for me to leave with my masters with thesis and be alive and healthy then stay in a place so toxic and not worth the mental, physical, financial, and emotional drainage.
- Before I was very much determined to finish, especially on time. Now with how my physical and mental health has impacted my personal and work life, I very much am more focused on taking care of myself instead of focusing on completing my degree on time. If my advisor or committee have a problem at the pace I am working then that's their problem. If it comes down to it, I will drop out if they won't work with me.
- I just want to be done and finished with my degree, so I can leave my graduate program. It has negatively affected me mentally and physically, and I do not want to contribute to academia or professional societies like others do
- I realized that getting a PhD is not worth my mental or physical health. I'm not quitting but I've accepted that I cannot and should not try to put in 14-hour days or work on weekends.

6j. Negative Productivity

- The pandemic decreased working capabilities, however the requirements for degree completion did not change. Putting increased stress on myself
- Lab equipment breaking down, resulting in more time spent in the program. A professor quit the program which was discouraging.
- Less progress being made
- I do not feel the additionally time put into my graduate studies has improved my career prospects in anyway and I no longer feel supported by my graduate program. Decreased social interactions with my advisor, peers and committee members has left me often distracted from my commitments.
- because the long time wasted due the pandemic which give me hard time to finish my degree
- Research seemed hopeless and there was a lot of pressure.
- I started grad school in Fall 2020, with everything being conducted virtually (classes, TAing duties, group meetings, etc.) and my education was negatively impacted, and so there was a period of time where I considered leaving.
- Because everything was mess- up. I wanted to start my program early but because of covid, it got postponed by 6 months to
- Already lost a year, really want to increase my progress
- Constant roadblocks to running experiments, lack of return on efforts
- less motivation. degree taking more time it seemed less worthwhile
- Most part of my research was conducted on the bench. So the COVID-19 quarantine really gave me a hard time to make progress.
- I wasn't able to hear much about the older graduate students who were graduating and getting jobs during COVID due to distancing requirements. I felt like this hindered my career development. Additionally, lab closures slowed things down by a few months. For these reasons, I felt more unsure about my future and this made me feel less motivated to be finishing.
- I had to allocate time and energy on other issues that resulted from the pandemic.
- Since I hadn't been able to work in lab for a few months, I have become more commitment to finishing up my degree.
- The pandemic occurred during my 3rd to 4th year which is when there's supposed to be that upswing in your research, and instead our lab was shut down for 3 months, and the NMR lab I need for my thesis was closed to students for six. It's delayed me and I'm unmotivated to finish.
- My planned timeline was changed, so I decided to aim for a different degree.
- would take too much work to relearn everything and difficult to justify the stress of five more years of school
- Because I lost significant amount of time in pandemic and even after that I feel unsafe to work
- I think I'm just feeling burned out since the pandemic. I think my momentum (which I felt I had a lot of before) has halted and never recovered
- Since my bachelors' degree I have lived many situations that mentally make me think if I can actually finish my degree and the pandemic depressed me given the time out of

the lab. When I came back it was very hard to catch up and still today I am affected because materials do not arrive because companies are behind in production.

- I didn't get to go to lab for a long time. My research has stalled and I had very little support. Many of my classmates dropped out of the program.
- I think I am more burn out because of having to makeup the time I lost in the lab (4months) due to stay at home orders and getting COVID.
- I spent the pandemic primarily taking care of my child and not focusing on my degree. This has made it hard to now try to jump right back into my thesis when much of it I have now forgotten. The other factor leading to this is that during the pandemic the funding for my project ended and this resulted in my project not having the extensiveness required for a PhD. I have been given the option of starting over with a new project or dropping out of the PhD program.
- Lockdown made me worry about finishing my requirements for PhD degree
- Since i lost 1.3 years due to lockdown,. I feel to be more committed in carrying my research work so that i can complete my phd within give timeline
- The professors don't care or even try to care. No support from faculty. Way behind in research and education. Not financially stable. I think I have like 2 semesters left and I'd rather just quit than continue since I've had such a horrible experience.
- I felt stagnant and unhappy with the lack of progress
- Lockdowns had a negative effect on productivity
- I couldn't concentrate myself to write and read works to develop my research. I tried a treatment with a psychologist, but it didn't work. I was afraid of me and my family getting contaminated again.

6k. Other – Career Prospects / Job Market

- I need to finish this to get a job that I make enough to fully support myself.
- Job markets have gotten harder to find a job. As an international student, I decided to pursue education than to immediately find a job.
- I need to get a job with higher salary. Its is more urgent for me now
- Learning about other options outside of graduate school
- I want to get out and start my job
- unsure if higher degree is necessary, or even harmful to future career success
- I want to finish my degree such that I can find a financially stable job.
- I want to graduate soon so I can start an industry career and kind of change my environment
- For a assured job in the future
- To get a job
- I need to finish my degree ASAP, so that my financial condition can improve after getting a decent job.
- Career prospects, uncertainty in the job market caused by pandemic
- I'm way more focused on make sure that I'm a strong candidate for jobs, which fueled my commitment to science.

- My commitment changed because i now have alot of responsibility meaning i have to graduate and get a job so i can cater for this new responsibilities
- Sought job opportunities when access to lab was restricted. I wasn't able to do the work I enjoyed doing
- Because after pandemic many company started layoff which decreasing possibility of hiring new PhD
- My costs are rising, my pay is decreasing when accounting for inflation, we are being asked to work more and more, and the skills I have are highly sought after and well paid for in industry. The only reason I would stay in the Ph.D. program is for the accolade.
- For having greater certainty attached to permanent job positions especially of higher positions that are ultimately connected to a certain level of education

6l. Other- Social / Isolation

- It didn't feel as important as things like seeing my loved ones and staying healthy. It's no longer my biggest goal in life, it's just another degree that I will work hard to earn, but not ruin myself in the process
- I do not feel the additionally time put into my graduate studies has improved my career prospects in anyway and I no longer feel supported by my graduate program. Decreased social interactions with my advisor, peers and committee members has left me often distracted from my commitments.
- During first year, I felt very isolated and was unable to talk to others in my position. I am a person who is very social and enjoys being with others. Since I was unable to do so, my first year of grad school was challenging and I questioned my ability to finish. Now, this is somewhat alleviated.
- While pushing through a global pandemic, I feel that because my mental health and relationships had suffered, I owe it to myself to push all the way through.
- COVID made the isolating experience of obtaining a graduate degree even more isolating. Not only were the students burnt out, but so were the faculty.
- Just being away from home/those I love during a pandemic made me realize I value family/loved ones over a graduate degree any day.
- I wasn't able to hear much about the older graduate students who were graduating and getting jobs during COVID due to distancing requirements. I felt like this hindered my career development. Additionally, lab closures slowed things down by a few months. For these reasons, I felt more unsure about my future and this made me feel less motivated to be finishing.
- Although we are not physically as isolated, interations are fewer and less productive. I feel isolated in my effort to finish- not motivated by anyone other than myself.
- It has been much harder to motivate myself due to missing out on in-person interactions
- Because the necessity of communication and social in our daily life
- I couldn't wait to be done and be able to move back closer to family.
- Sunken cost fallacy: at this point, I'm 3.5 years in to my degree, and I'm not going to let those years go to waste. I feel that some of my financial problems and overall

loneliness/isolation will diminish once I graduate, and increasing my productivity is the best way to achieve that end.

- It wavered some. Due to international travel restrictions, I didn't see my family or fiancé for too long. Even when I did, I had some personal health struggles that I needed to address. At some point, I was questioning why I was even here away from all my people, putting my life on hold for a PhD that wasn't even working. I think I would've had an easier time dealing with it if I could travel normally and see my family more frequently (me visiting or them visiting). Covid still impacts visa appointments so my family can still not visit me. The effects are still ongoing
- Lack of support from university, department, and PI. Haven't seen my committee fac-to-face since 2019.

6m. Other – Vague / Not Chem Ed Related

- I'm a seventh-year graduate student. I began the program before the pandemic (2016) and have experienced the dramatic shift of the entire program, department, and university. While I enjoy my field, I've simultaneously pondered many days if the stress of graduate school on top of the worldwide change we all experienced was worth it for how much I personally care for chemistry. I find chemistry interesting, but I was never interested in destroying my mental health for a degree. I was certain the graduate program would challenge me, but I accepted my university's offer due to their more friendly, relaxed nature compared to other chemistry departments. The addition of the pandemic, in my experience, intensified the work, stress, and lifestyle changes ultimately to a point I considered only possible if I had chosen one of those more intense chemistry departments.
- necessity
- Job markets have gotten harder to find a job. As an international student, I decided to pursue education than to immediately find a job.
- To reorganize the time.
- I enjoyed research less and less, and often thought about leaving my Ph.D. program early with a Master's. I felt like I didn't belong in graduate school and that I wasn't going to succeed, which was highly discouraging.
- Now, I always scared another virus or sth might happened and my education will be delayed
- I determined it was feasible
- Nihilism
- \$\$\$
- My disability made completing my degree near impossible
- I'm never coming back to school. This is it.
- Because it sucked
- would take too much work to relearn everything and difficult to justify the stress of five more years of school
- Because I lost significant amount of time in pandemic and even after that I feel unsafe to work

- As it became tougher I began to look at other opportunities more
- I plan to graduate but I am in no way excited about science or performing as high as my PI / department want me to. I am truly disgusted by how selfish for their careers and psychologically manipulative professors have acted in this pandemic.
- Since my bachelors' degree I have lived many situations that mentally make me think if I can actually finish my degree and the pandemic depressed me given the time out of the lab. When I came back it was very hard to catch up and still today I am affected because materials do not arrive because companies are behind in production.
- How does my research help anyone? How is it at all relevant when the world is in a state of constant change? Are my skills not better used to directly help people?
- I started to lose some faith in the academic institution, and even some of companies that I viewed as potential employers. I doubted if I wanted to stay on the track that would, seemingly, ostracize me for my views for the rest of my career.
- I felt more pressure about it
- I wanted the suffering to end, to be honest.
- Due to financial and family conditions
- I couldn't concentrate myself to write and read works to develop my research. I tried a treatment with a psychologist, but it didn't work. I was afraid of me and my family getting contaminated again.

B. 7 Other Policies or Programs that Could Help

Open-ended responses to the question, “Are there other policies or programs that might help graduate students in the chemical sciences recover from the impact of the pandemic on their careers? Please explain.” were coded into 9 categories. Many of these responses were multifaceted and coded into multiple categories.

Table B-7

Percentage Distribution of Students' Open-ended Suggestions for Policies or Programs That Could Help Pandemic Recovery

<u>Categories</u>	<u>Percent</u>
Mental health resources	4%
Acknowledgement/awareness of negative impact on graduate experiences	9%
More funding opportunities	28%
Better networking opportunities	16%
Better mentorship / academic support	13%
Extended academic / funding timelines	4%
Academic / research skill development opportunities	13%
Professional development opportunities	18%
Other/unclear	15%
DEI	7%

7a. Mental Health Resources

- Yes , mental health program
- A special session or a booth in the exhibition section at ACS Meetings dedicated to mental health awareness
- Seminars on well-being
- I think that the ACS could potentially offer ways to connect with mental health non-emergency mental health helplines. Like Better Help or Silver Line
- Yes, depending on the type of the impact, organisation of special "Summer School" courses on specific subject (ex. Get better in Lab , where major students will help the minor ones to handle better the lab equipment) might be beneficial. As well as, one-on-one, on demand, sessions with mental health professional

7b. Acknowledgement / Awareness of Negative Impact on Graduate Experiences

- I don't know how to codify this into policy per se and assume it is being generally adopted anyway but I think in many subfields, PhDs and postdocs that overlapped with the pandemic will be longer than they would have been otherwise - so the "policy" that would help is for employers not to stigmatize "long" PhDs/postdocs.
- I think policies or programs to help companies and employers change expectations for students who were in school or grad school during the pandemic would be helpful. For instance, people who were in school during the pandemic might take longer to graduate, but that is not a reflection of their abilities. I think we as grad students know this, but sometimes it feels like employers expect a certain profile when applying for jobs.
- More acknowledgment of the impact of the pandemic on student success/efficiency. As grad students, we often compare ourselves to others (not the healthiest choice). I think it would be helpful to point out that it isn't a fair comparison to compare ourselves to classes before and after the pandemic. There are tools that we had to use a modified version of or go without..
- Possibly an overall attitude change in terms of accepting that networking/interaction is not possible to the same degree for everyone, either due to health/pandemic concerns or personal reasons. Autistic academics face more barriers particularly when there is an emphasis that networking and social skills are more important than anything on CV.
- maybe not pretend the pandemic is over and actually try to implement policies that would end it and make it so that we can effectively return to developing our careers? Because any and all of the topics you previously provided for me to select from on the university, funding, and ACS levels are things I cannot ACTIVELY participate in as an immunocompromised person until the pandemic is ACTUALLY over.
- I do not foresee a way in which someone who is late in their graduate career will be able to make up for the lost time, resources, networking, etc that resulted from the pandemic. I think employers will need to remain aware that this is going to be an issue for several years to come.

- Perhaps some kind of support program for graduate students to interact in and discuss problems/issues and connect them with individuals who can help them navigate such things could be helpful.
- Advocating for change in the way we evaluate achievements as scientists. The quality of researchers is often summed up as, "X has Y papers in Z impactful journal." I understand the simplicity of such metrics in evaluating an increasing number of candidates for limited positions, but having one year of five removed from a PhD means at least a 20% reduction in what typical output from a PhD might be expected to look like. I'm not sure if the ACS has published anything (e.g. op-ed with fact/counter-fact or open statement to the field acknowledging the career impacts of an ongoing pandemic on future scientists), but it would make for a nice start in terms of helping graduate students realize they have not been handicapped by this experience.
- I think the main thing is additional opportunities to be part of the community, and more funding to be able to take that extra year to finish your PhD
- Casual networking/discussion groups regarding our experiences
- Relief for food insecurity, ie food pantry, free meal club programs. Inclusive AND trauma-informed language written into community guidelines, syllabi, code of conducts, etc.
- A program to help incoming graduate students two to three years from now adjust to and be ready for the rigors of graduate school. I have personally heard multiple accounts of whole classes of students that are two and three years behind me (those currently in their second or third year of undergraduate) still struggling to perform in chemistry classes that have already been made as simple and easy as reasonably possible. I feel that this could pose a major problem to future cohorts of graduate students and likely have effects beyond the academic and scientific communities. While outside of the scope of this question, I feel obligated to petition for another even more proactive approach than what I have previously mentioned. There should be a similar program for the current undergraduates I speak of so that this issue may be addressed as soon as possible, and reach a broader group that may or may not continue onto graduate school.

7c. Increased Funding Opportunities

- Funnel money into graduate students-cost of living is going up but stipend COL increases are pitiful. Teaching difficulties are increasing but opportunities for proper compensation are dwindling. Work with institutions to guide and enforce FAIR policies for increasing funding. For new funding opportunities, be sure that all students can be well-informed (i.e. use channels people actually use [Twitter, other social media] to spread awareness on funding opportunities, as opposed to bulk emails that are ignored)
- Honestly I think the big thing is living wages and reasonable workloads
- I feel the pandemic impacted graduate students who are supported by the department (as opposed to a funding agency) most. Support for new PIs (additional research funding, extended tenure timelines) will trickle down to also support and relieve pressure from graduate students in those labs

- Financial Support (Travel Grant's) to be able to present our work internationally at various ACS conferences.
- extended funding so we don't have to teach. I'm trying to catch up on work lost in a world that expects me to pretend like nothing happened but i lost over a year of lab time which ate into my PI's grant funding. Now were' "back to normal" and I have to teach because my grant is running out of funds to support my RA-ship. ITs hard to catch up when I have to spend ~30 hours a week TAing.
- The pandemic has resulted maybe indirectly in an increase in the cost of living for everyone. ACS should work with both universities and funding agencies to increase graduate student stipends
- Students need extra opportunities to gain presentation experiences. Students should also be given more funding, without the requirement of having previous authorship on publications as a measure of their scientific merit.
- We are seeing record inflation, yet our pay has stagnated despite increasing workloads and increased tolls on mental and physical health.
- Reduced fees or waived fees for ACS membership or subdivisions due to lack of financial support as a graduate student
- I'm especially looking for ways to meet chemistry professionals in my geographical area. Also funding to do research full-time.
- Funding is by far the biggest issue right now for me. While the pay prior to pandemic was satisfactory for my needs (although not great), the way prices have gone up has created uncertainty in my future ability to pay the bills. This is still the case even as we have received some inflation adjustment pay increases.
- Many of my lab mates were unable to go to conferences due to the pandemic, so funding to help students attend conferences would help counter this impact.
- compare graduate student stipends across top 30 programs to compel top programs to pay students more
- Universities should adopt financial policies to decrease financial insecurity and stress
- I'm not sure. I feel like most days I go to lab and come home, but with rising inflation, the school can't afford to pay us as much as we need to live in the area.
- Having extra travel funding available to students that are not able to get funding from their current institutions. This will help these students to present their research at a national conference, when they wouldn't have had the opportunity otherwise.
- Pay grad students fairly, protect them from academic bullying and from the whims of PIs
- Increase education and ACS meeting oppurtunities to students. Many students did not receive strong laboratory experinces. So we would benefit from increased lab/research opportunities along with funding to go to scientific conferences and engage with advanced/professional scientists.
- Increased stipend
- Increased funding and advocacy to help our disabled community members
- Increasing student incomes
- A requirement to be paid a livable wage.
- Increasing graduate student stipends and more rights for graduate students

- More funding
- Living wages
- More funding for students to go to conferences and maintaining/enhancing virtual network opportunities for those without funding or with health issues that preclude them from participating in traditional in-person conference events.
- Lower the membership costs for graduate students. We do not make enough money to be attending conferences and paying membership fees because of the increased financial strain from the pandemic's looming recession and inflation
- ACTUALLY committing to combating racism, sexism, misogyny, homophobia, transphobia, xenophobia, Islamophobia, ableism, and fatphobia in higher education instead of just paying lip service to it. Also continuing hybrid work programs that allow students to decide whether they are comfortable working in-person or remotely. Also increased funding, job security, and treating us like actual employees with rights.
- A movement to help increase funding for graduate students as stipends remain roughly the same and inflation is getting worse
- Financial support and more job opportunities
- Funding is the most important. Fund to travel for conferences and professional activities
- More funding and resources to help graduate students collect more data that they were not able to obtain during the pandemic
- Fair, open to all nationals funding depending on research and merit along with a supportive mentor appointment to help achieve the goal
- I think the funding opportunities to attend conferences and special sessions undertaking a technique could be beneficial to boost career development.
- Providing Funds, Grants and scholarship to graduate students in chemical Sciences and providing Job placements to students
- To pay graduate students adequately, have yearly inflation-based pay increases, provide subsidized housing. My future earning potential might be sold to a bank by me taking out a high interest loan. What's the point of a Ph.D. if I don't reap the benefits until I'm too old to earn significant money on investments?
- Can give career consultation and provide funding opportunities for future
- Funding opportunities to continue research,
- Providing paid internship in variety of majors I chemistry and collaborate with industrial companies to do so. offer scholarships and grants to all different students like undocumented and immigrants
- More funding

7d. Better Networking Opportunities

- Financial Support (Travel Grant's) to be able to present our work internationally at various ACS conferences.
- I'm especially looking for ways to meet chemistry professionals in my geographical area. Also funding to do research full-time.
- Increase education and ACS meeting opportunities to students. Many students did not receive strong laboratory experiences. So we would benefit from increased lab/research

opportunities along with funding to go to scientific conferences and engage with advanced/professional scientists.

- More funding for students to go to conferences and maintaining/enhancing virtual network opportunities for those without funding or with health issues that preclude them from participating in traditional in-person conference events.
- Possibly an overall attitude change in terms of accepting that networking/interaction is not possible to the same degree for everyone, either due to health/pandemic concerns or personal reasons. Autistic academics face more barriers particularly when there is an emphasis that networking and social skills are more important than anything on CV.
- Casual networking/discussion groups regarding our experiences
- Increased access to conferences and opportunities to meet both professionals in your field but also other graduate students outside of your department/university.
- Networking opportunities were lost/diminished with virtual events.
- networking and placement opportunities
- More Interaction with people from Industry
- Missing many in person conferences significantly limited interaction with other professionals. Hosting additional career workshops, mock interviews, and other events with professionals in the field would be helpful
- I think low-stakes social opportunities (brown-bag lunches, weekly/monthly breakfasts, etc.) could do a lot to promote discussions on science and research.
- A lot of graduate students missed out on conferences and opportunities to meet and network with other scientists in person in our field. Programs to help students share their work and network with more senior scientists would be very helpful.
- Opportunities to travel to conferences, workshops, and internships that may have been cancelled or delayed due to the pandemic
- more casual networking, no sense of cohort when you can't interact with other students
- increased amount of networking opportunities that were missed during COVID
- I think networking opportunities to help graduate students see how to best highlight the skills they have developed as a result of the pandemic (adaptability, resilience to difficult working conditions, etc.) to potential employers.
- More networking opportunities
- ACS can arrange industry focused seminar or conference
- networking opportunities with other professionals
- Greater opportunities to present and participate in conferences and assistance in finding jobs in the RnD or Industry.
- Hosting more conferences (So many of them were cancelled in the past 2 years..)

7e. Better Mentorship / Academic Support

- I feel the pandemic impacted graduate students who are supported by the department (as opposed to a funding agency) most. Support for new PIs (additional research funding, extended tenure timelines) will trickle down to also support and relieve pressure from graduate students in those labs
- Pay grad students fairly, protect them from academic bullying and from the whims of PIs

- More funding and resources to help graduate students collect more data that they were not able to obtain during the pandemic
- Fair, open to all nationals funding depending on research and merit along with a supportive mentor appointment to help achieve the goal
- Mentoring and leadership for PIs, because the lack of those two things have caused an increase in sufferage in the program
- Training professors in the basics of management of human resources, active listening and empathy. We need more humane supervisors that do not see students as a paper writing machine regardless of the global situation. There is also more training required for universities to implement science-based measures and inclusion of minorities
- Policies and programs geared towards faculty members to help them understand how to be flexible and not put chemistry first. Faculty members are at the root of why many graduate students experiences are terrible (including mine). They need to understand we are people with families and priorities that are not just our degrees. And I won 't hurt myself/health for three letters at the end of my name. They seem to think that just because they went through the same thing or that the system worked for them, then its fine. but its not. so programs and policies that focus on faculty development of being better members, and working to change the structure of programs to be graduate student oriented instead of research oriented would be helpful.
- This is a somewhat difficult question. A lot of things are uncertain, but I think having some sort of communication on "Where we go from here" that updates quarterly or bi-annually is a good start.
- I feel as though the departments are focused on only what we, students, can give them. There is no concern or advocates for the well being of graduate employees, especially now after the pandemic. Many peers have begun to support unionization. ACS and departments should publicly support all unions as it seems the only way to balance the powers
- ACS or university should more concern the relationship between PhD students and their advisors, during this pandemic, I saw more students stating have problem with their "boss", no matter the money we earn from woking in lab or teaching in classroom, "boss" are more care how many hour we stay at lab, how long of our work sheet present during group meeting. We are all facing same problems like high bill in our credit card, limited time with our relationship, long distance with our family etc. I care about my PhD, career, and of course my future. But more and more advisor they just want more grant, funding from national agency, then they push their student produce more data or some positive result. That's totally in a different way to communicate chemical science.
- Policy: New requirement for ACS accreditation - research faculty must meet certain standards of pedagogical, management, and mentorship training annually.
- To return some policies as they were before pandemic. Require advisors/professors to start coming back to work full time (Monday to Friday)
- Resources for navigating student - PI conflict
- Making supervisors learn how to help their students.

- Professors getting trained on mentoring and leading a lab - I can do all the work I can but if my PI cannot have clear expectations, has biases against POC, and has no motivation to graduate students, then it does not matter what I do. I want to ACS do programs or third party evaluations of departments and faculty and call out irresponsible behavior. A significant portion of graduate students struggling to graduate isn't because of issues they have. It is issues their PIs and department leadership have in graduating students in a timely manner with the appropriate work done.
- Tell PIs to have realistic expectations
- Any policies that address the toxicity of the PI-graduate student relationship
- Mentorship
- Mentorship programs, programs discussing publishing vs patenting, commercializing research, etc.

7f. Extended Academic /Funding Timelines

- I feel the pandemic impacted graduate students who are supported by the department (as opposed to a funding agency) most. Support for new PIs (additional research funding, extended tenure timelines) will trickle down to also support and relieve pressure from graduate students in those labs
- extended funding so we don't have to teach. I'm trying to catch up on work lost in a world that expects me to pretend like nothing happened but i lost over a year of lab time which ate into my PI's grant funding. Now were' "back to normal" and I have to teach because my grant is running out of funds to support my RA-ship. ITs hard to catch up when I have to spend ~30 hours a week TAing.
- Extended timelines of guaranteed funding
- According to our current contract with the university. We are guaranteed funding for 5 years however we lost a year due to the pandemic so I would like it if the contracts could be amended with an additional year of funding
- There is insufficient/no funding available to students whose publication timeline was delayed by the pandemic. It is a catch 22 because you need publications to be competitive for funding but it is very challenging to do publishable work without adequate funding already in place.
- I think being more generous with people's publication records or time to graduation. I know that I will go into a sixth year for my PhD and I won't have as many completed projects as I would have hoped for because I basically lost 6-8 months of real research at an important stage of my PhD to COVID related restrictions.

7g. Academic / Research Skill Development Opportunities

- Mentorship programs, programs discussing publishing vs patenting, commercializing research, etc.
- Increase education and ACS meeting oppurtunities to students. Many students did not receive strong laboratory experinces. So we would benefit from increased lab/research opportunities along with funding to go to scientific conferences and engage with advanced/professional scientists.

- Students need extra opportunities to gain presentation experiences. Students should also be given more funding, without the requirement of having previous authorship on publications as a measure of their scientific merit.
- A program to help incoming graduate students two to three years from now adjust to and be ready for the rigors of graduate school. I have personally heard multiple accounts of whole classes of students that are two and three years behind me (those currently in their second or third year of undergraduate) still struggling to perform in chemistry classes that have already been made as simple and easy as reasonably possible. I feel that this could pose a major problem to future cohorts of graduate students and likely have effects beyond the academic and scientific communities. While outside of the scope of this question, I feel obligated to petition for another even more proactive approach than what I have previously mentioned. There should be a similar program for the current undergraduates I speak of so that this issue may be addressed as soon as possible, and reach a broader group that may or may not continue onto graduate school.
- Yes, depending on the type of the impact, organisation of special “Summer School” courses on specific subject (ex. Get better in Lab , where major students will help the minor ones to handle better the lab equipment) might be beneficial. As well as, one-on-one, on demand, sessions with mental health professional
- Presentation prep, most people didnt have to do in-person presentations during the pandemic
- I wonder the degree to which the "learning loss" so well documented in K-12 classes might be present in graduate students / university students. Is there something different about the way grad school works that makes learning loss at this level different?
- I think the biggest items would be courses to help resolve any missed information and tackling the overall concept of what graduate school entails.
- Offer students who were impacted by the pandemic workshops on how incredibly important and necessary it is to work as a team and not individually
- I spent my last year of undergraduate studies during the peak of COVID era and feel like I missed some educational opportunities to learn higher-level chemistry in a better way. The workshop options listed in the previous questionnaire sounds very reasonable.
- I think the special 'catch up' instructional programs to help with missed lab/instructional experiences would be very beneficial to current undergraduate students who have not been receiving the same caliber of instruction due to the pandemic
- I believe that programs centered around building research skills in a remote environment is something that would be beneficial for students. Especially considering that even now people often will quarantine for a couple of days due to illness. There's a unique space for building how to be an effective researcher while working remotely that many could benefit from.
- Workshops regarding different instrumentation use by ACS so that students can learn more technical skills to cover up the loss in time during pandemic

- Specialized technical workshops (spectroscopies, particular synthesis or instruments etc) fully funded, to increase technical confidence if the in person lab training by senior students was thwarted by pandemic limitations
- It seems like a lot of programs (awards, workshops, etc.) are geared more so toward specific subsets of chemistry that aren't very broadly inclusive of all in chemistry.
- Autonomy in the choice of research focus where adequate supervision can be proven. 2. True interdisciplinary research
- I think the biggest hit to students was financial and educational. We need help learning the things we did not get to cover in undergrad. We are expected to have all this information for our courses and there is a huge gap in our knowledge causing us to struggle in our studies.
- "Catch up" courses would be awesome. Not only in chemistry, but also calculus, statistics, or other related topics.
- Hands on training of common and important instrumental methods to make up for previous online labs.

7h. Professional Development Opportunities

- Missing many in person conferences significantly limited interaction with other professionals. Hosting additional career workshops, mock interviews, and other events with professionals in the field would be helpful
- Opportunities to travel to conferences, workshops, and internships that may have been cancelled or delayed due to the pandemic
- Greater opportunities to present and participate in conferences and assistance in finding jobs in the RnD or Industry.
- Financial support and more job opportunities
- I think the funding opportunities to attend conferences and special sessions undertaking a technique could be beneficial to boost career development.
- Providing Funds, Grants and scholarship to graduate students in chemical Sciences and providing Job placements to students
- Can give career consultation and provide funding opportunities for future
- Providing paid internship in variety of majors I chemistry and collaborate with industrial companies to do so. offer scholarships and grants to all different students like undocumented and immigrants
- maybe not pretend the pandemic is over and actually try to implement policies that would end it and make it so that we can effectively return to developing our careers? Because any and all of the topics you previously provided for me to select from on the university, funding, and ACS levels are things I cannot ACTIVELY participate in as an immunocompromised person until the pandemic is ACTUALLY over.
- Extended 5th year or postdoc of PREP-programs
- Workshops or talks about what kind of jobs are out there with the degree they are pursuing. Not all jobs are bench lab jobs.
- More information about career opportunities
- Internships program/opportunities

- To arrange some seminars on the opportunity due to pandemic
- Encourage students by hosting one week paid internship to enhance their skills and also get used to industry environment
- I think the most important thing would be help with job placement or career transitions. I am most worried that graduating students will receive a negative bias in hiring because of our lost time in the pandemic. Some employers/universities may think that the quality or value of a PhD that was affected by or obtained during the pandemic is lower than others.
- Facilitating extended internship opportunities during the school year. For example semester long internships that would contribute towards a PhD thesis and graduation
- Help them out in achieving big career
- I don't think that instructional opportunities should be 'special'. I think that ACS should offer more technical training opportunities for students, especially since graduate programs and industry positions are becoming more interdisciplinary. It is very challenging to get all of the required training for a job just from graduate school
- Emphasis in internship opportunities that were missed altogether during pandemic
- Career mentorship programs. The pandemic really isolated a lot of graduate students.
- Yes, exchange programs will be a good one, also virtual lab experience or industrial tours to help students
- Seminars/workshops on how the pandemic changed the chemical industry landscape and (if so) how it affected tendencies in chemical market
- Programs for available job positions
- Promoting the availability of entry jobs

7i. Other- Unclear

- Yes, exchange programs will be a good one, also virtual lab experience or industrial tours to help students
- Honestly I think the big thing is living wages and reasonable workloads
- ACTUALLY committing to combating racism, sexism, misogyny, homophobia, transphobia, xenophobia, Islamophobia, ableism, and fatphobia in higher education instead of just paying lip service to it. Also continuing hybrid work programs that allow students to decide whether they are comfortable working in-person or remotely. Also increased funding, job security, and treating us like actual employees with rights.
- Perhaps some kind of support program for graduate students to interact in and discuss problems/issues and connect them with individuals who can help them navigate such things could be helpful.
- Advocating for change in the way we evaluate achievements as scientists. The quality of researchers is often summed up as, "X has Y papers in Z impactful journal." I understand the simplicity of such metrics in evaluating an increasing number of candidates for limited positions, but having one year of five removed from a PhD means at least a 20% reduction in what typical output from a PhD might be expected to look like. I'm not sure if the ACS has published anything (e.g. op-ed with fact/counter-fact or open statement to the field acknowledging the career impacts of an ongoing pandemic on future

scientists), but it would make for a nice start in terms of helping graduate students realize they have not been handicapped by this experience.

- Relief for food insecurity, ie food pantry, free meal club programs. Inclusive AND trauma-informed language written into community guidelines, syllabi, code of conducts, etc.
- Everyone at taxpayer-funded institutions who was forced under penalty of job loss to get vaccinated should get full back-pay for job time lost, any injuries obtained due to vaccination paid for, and a public apology.
- Personally, we need to get back to "In-Person" culture where many juniors like us get learned from many things
- emphasis on rebuilding the community
- Focus groups for students to discuss the impact and what we could best use.
- childcare support opportunities (childcare at conferences, grants/awards offered for parents/etc)
- work/life balance courses/seminars, as we used to only work from home and now the lines are blurred for where/when we work
- Family leave support
- All of the options listed previously might be helpful to some limited extent, which is why I didn't bother to mark any. The real problems are (i) residual pandemic policies like vaccine and booster mandates and (ii) precarious employment due to a poor job market and employer hiring strategies (e.g. favoring contingent labor). Until (i) and (ii) are solved, the rest is not going to help much.
- I'm sick of all the whining about "mental health." These were bizarre, unprecedented times, and it was totally normal to have negative emotions about it. Labeling it all as mental health problems is pathologizing perfectly normal reactions to a wildly abnormal situation and setting people up for future failure via brainwashing into thinking they are weaker than they are, defective, mentally unhealthy, whatever. Just focus on fixing the practical difficulties instead of putting bandaids on the feelings. The feelings are alarm bells that something is wrong for real. Fix THAT first and the feelings will take care of themselves.
- Work home balance for after pandemic catch up
- Let us move on from the pandemic! Stop holding it over our heads and expecting everyone to comply with stupid, not-grounded-in-science-and-reality policies.
- In the context of PRC, I don't think the problem is on universities but only being influenced by the problem. Recoveries take time even if the immunity issues on the criminals are solved.
- ***Emphasis on job placement***
- Help with research papers access
- I feel like its ok to slow down sometime in life, so motivating everyone not to think too much about the losses due to covid, rather to focus more on maintaining sound mental health and being steadily happy in the career one chooses, avoiding such lockdown outbreak should be more promoted

7j. DEI (Diversity, Equity, and Inclusion)

- ACTUALLY committing to combating racism, sexism, misogyny, homophobia, transphobia, xenophobia, Islamophobia, ableism, and fatphobia in higher education instead of just paying lip service to it. Also continuing hybrid work programs that allow students to decide whether they are comfortable working in-person or remotely. Also increased funding, job security, and treating us like actual employees with rights.
- Providing paid internship in variety of majors I chemistry and collaborate with industrial companies to do so. offer scholarships and grants to all different students like undocumented and immigrants
- Training professors in the basics of management of human resources, active listening and empathy. We need more humane supervisors that do not see students as a paper writing machine regardless of the global situation. There is also more training required for universities to implement science-based measures and inclusion of minorities
- Professors getting trained on mentoring and leading a lab - I can do all the work I can but if my PI cannot have clear expectations, has biases against POC, and has no motivation to graduate students, then it does not matter what I do. I want to ACS do programs or third party evaluations of departments and faculty and call out irresponsible behavior. A significant portion of graduate students struggling to graduate isn't because of issues they have. It is issues their PIs and department leadership have in graduating students in a timely manner with the appropriate work done.
- Possibly an overall attitude change in terms of accepting that networking/interaction is not possible to the same degree for everyone, either due to health/pandemic concerns or personal reasons. Autistic academics face more barriers particularly when there is an emphasis that networking and social skills are more important than anything on CV.
- Increased funding and advocacy to help our disabled community members
- In general, I just always hope the diversity of students on each campus is taken into consideration. Many students have gotten some help that they need, but the particular problems for students of color can be overlooked.
- Broad cultural change
- Implementing policies at ACS conferences and general assemblies that allow for at-risk and chronically ill or disabled people to attend will help everyone recover the career opportunities lost from the pandemic.
- Not having funding for only "under-represented" peoples

B.8. How Students' Plans Changed

Open-ended responses to the question, "Please explain how your plans changed." were coded into 9 categories. Many of these responses were multifaceted and coded into multiple categories.

Table B-8

*Percentage Distribution of Students' Open-ended Responses
Regarding How Their Plans Changed*

<u>Categories</u>	<u>Percent</u>
Change in research/academic interests	11%
Loss of interest in academia	42%
Increased interest in academia	4%
Longer time for degree completion	2%
Shifted academic/professional priorities	16%
Change in academic/professional opportunities	7%
Change in career plans/interests	24%
Other/unclear	10%
Other- unrelated to pandemic	3%

8a. Change in Research / Academic Interests

- It made me interested in infectious disease research. Plan on working on related research in the future, e.g. mechanisms of COVID
- I am less sure of staying in chemistry research.
- Financial stability became a priority and I shifted from pursuing a career in science policy to pursuing a career in industry. Personal science interest changes also contributed to this decision.
- Transition from more lab-based to model based research
- Wanted to get my PhD to advance in academia, but things have gotten so toxic (especially academia) I switched to focusing on getting my degree and going into industry.
- Like previously mentioned, much of the disbelief I felt my family began to have towards the sciences pushed my decisions to go into an area of chemistry more related to their disbelief.
- Now I am more focused on quality of my PhD research rather than finishing it early.
- I was going to do organic synthesis, but I have changed to chemical theory because of the pandemic..
- I switched to a different field, from synthetic chemistry to biochemistry.
- I have changed sub disciplines twice
- I decided I want to do general analytical chemistry research (as opposed to just forensic research) and do work to improve public health rather than criminal justice (i.e. work for FDA instead of FBI)
- Changed my field of interest based on the research I am doing now.
- More interested in preventing health than chemical interventions.
- I learned more about the research available to me and refined my interests
- I decided not to work on bioengineering anymore. I switched to more material research

- I was interested in academia post graduate degree, now I am much more interested in progressing science outside of the academic setting. I also had a personal change in research interest unrelated to the pandemic
- I am working on shifting specialties
- I am looking for expand my knowledge to other areas than Chemistry.
- I became more interested in computational chemistry after practicing more exotic computational techniques when I was not going in to the lab. I became more interested in an academic career because of my experience supporting junior students through hardship.
- More interested in physics so wont be doing just straight chemistry but more materials science
- Became more interested in machine learning
- I decided to switch fields and pursue my postdoc in neuroscience. I'm not sure if this was related to the pandemic
- I want to focus more on clinical research area now
- Earlier I was very excited about my research and I wanted to get involved in multiple side projects along with my PhD main project but because I lost my time during pandemic now I feel like I can't finish my primary project on time and therefore I have to cut down my other projects and I did that. Also as I couldn't manage my finances during pandemic now I want get job as soon as possible to balance back my finances.
- Increased interest in computers, coding, systems administration, and quantum computers. I also accepted that my definition of success does not have to look like everyone else's.
- Originally I was more focused on human rights, but with the pandemic and time available, I shifted to empirical confirmation of my cosmological theory, which led me to further considerations on biochemistry.
- I changed my research line to a more theoretical one to not go frequently to the university.

8b. Loss of Interest in Academia

- Wanted to get my PhD to advance in academia, but things have gotten so toxic (especially academia) I switched to focusing on getting my degree and going into industry.
- I decided to go into industry instead of academia
- I refuse to stay in academia after my degree now.
- Was wanting academia, but now I'm interested in industry
- I was thinking to go in academia but now I want to go in industry. I am realizing this now how much commitment you need in Academia after seeing my Advisor. As a girl, I want a family at some point and I believe working in industry will give me better work life balance as compared to academia.
- Earlier I wanted to pursue a career in academics. But after the pandemic I value other things in life, such as financial and employment stability. Earlier I was okay wandering

around to do 1 or even 2 post-docs and then applying for academic positions but now I want to put down my roots and settle at one place with my family.

- Have started to lean away from continuing in academia
- I really thought I wanted to be in academia, but now I am contemplating not only a career change, but a change in major and doing something not related to science
- no longer interested in academia
- Shifted away from a career in academia
- I am less interested in careers in academia
- Realized I was probably not going to be able to make a career in academia
- I am considering not going into academia due to how toxic my experience has been thus far.
- I have even less desire to stay in academia.
- Plans have not entirely changed, but the pandemic has made me consider if academia provides the opportunities and resources for people in challenging times, and if the benefits of academia are worth the costs
- I think the career plan change came because of a desire to find a better work/life balance than what I see in a lot of academia, especially during the pandemic
- I was thinking of becoming a professor but now I am looking into industry jobs since I don't think I will have a stellar CV from the look of it
- I had the aspirations of been an academic but that has changed as I plan now to go into industry after completing my program
- I am much less interested in pursuing a faculty job than I used to be.
- I used to want to teach, but after seeing how flawed and toxic academia is I just want to go into industry and make money, especially given inflation at this point.
- I used to be extremely interested in teaching students. Now that I have to worry about being infected with each interaction, I am leaning more towards a career where I can safely work with a small group of older (not college-aged) individuals.
- I was initially interested in going into academia, but now I am firmly against it. Post doc positions are grossly underpaid and overworked. It is not worth it.
- I do not want to be in academia. Industry for me. I think this pandemic has revealed many systemic problems in academia.
- I'm no longer interested in academia.
- Less likely to pursue faculty position
- I did get slightly less committed to being a professor. I was not universally impressed with how institutions of higher learning handled the pandemic. I am also realizing how severe the repercussions have been on the students I teach - they are all also traumatized, and don't have adequate support, and also are significantly worse at studying than they used to be, since they're coming out of years of inadequate remote education. Hopefully this changes soon, but it's still really disheartening and exhausting to see. It's also disheartening to see academic support staff being worked to the bone, then leave as soon as they're able because their job has become such a nightmare, then the job just gets even heavier for the staff still remaining. I've become more tempted to

go into industry - I'm now prizing stability over personal fulfillment, and industry might be more able to provide the former at the cost of some of the latter.

- Academia to industry
- Wanted academia, no longer sure that's viable given my financial situation and the job market
- I am now only considering industry, and not academia.
- Thought I wanted to be a professor, then I experienced academia during a pandemic
- No longer wish to pursue academia
- Fully convinced I don't want to teach in this environment
- I decided not to go into academia (although this likely would have occurred even without the pandemic)
- Less interested in academia due to financial insecurity
- Aimed to teach at a PUI but am now open to industry positions
- I decided that it would not be good to stay in academia, as the lack of support became more evident
- used to want to get academic job, now want industry
- I went from wanting to be a professor to working towards a career in entrepreneurship and/or consulting.
- I do not want to become a professor.
- I have shifted from wanting to work in academia to wanting to work in industry.
- I am no longer concerned about what position I get after graduation. I just want a well paying job to achieve financial stability. I originally wanted to stay in academia or find a position that was similar to my current specialization, but now I honestly do not care what I do as long as it pays well.
- Not interested in academia anymore as the environment is not supportive of women who want to have a family. I know I'm a great teacher but I'll be finishing my PhD around age 29 and doing a postdoc/early faculty work will not enable me to have a family with my partner.
- Until now I have wanted to be a professor at PUI. However, the longer I remain within academia the more disdain I grow for it. I am considering options such as academic publishing instead.
- I originally wanted to pursue a career in academia, but looking on how poor everything was handled I no longer want to be involve with academia.
- I no longer want a career in academia. I want a career in the chemical industry.
- I decided to pursue industry instead of academia. Pandemic has heightened financial stability in industry
- I wanted to be a professor, now I want to work in government or industry
- My career plans have more developed than changed. At the beginning, I thought I might be more interested in teaching but I was still open to most options. Now I'm definitely thinking industry.
- Previously had wanted to stay in academia. Became more anxious about financial stability etc, would now like to immediately enter industry, possibly even without a postdoc.

- Less interested in academia
- 2021-I was really interested in an academic post-doc after graduation. 2022-no longer interested in any academic career.
- Academia to interested in other industries
- Not as sure I want to stay in academia
- I decided not to go into academia
- I am focusing on getting a job in industry rather than continuing a career in academia.
- I want to work in admin and not professor anymore
- I plan to take an industry job, before I was thinking in the academia
- Prior to the pandemic, I was set on academia. Now I'm 50/50 between going into academia or industry. I worry that research setbacks during COVID will mar my resume if I apply for faculty jobs. I also got incredibly burned out doing research during the pandemic. Since there were no options to socialize outside of work due to social distancing guidelines, I spent basically all of my time working and didn't have much of a stress outlet outside of lab. It was very isolating and stressful to the point that after the vaccine became widely available I spent two months doing very little research and just spending time with family and friends to recover. I realized that time with family and friends is important to me, and I worry that a career in academia wouldn't allow me to prioritize that as much as a career in industry would.
- away from academia
- Industry from academia
- Plans changed from thinking about pursuing academia to industry
- I used to want to stay in academia. But the lack of financial support compared to working in the industry has made me decided to join industry after I graduate.
- There was a lot of stress for pursuing research while going through the pandemic. That changed my plans to get a job instead stay in academia
- From potential academia positions to industry.
- I thought that I would stick in academia but now my job search as expanded to both industry jobs as well as patent law.
- Changed my mind from academia to industry/national lab.
- I realized that A) I am capable of pursuing a role in academia and B) I am not interested in doing so.
- I am no longer interested in academia post-pandemic and actively do not want to have to teach in any capacity after transitioning to teaching virtually
- I initially wanted to remain in academia, but overall industry jobs in my field have become more attractive due to the introduction of remote options and more secure environment.
- I wanted to stay in academia, but now I am planning to go into industry after PhD
- Needed to look at other non-academia careers
- I wanted to pursue a lecturer position, but now I am looking more towards lab manager/tech positions.
- I have more interest in pursuing industry rather than academia
- No longer willing to continue in academia

- I decided not to go into academia
- Changed from wanting to be a chemistry professor to environmental educator
- I am tired and I am less willing to work longer hours. I went from considering academia to now only wanting an industry job.
- Plan to switch away from academia and towards industry.
- Went from pursuing academic jobs to industry
- Goals shifted from teaching as a priority to research as a priority
- I originally wanted to be a professor, but now I am exploring other career options because academia and belonging to professional societies does not necessarily align with my values
- Previously was interested in pursuing a PUI track job, now am solely interested in an industry position.
- Realized I don't want to be in academia
- I was planning to go into academic career. But I get to participate lot of online webinars on other career pathways. So I'm rethinking my career goals
- The experience made me realize that I want to prioritize a degree in industry and no longer continue in academia.
- I initially thought I definitely wanted to become faculty. Now I'm looking for jobs that would give me a better quality of life
- originally wanted to pursue a career in academia and now shifting focus towards industry
- Going into the pandemic, I wanted to go into academia. Seeing the challenges that academia faced over industry during the pandemic led me to pursue a career in industry
- Narrowed down possible career areas more by eliminating academia
- I wanted to be a chemist in academia or industry and now I want to completely change fields based on abusive and irresponsible behavior that is allowed and tolerated in academia and STEM.
- Became less sure that I want to continue into academia after seeing how expectations of the professors in my department have increased without significant additional support. Although I entered graduate school ultimately wanting to teach at a PUI, I'm now leaning more towards teaching at a community college or leaving academia altogether.
- Level of interest in staying in academia decreased
- I was previously open minded to an academic career but now I know that I NEVER want to work as a professor in a research capacity. Maybe if there was a teaching-only position open but I have almost completely soured at the idea of being stuck in academia. I hate it so much and I can't wait to graduate.
- I no longer want to pursue academia
- Leaning towards going into industry vs. academia
- Leaned away from a position in academia
- Not wanting to go into academia anymore

- I now want to be dead. Jk. But like chemistry aint it. And why teach highschool when I have so much education under my belt?? I should be financially independent not making entry level teacher pay. That's literally ðŸ’ ðŸ’©. Never wanted to teach.
- My initial career plan was to be a college instructor, but it has now changed to working in industry.
- Wanted to go into academia, after dealing with students plagiarizing and not caring during covid I lost interest and became mentally drained from teaching.

8c. Increased Interest in Academia

- I became more interested in computational chemistry after practicing more exotic computational techniques when I was not going in to the lab. I became more interested in an academic career because of my experience supporting junior students through hardship.
- Went from only thinking about joining the industry to also looking at staying in academia
- I don't love research, I am much more interested in teaching and embracing that human interaction.
- I became more interested in careers in academia and less interested careers in industry. This was not related to the pandemic
- I think undergraduates were done a disservice and I am now interested in teaching
- I initially did not know what I wanted to do when I graduated undergraduate school and when the pandemic hit I thought graduate school would be better than finding a job to figure out what I wanted to do. Since I have been teaching, I learned that I want to teach at the college level for a career.
- I realized I don't want to deal with the stress of having a research faculty position, and am now aiming toward a teaching-only position.
- I got a chance to teach online, and I like it. I didn't get much chance to do research, so that isn't my focus any more. I think I may go to teach full time, instead of a dual role.
- Before I wanted to go into industry but now I'm considering academia and establishing a collaboration between academia and nonprofit organizations to make education accessible to disadvantaged youth.
- I was more interested in industry jobs now I've developed an interest in academia.

8d. Longer time for Degree Completion

- I will probably have to stay in graduate school longer to make up for the time I lost due to the pandemic
- Time to degree increased
- Graduation got delayed.
- I initially planned to graduate by December 2022 but due to the delay caused by the pandemic, I now have to graduate by Summer of 2023

- Many opportunities has been missed due to delay in Ph. D completion. So the plans has been changed. I wish to pursue post doc. But due to financial constraints, I am ready to join in academic for the needs.

8e. Shifted Academic / Professional Priorities

- I was thinking to go in academia but now I want to g in industry. I am realizing this now how much commitment you need in Academia after seeing my Advisor. As a girl, I want a family at some point and I believe working in industry will gove me better work life balance as compared to academia.
- Earlier I wanted to pursue a career in academics. But after the pandemic I value other things in life, such as financial and employment stability. Earlier I was okay wandering around to do 1 or even 2 post-docs and then applying for academic positions but now I want to put down my roots and settle at one place with my family.
- I used to want to teach, but after seeing how flawed and toxic academia is I just want to go into industry and make money, especially given inflation at this point.
- I did get slightly less committed to being a professor. I was not universally impressed with how institutions of higher learning handled the pandemic. I am also realizing how severe the repercussions have been on the students I teach - they are all also traumatized, and don't have adequate support, and also are significantly worse at studying than they used to be, since they're coming out of years of inadequate remote education. Hopefully this changes soon, but it's still really disheartening and exhausting to see. It's also disheartening to see academic support staff being worked to the bone, then leave as soon as they're able because their job has become such a nightmare, then the job just gets even heavier for the staff still remaining. I've become more tempted to go into industry - I'm now prizing stability over personal fulfillment, and industry might be more able to provide the former at the cost of some of the latter.
- I am no longer concerned about what position I get after graduation. I just want a well paying job to achieve financial stability. I originally wanted to stay in academia or find a position that was similar to my current specialization, but now I honestly do not care what I do as long as it pays well.
- Prior to the pandemic, I was set on academia. Now I'm 50/50 between going into academia or industry. I worry that research setbacks during COVID will mar my resume if I apply for faculty jobs. I also got incredibly burned out doing research during the pandemic. Since there were no options to socialize outside of work due to social distancing guidelines, I spent basically all of my time working and didn't have much of a stress outlet outside of lab. It was very isolating and stressful to the point that after the vaccine became widely available I spent two months doing very little research and just spending time with family and friends to recover. I realized that time with family and friends is important to me, and I worry that a career in academia wouldn't allow me to prioritize that as much as a career in industry would.
- Goals shifted from teaching as a priority to research as a priority
- I initially thought I definitely wanted to become faculty. Now I'm looking for jobs that would give me a better quality of life

- I wanted to be a chemist in academia or industry and now I want to completely change fields based on abusive and irresponsible behavior that is allowed and tolerated in academia and STEM.
- I now want to be dead. Jk. But like chemistry aint it. And why teach highschool when I have so much education under my belt?? I should be financially independent not making entry level teacher pay. That's literally 80% of what I want. Never wanted to teach.
- Financial stability became a priority and I shifted from pursuing a career in science policy to pursuing a career in industry. Personal science interest changes also contributed to this decision.
- Now I am more focused on quality of my PhD research rather than finishing it early.
- Earlier I was very excited about my research and I wanted to get involved in multiple side projects along with my PhD main project but because I lost my time during pandemic now I feel like I can't finish my primary project on time and therefore I have to cut down my other projects and I did that. Also as I couldn't manage my finances during pandemic now I want to get a job as soon as possible to balance back my finances.
- Increased interest in computers, coding, systems administration, and quantum computers. I also accepted that my definition of success does not have to look like everyone else's.
- I changed my research line to a more theoretical one to not go frequently to the university.
- It made me think about what my real passion is and what's important in life. And titles and money started to matter less.
- I started the pandemic in industry and when everything went south I applied to grad school because I realized how little satisfaction I got from manufacturing.
- I have further clarified my career plans after graduation
- I, for the first time, considered getting a job
- Greater desire to find a career that would not be affected by any future pandemics
- My PI implied that I wasn't cut out for being a postdoc, and I got increasingly exhausted with grad school. I now just want a nice job out of grad school
- I learned that there was a lot I was missing out on in my home life, and I became more dedicated to having a career where my friends and family are put first.
- Field or position aren't important anymore but economic and contractual stability since the person is not valued anyway
- The pandemic made me realize that in times of need, your career will not fulfill you aside from providing financial stability. While I am finishing my degree, I don't find it worth it to be as ambitious as I used to be.
- I think it was more of an emphasis on why was I doing this degree. I think I would likely have had this change regardless of the pandemic. Also the pandemic gave me a chance to interact with roommates and other people's work life and I saw how academia demands much and gives almost nothing

- Started dating someone during the pandemic and recently married so career aspirations are less appealing to me now than when I started the program versus other life goals with my spouse.
- I am considering going into industry for a healthier lifestyle
- The ability to find work-from-home jobs has increased post-pandemic. Now I am looking for opportunities to work remotely.
- I came to do PhD due to changes because of covid
- I was considering staying in the US very seriously. But due to significant homesickness and disconnect I feel on a daily basis now, I have no willpower to expend extra energy to still be treated like an outsider who doesn't understand most references made in daily conversation. I'm considering going back to my home country after my PhD more seriously
- I didn't plan to take PhD at the beginning but I decided to go for it during the pandemic.
- I am not hopeful that I can find a job in the chemical sciences that is flexible with my care-taking duties. I have also had to decide between starting my PhD project over or drop the PhD to an MS which has changed my options for a career.
- More because of the financial side of things I want a more stable, less risky job
- I am looking now for more flexible jobs with remote aspects.
- The aspiration of wanting to earn more
- I had always imagined myself in biotech or pharma industry, but I had no idea what exactly I wanted to focus on research wise. Now I know what motivates me and which companies I would like to apply to for jobs.
- I think I was able to better identify my interests and lock in on areas where I really want to spend my time and energy moving forward.
- I have become more receptive of creating multiple income and financial security streams instead of relying on the conventional method. This has impacted my pursuit of science in some way that I will have to gauge other personal factors alongside.

8f. Change in Academic / Professional Opportunities

- Earlier I wanted to pursue a career in academics. But after the pandemic I value other things in life, such as financial and employment stability. Earlier I was okay wandering around to do 1 or even 2 post-docs and then applying for academic positions but now I want to put down my roots and settle at one place with my family.
- I have become more receptive of creating multiple income and financial security streams instead of relying on the conventional method. This has impacted my pursuit of science in some way that I will have to gauge other personal factors alongside.
- Many opportunities has been missed due to delay in Ph. D completion. So the plans has been changed. I wish to pursue post doc. But due to financial constraints, I am ready to join in academic for the needs.
- I was thinking of becoming a professor but now I am looking into industry jobs since I don't think I will have a stellar CV from the look of it
- Wanted academia, no longer sure that's viable given my financial situation and the job market

- Wanted to have a career in epa or air quality or post doc but no way to network
- It changed less in that I changed what exactly I was intending to do post-graduation, but more so in what my potential opportunities might be after graduation, whether due to the new situation we all find ourselves in, or due to the inability to network as I might have been able to were the pandemic not to occur.
- The company and research institutes stop investing the fundamental study of chemistry because they are also having trouble in their finance
- I believe the chances to find a job decreased a lot
- Didn't get the opportunity to pursue my career plans because of covid
- The whole environment of career gradually become more and more competitive
- Feel hopeless to find a good faculty position in US and tend to go back to homeland
- Future career location changed to back home to care for parents
- Because of I didn't have chance to involve in neutron experiments, now I'm becoming a computationalist instead of experimentalist..
- I plan to do my postdoc after graduating, but I need to reconsider this as there are less positions or grants offered.
- Realization that, partially due to disability, it will be very challenging for me to have both children and the career in academia I want

8g. Change in Career Plans / Interests

- It changed less in that I changed what exactly I was intending to do post-graduation, but more so in what my potential opportunities might be after graduation, whether due to the new situation we all find ourselves in, or due to the inability to network as I might have been able to were the pandemic not to occur.
- Future career location changed to back home to care for parents
- Financial stability became a priority and I shifted from pursuing a career in science policy to pursuing a career in industry. Personal science interest changes also contributed to this decision.
- The ability to find work-from-home jobs has increased post-pandemic. Now I am looking for opportunities to work remotely.
- I am not hopeful that I can find a job in the chemical sciences that is flexible with my care-taking duties. I have also had to decide between starting my PhD project over or drop the PhD to an MS which has changed my options for a career.
- I had always imagined myself in biotech or pharma industry, but I had no idea what exactly I wanted to focus on research wise. Now I know what motivates me and which companies I would like to apply to for jobs.
- Went from only thinking about joining the industry to also looking at staying in academia
- I don't love research, I am much more interested in teaching and embracing that human interaction.
- I became more interested in careers in academia and less interested careers in industry. This was not related to the pandemic

- I realized I don't want to deal with the stress of having a research faculty position, and am now aiming toward a teaching-only position.
- There was a lot of stress for pursuing research while going through the pandemic. That changed my plans to get a job instead stay in academia
- Changed from wanting to be a chemistry professor to environmental educator
- Narrowed down possible career areas more by eliminating academia
- I was interested in academia post graduate degree, now I am much more interested in progressing science outside of the academic setting. I also had a personal change in research interest unrelated to the pandemic
- Originally I was more focused on human rights, but with the pandemic and time available, I shifted to empirical confirmation of my cosmological theory, which led me to further considerations on biochemistry.
- Seeing how americans treated scientists during the pandemic made me not want to enter science communications for a career
- I have experienced the field of entrepreneurship and this is something I am planning to explore.
- I have opened up to the possibility of going into industry
- I have been looking for more science adjacent jobs
- no longer wanted to work in a research setting as a career
- I don't plan on getting a job in chemistry after I get my PhD
- Before, I was interested in research. Now I may look into simply teaching or industry.
- I was interested in a career in forensic science, now I will settle for any career in science.
- I now feel like a career in the research and development space may not be an interest to me which was my main reason to attend graduate school.
- Interested in working in alternative protein rather than biopharmaceuticals
- I'm less interested in being a research professor and more interested in doing industry or lecturing instead
- I intend to spend the bare minimum of time working in industry or a similar field rather than continuing on with research as originally planned
- Originally I had wished to work for a large chemical corporation but now I desire something more personal.
- Less interested in continuing to pursue a career in chemistry
- I dont intend to be a chemist for my entire career. I love chemistry and my field but its disgusting to hear how peers are treated and looked over. It makes more sense to branch out as soon as possible.
- I want to choose an industrial path after the graduate studies
- I no longer really have career aspirations
- I am more unsure than ever if I want to use my PhD at all
- I am thinking to omprove my skills and try other fields
- I want to go into science policy now instead of going on to a research position after grad school
- I want to be a teaching professor instead of R1
- Industry right away instead of post-doc

- Again, nothing to do with the pandemic, but rather my career path shifted due to my graduate school experience in general
- I don't want to work in a lab any more
- it is getting harder to get a job from industry, I probably consider to work as a postdoc
- There's no way I would like to continue staying in research.
- Prior to last year, I was completely unaware of post-PhD options besides academia and industrial R&D. About a year ago, I learned about numerous other alternatives and have since decided a career in science policy will be a significantly better fit for me.
- I will no longer be seeking employment as a post-doc or in a research lab.
- I am now considering starting my own business instead of going into industry.
- I started looking into policy careers
- during that time I was awarded a fellowship and now I am interested in pursuing a career at a national lab
- Originally I wanted to pursue a career at NASA. Due to the work I've done in my department with advocating for graduate student wellbeing, I have now been considering entering into law or human rights.
- Considered working in technical roles post-grad and becoming an expert in my field. Now, want to move as far away from any lab-setting as possible.
- I lost interest in continuing to do research in my future career.
- I am no longer dead set on a professional field. I could definitely see myself finishing up the PhD only because I am already so far in, and then doing something completely different.
- I started to consider work on the industry instead a postdoc
- I realized I may not want to teach in a virtual environment
- I found my passion for DEI and helping other students, specifically minorities to excel in STEM and higher education
- Greater interest in health sciences. Less interest in capitalistic structures.
- I came up with better ways to go about self development and I changed my career goals.
- I wanted R1 now I want PUI

8h. Other/Unclear

- Was still considering options (early stage in program), but time out of the lab allowed me to participate in some workshops and trainings that helped me decide (building collapse related, not due to the pandemic actually)
- Chemistry doesn't seem as stable or fun as it did.
- I became less confident in my original plans
- I'm only considering a narrow geographic region; if I can't get a chemistry job near my brother, I will work in some other field
- From last experience in my master
- I got more interested in the science happening in the US
- work remotely

- I realized that the scientific community is in an echo chamber and not full of free thinkers
- Just some rethinking of what I want my future to be
- Plans are increasingly uncertain
- Due to the negative effects on the economics, now I would take the local economics and policy for COVID into consideration when applying a job.
- I want to get out of the Chemistry field
- Decided to leave the United States and pursue a career in my home country
- The overall economic and circumstances changed and turn bad.
- For reasons stated earlier, I have had to become more "open-minded," to use HR-speak, about future employment.
- Came to USA for phd
- The plan was delayed
- I made plans to move to the USA
- My interest in biomedical applications of natural products increased

8i. Other- Unrelated to Pandemic

- I became more interested in careers in academia and less interested careers in industry. This was not related to the pandemic
- I was considering staying in the US very seriously. But due to significant homesickness and disconnect I feel on a daily basis now, I have no willpower to expend extra energy to still be treated like an outsider who doesn't understand most references made in daily conversation. I'm considering going back to my home country after my PhD more seriously
- Not because of the pandemic, but research is going well, so I thought maybe I would work in a national laboratory
- Change was not related to pandemic, but to better understanding what I want in a job.
- Nothing to do with pandemic
- I don't think it was due to the pandemic. Plans change as you mature and grow in experience.

B. 9. How the Pandemic Affected Students and Their Future in the Chemical Sciences

Open-ended responses to the question, "Feel free to use the space below to expand upon how the pandemic affected you personally and how this might impact your future in the chemical sciences." were coded into 13 categories. Many of these responses were multifaceted and coded into multiple categories.

Table B-9

Percentage Distribution of Students' Open-Ended Responses to How the Pandemic Affected Them Personally and Their Future in the Chemical Sciences

<u>Categories</u>	<u>Percent</u>
Neg financial reasons	26%
Neg social/ isolation	1%
Loss of productivity/academic progress	37%
Neg mental health/stressors	42%
Neg physical health affected	9%
New childcare/caretaking responsibilities	3%
Neg familial affects	6%
Neg professional/career affects	17%
No neg affect	2%
Pos affect reported	8%
Neg affect routine/livelihood	12%
Neg view of field/scientists	5%
Other/vague	10%

9a. Negative Financial Stressors

- 2 person household operating on a grad student stipend due to hiring freezes,
- After having COVID multiple times I was forced to miss work which set me behind for graduation. Family members passed away forcing me to drive home (5 hours away). My partner lost their job and relied on me as the main financial provider for months, the impact of that is something we are still struggling to overcome. The stress and mental impacts have forced me to seek treatment for a debilitating anxiety order.
- After pandemic, the cost of living sky-rocketed due to inflation whereas there was no increase in stipend.
- As an international student, the pandemic and its impact on global political and economic status has increased my financial burden regarding traveling internationally and living abroad. They also stirred more mental health issues and physical health issues
- b*****, iâ€™m broke af
- Cost of living and food is very high. Itâ€™s difficult to sustain anything as a graduate student on food stamps.
- Cost of living and healthcare are the major stressors. Rent and costs has exponentially grown in the past two years while salary has remained the same effectively cutting the amount of time I have for research and myself. My productivity has severely decreased when I have had had to contact university law team every year to sue a new landlord or take on extra jobs so you can pay to eat.
- Did not exercise as often, stressed as my experiments were delayed and had more financial responsibilities

- Due to inflation, my financial concern has grown worse over time.
- Due to the lockdown in the country during this period, my siblings, and other members of the family including myself were forced to stay at home in order not to contact the virus and during this period, the care-responsibility increased and there was not enough finances to foot these bills and life became worst because even the food was barely enough to take care of the family, so most times we resorts to allowing the younger ones eat most meals and this made my physical health to be threaten. And after the pandemic, the family business crashed and uptil now we are still suffering the impact of the pandemic. Issues of tuition fees has become a problem for me including my siblings, who are still in their high school. So i must confess Life has been hard and dropping out of school is the solution for now since we barely feed talkless of paying tuition
- During the pandemic, I had to start taking care of my father who fell ill. This hard mentally and physically on myself and my family. During this time the cost of living has been increasing, and finding places to live on a grad student wage has been difficult. This along with student loans have been a big stressor in my day-to-day life outside the lab.
- Extra costs made living/paying rent harder. Mental health deteriorated quite a bit during the pandemic itself. This has placed a shadow over my career moving forward.
- Finances were not meant causing stress due to the universoty not meeting the salary to survive, mental due to the more hostile environment in lab as well as with instructors, NO actual help with menatl health and used against you, and overall no one really focusing on someone who is struggling ans used it against them.
- Financial concerns for sure, as an international grad student on a stipend, things have just been more difficult since interest rate went up. My mental health was not great during the pandemic itself, but it's been better over time. My major concern is how much time I lost during the pandemic of work in the lab, which can makes me look as a weak candidate for a post-doc position
- From a mental health perspective, I had almost no interaction with students going through the same program (in my case during first year). I had no idea of my standing in the program in comparison to others and more importantly found it difficult to make connections in a virtual format. Financially, the rapid rise in inflation has significantly eaten into my comparatively small stipend. While I had some money saved for emergencies, that is now in jeopardy of going towards rent, groceries, and other basic necessities it really shouldn't go towards.
- Funding source are decreased and available faculty positions are decreased
- Given the additionally financial strains incurred on me during the pandemic I no longer view a career in chemical sciences a viable option to me, in regards to staying in the place I want to live. This consequently has increased stress on my mental health.
- I feel more concern about the future and also the living cost increases yet the salary stays the same
- I had familial and financial obligations which increased due to the pandemic. This compelled me to spend more time tending to those duties, instead of focusing on my research responsibilities.

- I have taken a 20 percent pay drop since starting due to inflation
- I was an essential worker in a mRNA development center so I started dealing with pandemic stress in January 2020. Increased food costs, gas price increases, and now increased rent all while grad stipends stay the same mean that I am essentially consistently taking pay decreases has caused me immense financial difficulty to the point that I am not sure I can afford to stay in grad school even though my tuition is covered and I have a stipend.
- I'm anxious, and so is everyone I know. Since I started grad school 4 years ago, my cost of living (rent, groceries, gas) is up more than 20%, but my stipend is lower (even before adjusting for inflation). Gotta eat to do chemistry...
- Inflation and other financial contrasts have made living on a graduate student income much harder
- Inflation makes budget tighter than usual.
- Inflation post-pandemic has made life more expensive
- Inflation.
- It got me down mentally and financially
- It's really tempting to leave graduate school for a job making real money to help deal with increased cost of living
- Largely, the pandemic isolated me for the first years of my graduate school experience. I moved across the country in the middle of the pandemic, and it worsened many of my anxieties around social interactions. This has overall made it difficult for me to re-enter these spaces with confidence and has overall weakened my confidence in my ability as a researcher. Fiscally, these issues have been closer related to the recent inflation issues and relatively stagnant pay, which is related but not entirely caused by the pandemic.
- My father passed away in July 2020 because of the COVID-19. My father's death impacted my life and my family's life financially more than I can say in words. My father was admitted to a hospital in July'2020 and passed away after two weeks. It cost our family more than \$11,000. I have been sending \$1000/semester since then, from my savings to support my mother and to take care of the things back at home. We had to borrow quite an amount of money to pay for the hospital bills, despite all the effort we put, we could not save my father. I am married and I need to support my wife also. The two past years were very stressful because of my financial situation and the events associated with it. Right now, I financially support my wife, my mother in India, and myself from the savings I have. Any help will help me to focus more on completing my graduate studies/research by next year which also mean I can get a job, become financially stable and take care of my family.
- My husband lost his job during the pandemic so we were living off my stipend and despite everyone saying "no one wants to work" the only job application of his that has been accepted was for a part time manual labor position with no benefits. We also have a small immunocompromised child at home so we have to act as if every sneeze or cough around us could be COVID but everyone else wants to move on and stop wearing masks. In our local area there's been an uptick in COVID cases again but no one is taking any precautions any more its just become up to the individual.

- My motivation for research and my interest in the chemical sciences has dwindled because of the personal stressors caused by the pandemic. I have little motivation because I am drained due to mental health struggles, but must work regardless in order to keep up with finances. I feel forced to work more to keep up financially, rather than working because I want to. This mindset has caused me to develop a disdain for the chemical sciences that I don't think will ever fully dissipate.
- Our institution refuses to increase stipends to keep up with cost of living increases associated with the work-from-home needs or the resulting inflation. I have had to take out additional jobs to afford food which will diminish my ability to be a competitive candidate after graduation.
- Our rent has been significantly fluctuating. This leaves me much less wiggle room in terms of budget from day-to-day. Therefore, I can't typically allow myself to be flexible if an experiment runs long / fails / etc.
- Pandemic increased the prices of almost everything which caused a financial burdens. Also the supply chain of many things has broken which results in timely unavailability of necessary items.
- prices were dramatically inflated due to pandemic but my pay never increased
- Shortages and inflation have greatly affected me.
- The amount of grant funding at a federal level was decreased, making the chances of our lab getting a grant decrease. Therefore, we have not had money brought into the lab and my funding has gotten tight. University support (financial) is not enough to have a livable wage and it made me understand why people are willing to leave school without finishing a degree.
- The cost of inflation driven partially by the pandemic is now making it difficult to continue living on the stipend provided. Additionally, the university is under increased strain, and thus is pressured to keep the stipend at pre-pandemic levels
- The financial support did not increase with increasing cost of living, so my financial support effectively decreased
- The graduate stipend has not increased to respond to the massive inflation during/following the pandemic, so most graduate students are significantly financially strained
- The growing rate of inflation has completely outpaced any sort of increase in compensation at my university. And then Since the pandemic I have experienced severely decreased focus and frequent bouts of high anxiety.
- The increase of goods in the area has made cost of living much more expensive, but the stipend we receive went only up to the next tax bracket meaning we end up with the same money to cover for costs.
- The Pandemic affected my family income significantly. That's why I need to see my whole family now including my mother and sister. Also, the expenses has increased significantly which is very tough to manage with Grad fund
- The pandemic and how poorly UCR pays has made it impossible for me to advance my life in any meaningful way that doesn't directly benefit the UC system. Many of my

nongraduate peers are already buying houses and getting married, but not me, not for many years to come.

- the pandemic brought more responsibilities in term of care taking and financially but that has been my source of motivation to complete my program in due time
- The pandemic fully committed me into chemical theory because I was able to continue undergraduate research and successfully get admitted to graduate school; however, post-pandemic inflation is making it unsustainable to attend graduate school
- The pandemic slowed our research to a crawl, my advisor became unresponsive, and it's definitely pushed back my graduation by a year which is stressful because we don't make a lot of money as grad students.
- The university doesn't pay us a wage high enough to cover cost of living in this town. The department does not support its graduate students
- unsure if financial support will be lost/harder to renew since pandemic has unexpected/hidden costs, government may divert money from basic grants to covid related research or covid response measures
- Wages don't match inflation
- Our pay at Arizona State has barely increased over the pandemic while the cost of living in our area has increased by >15% over the past two years. Doing a Ph.D. has a high opportunity cost associated with it, your 20's are the best years to be investing and not only am I not able to invest I am on the verge of having to take out loans to live, and many of my colleagues already have..
- With much less certainty in access to resources, poor stipend and less savings, less financial security in terms of savings and jobs, mental health is a constant struggle alongside physical vulnerability.
- Financially it cut down all my fellowship from government. I couldn't able to revive that. So without financial support i supposed to complete my Ph. D. Hopefully I am looking for my career after this. But now also i couldn't able to get any financial support from supervisors for my postdoc due to this pandemic
- It affected me by delaying my academic pursuit and also in the area of finance.
- I cant afford to be a graduate student. For half a cart of groceries we spend close to \$200. Financial and mental stress are boiling over.
- In the graduate program the act of "always thinking about your research, even in the background" is considered necessary to succeed. This requirement for success is in direct contrast with the global results of the pandemic: food and financial scarcity and stress, losses of support systems, and other destabilizing results of the traumatic stress we all collectively experienced.
- Staying at home for 2 years doomed me to obesity, slowing down my career progress, loosing few of my relatives due to covid and financial insecurity. I got fund for two projects in material chemistry but couldn't work on any one of these, due to the confusions and restrictions of covid. I feel sad to think of this fact that I could have done some interesting research works or working on my own ideas and obviously could have explored more about my research interest and potentials, if covid was not there.....

- With the current rate of inflation, living on a graduate student stipend has become increasingly difficult. Also, having worked in industry post-pandemic (prior to beginning my graduate studies), I could see the toll it had on company finances, job openings, and supply chain issues.
- The pandemic has affected my family and I by increasing my care-taking responsibilities and financial insecurity. Prices of basic necessities have risen drastically throughout the pandemic and continue to do so making it difficult to meet daily needs, which has been detrimental to my mental health. Often, institutions do not take into account these extenuating circumstances and only focus on their academics and finances. It has been very difficult to pursue my graduate degree in the chemical sciences, something that I have been very passionate about, in these circumstances where institutions are not offering the flexibility needed during this time.
- no employment therefore no money
- I lost my job during the pandemic. This depleted my savings and I have never really been able to catch up due to now being in a recession. I am just feeling more secure knowing that I do not have to worry about job security and that I have opportunities to make more money through scholarships and fellowships.
- At first it had a negative impact mentally which resulted in negative impacts in education. Then healing came. The negative financial impact, however, persisted.
- Due to financial concerns, Working part time while being a full time graduate student greatly affected my ability to give my 100% in my research.
- I think that the pandemic really disrupted the economy and I wish that I could be paid more as a graduate student now.

9b. Negative Social/Isolation

- A couple of occasions I had to Isolate away from classes and lab work because I was in contact with a Covid 19 positive individual or I was ill
- Allowed me less to branch out for friends and support systems outside of my immediate work environment because of close hobby clubs and "fear" of including new people in social bubbles
- Because of the pandemic I was unable to travel or see my family. I felt cut out from the rest of the world and that led to loneliness
- Being forced to stay out of the lab for 6 months and not knowing when I was able to return was mentally exhausting. I stayed at home and didn't leave my house for all of those months. The lack of sun, the removal of a daily routine, and the minimization of socialization risk forced me into a bad mental and thus physical state. I eat when I am stressed and I became obese in graduate school, but the tip of the iceberg was having a gallstone attack and having to have surgery when we were out of lab because of the pandemic.
- Due to pandemic I have become an introvert from an ambivert I was. This affects me as I developed imposter syndrome. I could not learn new techniques from my seniors because we lost interaction in lab during pandemic and now they all graduated

- During the period of the pandemic there were no social or academic meetings or gathering, interaction with colleagues on researches and collaboration weren't attainable. So during this period i was a sit at home would could build herself, her career and achieve her goals.
- During these year of pandemic, I'm more prefer not go out with my lab mate, I feel maybe go out with other people is not necessary to me. I also spend more time on other things, like driving to travel(alone) or play more video game and watch more dram show to reduce my pressure on myself about research.
- From a mental health perspective, I had almost no interaction with students going through the same program (in my case during first year). I had no idea of my standing in the program in comparison to others and more importantly found it difficult to make connections in a virtual format. Financially, the rapid rise in inflation has significantly eaten into my comparatively small stipend. While I had some money saved for emergencies, that is now in jeopardy of going towards rent, groceries, and other basic necessities it really shouldn't go towards.
- hard to say if it is the pandemic or just grad school, but anxiety, loneliness, depression
- I was extremely isolated during the pandemic. The isolation has taken a huge toll on my mental health. There were times when I felt unsupported and alone. It was also extremely hard to meet people because graduate school has not had any events.
- I almost quit graduate school because I felt so isolated and depressed during the pandemic.
- I am immuno-compromised, so it has been difficult trying to balance being safe for my health with the networking/in-person event/social aspects of grad school. Also, the pandemic started in the first year I was planning on attending my first conferences, which resulted in them either being canceled or moved to a virtual platform. I did not have any opprotunity to present/network in person at a conference until 2022 at the end of my graduate studies.
- I entered grad school in 2020 at the peak of lockdown. Moving to a new city alone can be quite lonely, but doing so in a time where your social interaction is limited (for a good reason obviously) made me feel so isolate and lonely at times.
- I had a period of loneliness and depression which decreased my productivity and lagging behind with work further exacerbated that. Also I didnâ€™t have chance to attend any conferences in person. One got canceled (2021) and the second one (2022) was virtual. So I havenâ€™t met anyone from my discipline even though Iâ€™m fourth year graduate student at this point.
- I have lost social skills needed to network.
- I lost connections with my community and those around me, my anxiety and agoraphobia increased massively, and I feel any progress I had made before the pandemic mentally was lost and now I have to learn to be an operational human again
- I lost two years of development as a researcher - particularly in terms of how to speak to other researchers in a professional sense and how to feel connected to the field. As I am in theory close to graduating I feel far more connected to the non-chemical fields

and extracurriculars that I was more able to be part of during the pandemic than the professional chemical field.

- I moved for grad school in 2020, and didn't know anyone in the new city
- I now socialize less than I did before. But I also drink less.
- I struggled with mental health pre-pandemic, but the pandemic made it worse and very difficult to do tasks needed for graduate school. I also could not be in lab for several months and lost valuable time learning skills and making progress on my projects. Additionally, I was not really able to interact with fellow students or my PI which hurt my development as a scientist.
- I think the forced isolation placed those with already existing mental health issues at a greater risk and there was no university-wide response for this. All the focus went to in-person activities but they failed to realize the great mental toll this type of isolation would have on the mind of not just adults but also children. This experience made me value the in-person interactions that we are able to have and has pushed me into a more community-outreach mindset to maintain human interactions.
- I used to be a much more social person, but now suffer from some social anxiety. I get stage fright when I present now and have a hard time networking
- I work from home a lot as I finish my degree. I feel like I lost out on a lot of networking events (conferences, informal meetings) that make me feel less prepared as I get ready to enter my career.
- Impacted social skills long term
- Initially, I think I felt the strain of lack of in-person interaction. But after the vaccine rollout, it has improved
- It has negatively affected social interactions, and I feel like I am 2 years behind in making social connections (both personal and professional)
- It reduced the chances of interacting with other students/colleagues, and it might influence the following job application.
- It was a tough time trying to move around the country from undergrad to grad all while remaining quarantined and alone. A very isolating experience that affected mental health and social skills
- It was more of not having much people around but was able to do my research work.
- It was my first year to UMN, and I needed to get rested against anxiety maybe by meeting people in campus. But the pandemic didn't allow me for it. I had to be isolated in my apartment with my unfriendly roommate. Since I entered my PhD program, I didn't have anyone to know, interact with, and spend time with - except for my psychiatrist
- Lack of ability to network
- lack of in-person events made networking more difficult or less than pre-pandemic
- Largely, the pandemic isolated me for the first years of my graduate school experience. I moved across the country in the middle of the pandemic, and it worsened many of my anxieties around social interactions. This has overall made it difficult for me to re-enter these spaces with confidence and has overall weakened my confidence in my ability as a

researcher. Fiscally, these issues have been closer related to the recent inflation issues and relatively stagnant pay, which is related but not entirely caused by the pandemic.

- My mental health really dropped due to the stress and lack of socialization at the beginning of the pandemic. My social web still hasn't really recovered from this. My mental health has improved, since then but I could see it affecting my motivation to pursue and maintain my career.
- My personality changed and sometimes I'm scared to talk to other people.
- Our department relies heavily on interpersonal relations outside the lab to stay in touch with other peers. The pandemic reduced social interaction to a minimum, thus limiting scope for me to learn cultural cues as an international student and become a part of the informal lives of my colleagues where I would hear more about their daily lives and academic struggles, thus limiting my growth in some way
- Our school took the first two years of covid pretty seriously, restricting almost 100% of contact with people outside of our household. Many of us live with random roommates who also attend the school, so it was extremely hard on me for a while. Losing so much time in lab and then being on a shift schedule for a year really put me behind on my research. I was also going through advancement during May-July 2020 and I just had such a hard time, leading to years of not really feeling like I was successful in that process. Overall, while it has made me a more thoughtful and balanced scientist, the pandemic really hit me and some of my labmates pretty hard in how much science we could actually get done.
- Pandemic decreased the sense of community in PhD programs and this made it feel lonely at times.
- Staying home was a large mental challenge, I was removed from all areas of my life I enjoyed, including research experiences. I feel that the pandemic slowed my progress as a scientist. If there was no shutdown I could have achieved many more things,. I lost time for research, I have no authorship on any papers, and I have no experience giving presentations at conferences. I feel this will negatively impact my eligibility for future opportunities like fellowships.
- The isolation early in the pandemic was a toll on my mental health. I sustained a concussion later on, which made working remotely impossible. The lost lab time caused some research project directions and collaborations to be lost, which has significantly impacted the trajectory of my dissertation.
- The pandemic brought a lot of anxiety forward for me. I felt quite isolated and hopeless and worry for my family who are in PA (while I am in MS). It has led to a deeper perspective of anxiety that I have not been able to shake.
- The pandemic made coming in to work really hard because there was little motivation to do so. Slower progress combined with minimized interactions with peers left me to struggle with research.
- the pandemic removed any in-person meetings, interactions, lab recruitment events, visitations, in person interviews, lab rotations, campus and department visits, and all the very important social and educational events that are normally at the beginning of the graduate career. I personally became to know how important it is to have these events

to expose the graduate students to all the research and career opportunities within the program. without these events, graduate students are left to fend for themselves and make relatively blind decisions that will have profound impacts on their careers.

- The pandemic was a very isolating experience for me. Moving to graduate school during the summer of 2020 meant difficulty in connecting with others in my program.
- The sense of loneliness (both personal and in work) I think has negatively impacted me and the level of interest in research
- The social isolation and lack of tangible productivity while in grad school has led to pretty severe anxiety issues with being able to graduate with a fully rounded CV.
- There are definitely less social interactions among chemists in the department. However, I like how I can easily virtually attend seminars at different institutions.
- We will be forever the generation that had a big hole in their CV due to lack of interaction and a significant slowdown in all activities regarding training
- When pandemic was at it peak I was still a second year graduate student, learning new things in my lab. Many senior students didnot get chance to do any in-person conferences and meetings. Due to which I never talked to people who have had same experience before me when I went to last ACS meeting. I think due to pandemic, people did not experience lot of things which could have been great learning experience for them. I think listening to people's experience is really helpful for me because I can picture myself in that situation and think through things before that happen.
- At the time, I lived alone so it was difficult to have social interactions causing my mental illnesses to become worse.
- In the graduate program the act of "always thinking about your research, even in the background" is considered necessary to succeed. This requirement for success is in direct contrast with the global results of the pandemic: food and financial scarcity and stress, losses of support systems, and other destabilizing results of the traumatic stress we all collectively experienced.
- I wouldn't quite say that I am 100% like I was pre-pandemic, but I am doing much better now that I am interacting more with other people and not so isolated. The pandemic has made me enjoy being at home and not interacting as much as other people though.
- I felt pretty isolated during the pandemic and it was definitely a struggle to make connections.

9c. Loss of Productivity / Academic Progress

- A couple of occasions I had to Isolate away from classes and lab work because I was In contact with a Covid 19 positive individual or I was ill
- A sudden and unexpected increase in responsibilities and independent work during and after the pandemic has really contributed to physical and mental burnout with my personal projects and lab work in general
- After having COVID multiple times I was forced to miss work which set me behind for graduation. Family members passed away forcing me to drive home (5 hours away). My partner lost their job and relied on me as the main financial provider for months, the

impact of that is something we are still struggling to overcome. The stress and mental impacts have forced me to seek treatment for a debilitating anxiety disorder.

- Childcare has become more expensive and more limited making it difficult to have time to work on school and career development. For the future, this lack of childcare means that I am limited to part-time work which is difficult to find in the chemical sciences.
- Cost of living and healthcare are the major stressors. Rent and costs has exponentially grown in the past two years while salary has remained the same effectively cutting the amount of time I have for research and myself. My productivity has severely decreased when I have had to contact university law team every year to sue a new landlord or take on extra jobs so you can pay to eat.
- COVID-19 affected my heart, and as such, I had a heart monitor surgically implanted. I was no longer able to perform NMR experiments because there would be an issue with the magnetic field and my monitor. By not being to perform NMRs, I was reliant on other researchers and decreased the time periods that I could perform certain reactions..
- Delayed my ability to be in lab and do research, and to make progress on my work.
- Did not exercise as often, stressed as my experiments were delayed and had more financial responsibilities
- Didn't work in lab for almost a year and hence had difficulties getting the skills back leading to a big loss of time
- Due to pandemic I have become an introvert from an ambivert I was. This affects me as I developed imposter syndrome. I could not learn new techniques from my seniors because we lost interaction in lab during pandemic and now they all graduated
- Due to the pandemic, lab work was halted and/or delayed significantly. This adds to the pressure of trying to graduate on time, as I am trying to catch up, while still accomplishing new feats.
- during the pandemic, I was in Iran and that time I looked for admission to universities and IELTS exam , and everything was canceled due to COVID and postponed to another time. these things have a very bad effect on my mind.
- Financial concerns for sure, as an international grad student on a stipend, things have just been more difficult since interest rate went up. My mental health was not great during the pandemic itself, but it's been better over time. My major concern is how much time I lost during the pandemic of work in the lab, which can make me look as a weak candidate for a post-doc position
- Have greater feelings of imposter syndrome due to slowed progress from the pandemic. Feelings of anxiety about defense and job prospects were not alleviated by the current situation post-pandemic.
- Have to spend more time tutoring my children at home
- Having to manage situations where research and graduate school has been delayed to a certain point, there is an impact in my future to when I will graduate.
- I almost waste one year because of the pandemic, I am still getting used to the affect.

- I became so used to not working round the clock and it took me a while to get back to being productive and this was a negative feed back look. Needed to go to therapy to get out of this
- I believe i lost a great deal of lab hours and possibility to grow due to the pandemic. This gap in my phd would not be fulfilled in the future in terms of publication and etc in career preparation.
- I face additional stress in the face of degree progression delays and knowing I may take longer to achieve goals or will suffer from lack of preparation for next career steps
- I feel minimally affected by the pandemic directly, but the pandemic indirectly caused a number of long-term issues in my lab (needed a service visit for an instrument, only qualified tech is internationally based, couldn't get him into the US until long after we were back in lab) which has lead to a broad feeling of being behind where I should or could be.
- I found it very difficult to concentrate on research for the first year of the pandemic, and consequently my progress stalled and I have never quite recovered the lost momentum. My publication record is thinner than I hoped it would be.
- I had a period of loneliness and depression which decreased my productivity and lagging behind with work further exacerbated that. Also I didn't have chance to attend any conferences in person. One got canceled (2021) and the second one (2022) was virtual. So I haven't met anyone from my discipline even though I'm fourth year graduate student at this point.
- I had familial and financial obligations which increased due to the pandemic. This compelled me to spend more time tending to those duties, instead of focusing on my research responsibilities.
- I had one semester of my undergraduate career online and I had to miss my in person physical chemistry lab. I was also taking a medicinal chemistry class that semester which was switched to online. I didn't have reliable access to internet and that semester of my education suffered because of it.
- I lost a lot of research time in my first year so i felt less prepared professionally and as a researcher. I felt that some of my qualification exams were not the best as i didnt have time to develop them. It also took longer to form important relationships with faculty and students
- I lost two years of development as a researcher - particularly in terms of how to speak to other researchers in a professional sense and how to feel connected to the field. As I am in theory close to graduating I feel far more connected to the non-chemical fields and extracurriculars that I was more able to be part of during the pandemic than the professional chemical field.
- I missed my opportunity to work on neutron science experiments that I was planning to use as my career field
- I personally experiences a lot of feelings of stress and anxiety before, during and after the pandemic. These feelings especially went through a series of highs and lows throughout the pandemic as we were experiencing a lot of unforeseen changes. The pandemic definitely slowed things down on a number of fronts both academically and

personally. Since the pandemic, feelings of burnout have been intensified, however it is hard to say if this is directly related to the pandemic.

- I struggled with mental health pre-pandemic, but the pandemic made it worse and very difficult to do tasks needed for graduate school. I also could not be in lab for several months and lost valuable time learning skills and making progress on my projects. Additionally, I was not really able to interact with fellow students or my PI which hurt my development as a scientist.
- I think it made me feel impatient as I have lost time towards my degree, a feeling that may not have been present if I had had a more traditional experience
- In the start it was just fear, but later it turned into depression and waste of time. Staying home caused obesity and depression
- It has caused a severe hit to my motivation
- It's very complicated. In a lot of ways my mental and physical health have improved to levels even better than before the pandemic. However, that is largely due to very personal circumstances that don't necessarily reflect the general experience. I do get tired quicker and need more rest still than before the pandemic. Working from home has given me the flexibility to take care of my health but has also caused a lot of anxiety and guilt as I often felt that I was not working enough. The personal circumstances which resulted in my mental health improving significantly also carry a high probability of negatively impacting my career.
- I've had COVID three times, which has kept me out of work and feeling unhealthy quite a bit. But I did benefit from completing a project related to COVID as part of my PhD research.
- Lack of experiments and instrument time slowed down research
- Literally not sure if I want to continue in my degree based on this and the stress I am now under due to university policies not really changing timelines and still expecting the same out of me even though 6 months of my degree was essentially lost.
- My brother's health failed and I became his primary caretaker/financial support; I am taking more time to graduate and considering leaving the field so I can be close to and care for him
- My husband (a fellow chemistry graduate student) passed away from a heart attack due to the long-term effects of COVID. I took a 2-month break from the program to take care of him in the hospital, and then arrange his memorial and grieve. This time severely diminished my research progress, and I feel I lost a lot of my previous knowledge/skills during the time outside of the lab and the grieving period afterwards.
- My mental health has tanked and I feel like I am behind my peers and younger students due to the timing of when this pandemic hit.
- My mental health was severely impacted by the pandemic. It's improved slightly since things are returning to normal, but I'm still significantly more anxious, depressed, and generally strange than I was before. At the moment, I'm functioning alright because most of the people around me are in the same boat, but I worry that my concerns won't be taken seriously as I progress further in my career. How will someone with all this baggage ever be a better candidate for jobs than someone who is more functional,

whose brain didn't snap in half two years ago? My memory has also severely worsened, as has my attention span, so I also just feel like a significantly worse chemist than I used to be - I'm having a harder time keeping up with the literature and thinking of how to execute new reactions.

- My motivation for research and my interest in the chemical sciences has dwindled because of the personal stressors caused by the pandemic. I have little motivation because I am drained due to mental health struggles, but must work regardless in order to keep up with finances. I feel forced to work more to keep up financially, rather than working because I want to. This mindset has caused me to develop a disdain for the chemical sciences that I don't think will ever fully dissipate.
- My physical health has deteriorated from the stress of the pandemic and graduate school. I now have chronic pain issues that affect my working hours and abilities. As well as mental health issues that do the same.
- My PI doesn't take into account the effect of the pandemic, and complains that students in the lab are not as productive as before. He doesn't realize the effect it had on graduation timelines of most students. Consequently I am getting a poorer recommendation letter from him
- My program has a 5-year cap, and I am behind due to the pandemic. I feel like I should have had more time to develop my professional prospects
- Not to have time to do research
- Our institution refuses to increase stipends to keep up with cost of living increases associated with the work-from-home needs or the resulting inflation. I have had to take out additional jobs to afford food which will diminish my ability to be a competitive candidate after graduation.
- Our rent has been significantly fluctuating. This leaves me much less wiggle room in terms of budget from day-to-day. Therefore, I can't typically allow myself to be flexible if an experiment runs long / fails / etc.
- Our school took the first two years of covid pretty seriously, restricting almost 100% of contact with people outside of our household. Many of us live with random roommates who also attend the school, so it was extremely hard on me for a while. Losing so much time in lab and then being on a shift schedule for a year really put me behind on my research. I was also going through advancement during May-July 2020 and I just had such a hard time, leading to years of not really feeling like I was successful in that process. Overall, while it has made me a more thoughtful and balanced scientist, the pandemic really hit me and some of my labmates pretty hard in how much science we could actually get done.
- Pandemic affected on my personality as I started worrying about my research development and was pretty stressed at the beginning of COVID.
- Physical and mental health problem affect the productivity of my work.
- Research opportunities
- Research time was lost, so less data for dissertation
- Since due to lockdown, campus was closed for almost 1.3 years, due to which my research work was hampered

- Since the pandemic I have lost many relatives and loved ones from either COVID complications or other illnesses and I wasn't even able to mourn their deaths properly due to closed funeral services. I was responsible for making sure my parents who are elder and smokers got everything they needed by going to the store for them. I was dealing with a lot of stress and mental instability and my work productivity was definitely negatively impacted and never fully got restored.
- Starting a graduate program in the fall of 2020, there was so much uncertainty in everything. Starting from orientation, which was sloppily thrown together for virtual orientation. The university did allow the majority of our classes to meet in-person, and that was beneficial. However, once we transitioned to virtual learning, it was much more difficult to concentrate on coursework. Our department also changed various policies and procedures, seemingly because of the pandemic, but I'm not privy to that information. The changes to structural parts of our program throws off what plans a graduate student can come to expect.
- Staying home was a large mental challenge, I was removed from all areas of my life I enjoyed, including research experiences. I feel that the pandemic slowed my progress as a scientist. If there was no shutdown I could have achieved many more things. I lost time for research, I have no authorship on any papers, and I have no experience giving presentations at conferences. I feel this will negatively impact my eligibility for future opportunities like fellowships.
- The amount of grant funding at a federal level was decreased, making the chances of our lab getting a grant decrease. Therefore, we have not had money brought into the lab and my funding has gotten tight. University support (financial) is not enough to have a livable wage and it made me understand why people are willing to leave school without finishing a degree.
- The first year the pandemic hit, the University essentially went virtual and coming in to do research was an "at your own risk/comfort level". My PI helped set up research rotations to limit the number of people in the lab and potential exposures and they understood students not being comfortable coming in to do research. The first year was actually a benefit to my mental health because for the first time I could finally focus and implement a good work life balance. I felt like I was finally able to manage and work on my mental health issues. However when the University started ramping back up my PI and the university tried playing it like nothing happened and we were all able to be as productive during the shutdown compared to pre-pandemic times which was and is incredibly stressful. Now a year later I feel like I'm still trying to play catchup. This takes a MAJOR toll on my mental health.
- The growing rate of inflation has completely outpaced any sort of increase in compensation at my university. And then since the pandemic I have experienced severely decreased focus and frequent bouts of high anxiety.
- The halt in research activities during the beginning of the pandemic has held back my degree progression by more than the simple time away from the lab, such that it can't be truly measured. The inability to attend conferences to present research in person

and network with potential employers or postdoc mentors has detrimentally affected my future prospects post-graduation.

- The isolation early in the pandemic was a toll on my mental health. I sustained a concussion later on, which made working remotely impossible. The lost lab time caused some research project directions and collaborations to be lost, which has significantly impacted the trajectory of my dissertation.
- The most affected is the mental health because of added anxiety regarding graduation and grad requirements. I feel like I do not have much time to complete my requirements and my adviser wants me to graduate next year because he cannot support me after that.
- The pandemic changed the lab staffing hours. Instead of 8 hours a day, we had to work 10 hour days and four days a week, with no 3 days off in a row. We added weekends to our schedule. This was a poor move because we could not fully rest when we did not have three full days off in a row. It affected how lab results were reported and often other people had to finish work someone else started. It was a poor business decision for a lab environment.
- The pandemic eradicated my confidence as a researcher and will delay my graduation. I lost a lot of my love of science and feel less motivated to succeed.
- The pandemic led to isolation when I was just starting my program. I am still not quite over it and have many down days that affect my motivation. I still feel like I haven't gotten my old self and old work ethic back.
- The pandemic made coming in to work really hard because there was little motivation to do so. Slower progress combined with minimized interactions with peers left me to struggle with research.
- the pandemic removed any in-person meetings, interactions, lab recruitment events, visitations, in person interviews, lab rotations, campus and department visits, and all the very important social and educational events that are normally at the beginning of the graduate career. I personally became to know how important it is to have these events to expose the graduate students to all the research and career opportunities within the program. without these events, graduate students are left to fend for themselves and make relatively blind decisions that will have profound impacts on their careers.
- The pandemic slowed our research to a crawl, my advisor became unresponsive, and it's definitely pushed back my graduation by a year which is stressful because we don't make a lot of money as grad students.
- The pandemic worsened my anxiety for a period of time, and this made it difficult to be productive.
- The social isolation and lack of tangible productivity while in grad school has led to pretty severe anxiety issues with being able to graduate with a fully rounded CV.
- too many years away from school and difficult to return
- usual issues about work progress and research , plus planning on graduation and job searches!
- We will be forever the generation that had a big hole in their CV due to lack of interaction and a significant slowdown in all activities regarding training

- What did I even bleeping learn in those online classes? I needed that information. I remember very little of it.
- With my homosexual marriage, the pandemic further prolonged the time for the already difficult intergovernmental processes with one side of strict suppressions. Also this has impacted on my possibilities of getting real laboratory experiences.
- It affected me by delaying my academic pursuit and also in the area of finance.
- The increased vigilance about mask wearing and social distancing have worn on my mental health. Additionally, with pandemic slowing businesses some of the donors for grants have slowed down in their funding. One of my research grants got cancelled.
- I was unable to carry out research during the lockdown, this has affected my research output
- Because the pandemic, i delay my graduate school entrance.
- Taking courses online did not ensure me as much confidence about my subject as I would've liked, so this has made me have to put in more effort to learn since the start of grad school.
- I was supposed to do my undergrad research in 2020-2021 but I couldn't b/c pandemic. I feel less prepared as a result
- The biggest effect the pandemic had on me was a lack of practical, physical, working knowledge of the laboratory that is necessary to succeed in graduate school.
- Staying at home for 2 years doomed me to obesity, slowing down my career progress, losing few of my relatives due to covid and financial insecurity. I got funded for two projects in material chemistry but couldn't work on any one of these, due to the confusions and restrictions of covid. I feel sad to think of this fact that I could have done some interesting research works or working on my own ideas and obviously could have explored more about my research interest and potentials, if covid was not there.....
- So i started my masters in my home country but we could never have any equipment or chemicals delivered on time so it delayed my degree to 3 years. By the time i got admission in US i was so anxious about my masters degree
- In addition to general upward trend of mental health problem severity, I have also felt like I have lost the ability to perform some non-physical tasks at the same level as I could previously. Tasks include reading literature and less scientific writing, both of which seem to take me longer and have worse performance than before and during the first year of the pandemic.
- Delayed enrollment in my current program due to transplant surgery during the pandemic
- Pandemic has set back my plans about my career. It has cost me a couple of years primarily by taking a toll on my mental health and set my preparations of joining a grad school back by couple of years.
- The pandemic has affected my family and I by increasing my care-taking responsibilities and financial insecurity. Prices of basic necessities have risen drastically throughout the pandemic and continue to do so making it difficult to meet daily needs, which has been detrimental to my mental health. Often, institutions do not take into account these extenuating circumstances and only focus on their academics and finances. It has been

very difficult to pursue my graduate degree in the chemical sciences, something that I have been very passionate about, in these circumstances where institutions are not offering the flexibility needed during this time.

- At first it had a negative impact mentally which resulted in negative impacts in education. Then healing came. The negative financial impact, however, persisted.
- The pandemic limited my chances to partake in research and physical labs.
- Due to financial concerns, Working part time while being a full time graduate student greatly affected my ability to give my 100% in my research.
- The pandemic delayed my enrollement year to graduate school by two years and i feel this has delayed my future goals and directions in my career

9d. Negative Mental Health / Stressors

- A sudden and unexpected increase in responsibilities and independent work during and after the pandemic has really contributed to physical and mental burnout with my personal projects and lab work in general
- After having COVID multiple times I was forced to miss work which set me behind for graduation. Family members passed away forcing me to drive home (5 hours away). My partner lost their job and relied on me as the main financial provider for months, the impact of that is something we are still struggling to overcome. The stress and mental impacts have forced me to seek treatment for a debilitating anxiety order.
- As an international student, the pandemic and its impact on global political and economic status has increased my financial burden regarding traveling internationally and living abroad. They also stirred more mental health issues and physical health issues
- Because of the pandemic I was unable to travel or see my family. I felt cut out from the rest of the world and that lead to loneliness
- Being forced to stay out of the lab for 6 months and not knowing when I was able to return was mentally exhausting. I stayed at home and didn't leave my house for all of those months. The lack of sun, the removal of a daily routine, and the minimization of socialization risk forced me into a bad mental and thus physical state. I eat when I am stressed and I became obese in graduate school, but the tip of the iceberg was having a gallstone attack and having to have surgery when we were out of lab because of the pandemic.
- Burn out makes me want to quit
- Burnout. No longer interested in academia.
- Cost of living and healthcare are the major stressors. Rent and costs has exponentially grown in the past two years while salary has remained the same effectively cutting the amount of time I have for research and myself. My productivity has severely decreased when I have had had to contact university law team every year to sue a new landlord or take on extra jobs so you can pay to eat.
- depressed
- Did not exercise as often, stressed as my experiments were delayed and had more financial responsibilities
- Due to inflation, my financial concern has grown worse over time.

- Due to pandemic I have become an introvert from an ambivert I was. This affects me as I developed imposter syndrome. I could not learn new techniques from my seniors because we lost interaction in lab during pandemic and now they all graduated
- Due to the lockdown in the country during this period, my siblings, and other members of the family including myself were forced to stay at home in order not to contact the virus and during this period, the care-responsibility increased and there was not enough finances to foot these bills and life became worst because even the food was barely enough to take care of the family, so most times we resorts to allowing the younger ones eat most meals and this made my physical health to be threaten. And after the pandemic, the family business crashed and uptil now we are still suffering the impact of the pandemic. Issues of tuition fees has become a problem for me including my siblings, who are still in their high school. So i must confess Life has been hard and dropping out of school is the solution for now since we barely feed talkless of paying tuition
- During the pandemic, I had to start taking care of my father who fell ill. This hard mentally and physically on myself and my family. During this time the cost of living has been increasing, and finding places to live on a grad student wage has been difficult. This along with student loans have been a big stressor in my day-to-day life outside the lab.
- during the pandemic, I was in Iran and that time I looked for admission to universities and IELTS exam , and everything was canceled due to COVID and post poned to another time. these things have a very bad effect on my mind.
- Extra costs made living/paying rent harder. Mental health deteriorated quite a bit during the pandemic itself. This has placed a shadow over my career moving forward.
- Finances were not meant causing stress due to the university not meeting the salary to survive, mental due to the more hostile environment in lab as well as with instructors, NO actual help with mental health and used against you, and overall no one really focusing on someone who is struggling and used it against them.
- Financial concerns for sure, as an international grad student on a stipend, things have just been more difficult since interest rate went up. My mental health was not great during the pandemic itself, but it's been better over time. My major concern is how much time I lost during the pandemic of work in the lab, which can makes me look as a weak candidate for a post-doc position
- From a mental health perspective, I had almost no interaction with students going through the same program (in my case during first year). I had no idea of my standing in the program in comparison to others and more importantly found it difficult to make connections in a virtual format. Financially, the rapid rise in inflation has significantly eaten into my comparatively small stipend. While I had some money saved for emergencies, that is now in jeopardy of going towards rent, groceries, and other basic necessities it really shouldn't go towards.
- Given the additionally financial strains incurred on me during the pandemic I no longer view a career in chemical sciences a viable option to me, in regards to staying in the place I want to live. This consequently has increased stress on my mental health.
- hard to say if it is the pandemic or just grad school, but anxiety, loneliness, depression

- Have greater feelings of imposter syndrome due to slowed progress from the pandemic. Feelings of anxiety about defense and job prospects were not alleviated by the current situation post-pandemic.
- high risk and chronically ill students such as myself now have to manage the social and professional implications of pandemic mitigation. Wearing a mask signals that I am chronically ill and my risk level for attending most seminars and classrooms is incredibly high. I worry about discrimination in the job market.
- I was extremely isolated during the pandemic. The isolation has taken a huge toll on my mental health. There were times when I felt unsupported and alone. It was also extremely hard to meet people because graduate school has not had any events.
- I almost quit graduate school because I felt so isolated and depressed during the pandemic.
- I am currently teaching high school chemistry to be able to take care of my father, who has blood clots and a pacemaker now from COVID, and my autistic brother. Not fun. I hate it here.
- I became so used to not working round the clock and it took me a while to get back to being productive and this was a negative feedback loop. Needed to go to therapy to get out of this
- I definitely feel more burnt out.
- I developed an eating disorder during the pandemic because of the stress of my graduate program, life, and pandemic concerns. I now have to monitor how much I eat because I lost weight so quickly. I'm also now on multiple anti-anxiety medications to ensure that I am able to function in graduate school as if nothing happened to me or those I know during the pandemic
- I don't know, I'm just a lot more scared of public places now. And my brain hasn't been the same since before I had covid last January. It's just rough. The exhaustion placed on society to have to justify the existence and significance of a threat to national health has killed my drive to understand people with differing views.
- I entered grad school in 2020 at the peak of lockdown. Moving to a new city alone can be quite lonely, but doing so in a time where your social interaction is limited (for a good reason obviously) made me feel so isolate and lonely at times.
- I face additional stress in the face of degree progression delays and knowing I may take longer to achieve goals or will suffer from lack of preparation for next career steps
- I feel minimally affected by the pandemic directly, but the pandemic indirectly caused a number of long-term issues in my lab (needed a service visit for an instrument, only qualified tech is internationally based, couldn't get him into the US until long after we were back in lab) which has lead to a broad feeling of being behind where I should or could be.
- I feel more concern about the future and also the living cost increases yet the salary stays the same
- I feel very anxious about most things (social life, physical health, work performance) nowadays - this became apparent at some point during the pandemic, but hasn't gone away.

- I found that my sleeping schedule has been drastically changed. I assume this has to do with mental health, lack of exercise, and more screen-time, which were all heavily affected by the pandemic.
- I got covid two times, which affected my mental and physical health
- I had a period of loneliness and depression which decreased my productivity and lagging behind with work further exacerbated that. Also I didn't have chance to attend any conferences in person. One got canceled (2021) and the second one (2022) was virtual. So I haven't met anyone from my discipline even though I'm fourth year graduate student at this point.
- I have found that my anxiety has risen, which has made it challenging to continue to pursue my career goals.
- I have had to rethink if chemistry is for me after having some mental health struggles brought on by the pandemic.
- I have significant more social anxiety
- I have started overthinking and I have started thinking more about the negative outcomes of my experiments rather than focus on positive ones.
- I lost connections with my community and those around me, my anxiety and agoraphobia increased massively, and I feel any progress I had made before the pandemic mentally was lost and now I have to learn to be an operational human again
- I personally experiences a lot of feelings of stress and anxiety before, during and after the pandemic. These feelings especially went through a series of highs and lows throughout the pandemic as we were experiencing a lot of unforeseen changes. The pandemic definitely slowed things down on a number of fronts both academically and personally. Since the pandemic, feelings of burnout have been intensified, however it is hard to say if this is directly related to the pandemic.
- I started off my experience in labs with stacked schedule. While I could learn to be independent and make decisions, I developed anxiety from being out of control of certain situations. I believe it will take some time for me to be a team player and a confident in my decisions.
- I struggled with mental health pre-pandemic, but the pandemic made it worse and very difficult to do tasks needed for graduate school. I also could not be in lab for several months and lost valuable time learning skills and making progress on my projects. Additionally, I was not really able to interact with fellow students or my PI which hurt my development as a scientist.
- I think my anxiety and stress from the pandemic has only increased because now I see incoming students adjusting to graduate school better even though I still cannot.
- I think the forced isolation placed those with already existing mental health issues at a greater risk and there was no university-wide response for this. All the focus went to in-person activities but they failed to realize the great mental toll this type of isolation would have on the mind of not just adults but also children. This experience made me value the in-person interactions that we are able to have and has pushed me into a more community-outreach mindset to maintain human interactions.

- I used to be a much more social person, but now suffer from some social anxiety. I get stage fright when I present now and have a hard time networking
- I was an essential worker in a mRNA development center so I started dealing with pandemic stress in January 2020. Increased food costs, gas price increases, and now increased rent all while grad stipends stay the same mean that I am essentially consistently taking pay decreases has caused me immense financial difficulty to the point that I am not sure I can afford to stay in grad school even though my tuition is covered and I have a stipend.
- I'm pretty sure the pandemic broke my brain
- I'm anxious, and so is everyone I know. Since I started grad school 4 years ago, my cost of living (rent, groceries, gas) is up more than 20%, but my stipend is lower (even before adjusting for inflation). Gotta eat to do chemistry...
- In the start it was just fear, but later it turned into depression and waste of time. Staying home caused obesity and depression
- increase anxiety and impostor syndrome
- Inflation and other financial contrasts have made living on a graduate student income much harder
- It affected me in such a way that I had to go to therapy and mental health services for 1.5 years after the pandemic until getting better.
- It got me down mentally and financially
- It was a pressure to the mental health
- It was a tough time trying to move around the country from undergrad to grad all while remaining quarantined and alone. A very isolating experience that affected mental health and social skills
- It's hard to say whether it was just the pandemic or the general geopolitical situation, but I feel pretty gloomy about everything right now.
- Largely, the pandemic isolated me for the first years of my graduate school experience. I moved across the country in the middle of the pandemic, and it worsened many of my anxieties around social interactions. This has overall made it difficult for me to re-enter these spaces with confidence and has overall weakened my confidence in my ability as a researcher. Fiscally, these issues have been closer related to the recent inflation issues and relatively stagnant pay, which is related but not entirely caused by the pandemic.
- Literally not sure if I want to continue in my degree based on this and the stress I am now under due to university policies not really changing timelines and still expecting the same out of me even though 6 months of my degree was essentially lost.
- made me jaded, will be difficult to keep on going like this
- More stress, memory loss, trouble focusing none of this is good for my future
- My brother's health failed and I became his primary caretaker/financial support; I am taking more time to graduate and considering leaving the field so I can be close to and care for him
- My father passed away in July 2020 because of the COVID-19. My father's death impacted my life and my family's life financially more than I can say in words. My father was admitted to a hospital in July'2020 and passed away after two weeks. It cost our

family more than \$11,000. I have been sending \$1000/semester since then, from my savings to support my mother and to take care of the things back at home. We had to borrow quite an amount of money to pay for the hospital bills, despite all the effort we put, we could not save my father. I am married and I need to support my wife also. The two past years were very stressful because of my financial situation and the events associated with it. Right now, I financially support my wife, my mother in India, and myself from the savings I have. Any help will help me to focus more on completing my graduate studies/research by next year which also mean I can get a job, become financially stable and take care of my family.

- My husband (a fellow chemistry graduate student) passed away from a heart attack due to the long-term effects of COVID. I took a 2-month break from the program to take care of him in the hospital, and then arrange his memorial and grieve. This time severely diminished my research progress, and I feel I lost a lot of my previous knowledge/skills during the time outside of the lab and the grieving period afterwards.
- My mental health has tanked and I feel like I am behind my peers and younger students due to the timing of when this pandemic hit.
- My mental health issues prior to the pandemic included a massive fear of germs and of hurting people I care for. So a worldwide pandemic was basically the perfect storm of real-life events that seriously challenged my health and views of the world. My family doesn't actually believe there is a pandemic, so ties have been strained and discussions can be far more intense and stressful than ever before, especially as a chemist. It personally bothers me to the point that I've basically shifted my interest to searching for jobs in areas of chemistry that involve ideas my family doesn't believe to be true or even exist.
- My mental health really dropped due to the stress and lack of socialization at the beginning of the pandemic. My social web still hasn't really recovered from this. My mental health has improved, since then but I could see it affecting my motivation to pursue and maintain my career.
- My mental health was severely impacted by the pandemic. It's improved slightly since things are returning to normal, but I'm still significantly more anxious, depressed, and generally strange than I was before. At the moment, I'm functioning alright because most of the people around me are in the same boat, but I worry that my concerns won't be taken seriously as I progress further in my career. How will someone with all this baggage ever be a better candidate for jobs than someone who is more functional, whose brain didn't snap in half two years ago? My memory has also severely worsened, as has my attention span, so I also just feel like a significantly worse chemist than I used to be - I'm having a harder time keeping up with the literature and thinking of how to execute new reactions.
- My physical health has deteriorated from the stress of the pandemic and graduate school. I now have chronic pain issues that affect my working hours and abilities. As well as mental health issues that do the same.
- Our lab adopted a shift schedule to accommodate occupancy restrictions. For six months, I was only allowed to be present in the lab between 3:00pm-3:00am. I

petitioned my advisor once a month for six months to be changed to the day shift, but was denied each time. Other students began bullying me because of my lack of research progress; they also worked together to preserve their own spots on the day shift and make sure I stayed on the night shift.

- Our school took the first two years of covid pretty seriously, restricting almost 100% of contact with people outside of our household. Many of us live with random roommates who also attend the school, so it was extremely hard on me for a while. Losing so much time in lab and then being on a shift schedule for a year really put me behind on my research. I was also going through advancement during May-July 2020 and I just had such a hard time, leading to years of not really feeling like I was successful in that process. Overall, while it has made me a more thoughtful and balanced scientist, the pandemic really hit me and some of my labmates pretty hard in how much science we could actually get done.
- Pandemic affected on my personality as I started worrying about my research development and was pretty stressed at the beginning of COVID.
- Physical and mental health problem affect the productivity of my work.
- Since the pandemic I have lost many relatives and loved ones from either COVID complications or other illnesses and I wasn't even able to mourn their deaths properly due to closed funeral services. I was responsible for making sure my parents who are elder and smokers got everything they needed by going to the store for them. I was dealing with alot of stress adn mental instability and my work productivity was definitely negatively impacted and never fully got restored.
- Starting a graduate program in the fall of 2020, there was so much uncertainty in everything. Starting from orientation, which was sloppily thrown together for virtual orientation. The university did allow the majority of our classes to meet in-person, and that was beneficial. However, once we transitioned to virtual learning, it was much more difficult to concentrate on coursework. Our department also changed various policies and procedures, seemingly because of the pandemic, but I'm not privy to that information. The changes to structural parts of our program throws off what plans a graduate student can come to expect.
- The effect of the pandemic on my mental health has diminished, but not to pre-pandemic levels.
- The first year the pandemic hit, the University essentially went virtual and coming in to do research was an "at your own risk/comfort level". My PI helped set up research rotations to limit the number of people in the lab and potential exposures and they understood students not being comfortable coming in to do research. The first year was actually a benifit to my mental health because for the first time I could finally focus and implement a good work life balance. I felt like I was finally able to manage and work on my mental health issues. However when the University started ramping back up my PI and the university tried playing it like nothing happened and we were all able to be as productive during the shutdown compared to pre-pandemic times which was and is incredibly stressful. now a year later I feel like I'm still trying to play catchup. This takes a MAIJOR toll on my mental health

- The growing rate of inflation has completely outpaced any sort of increase in compensation at my university. And then Since the pandemic I have experienced severely decreased focus and frequent bouts of high anxiety.
- The isolation early in the pandemic was a toll on my mental health. I sustained a concussion later on, which made working remotely impossible. The lost lab time caused some research project directions and collaborations to be lost, which has significantly impacted the trajectory of my dissertation.
- The mental repercussions of the pandemic are still under progress despite programs expecting our mental health to bounce back just as quick as guidelines and policies have. It is a slow process that is undermined by some when I mention that my mental improvement is still in progress
- The most affected is the mental health because of added anxiety regarding graduation and grad requirements. I feel like I do not have much time to complete my requirements and my adviser wants me to graduate next year because he cannot support me after that.
- The pandemic brought a lot of anxiety forward for me. I felt quite isolated and hopeless and worry for my family who are in PA (while I am in MS). It has led to a deeper perspective of anxiety that I have not been able to shake.
- The pandemic caused me to reach rock bottom in terms of my mental health which caused me to finally take the time to get the help I needed and I am now in a much better place personally and professionally
- The pandemic led to isolation when I was just starting my program. I am still not quite over it and have many down days that affect my motivation. I still feel like I haven't gotten my old self and old work ethic back.
- The pandemic slowed our research to a crawl, my advisor became unresponsive, and it's definitely pushed back my graduation by a year which is stressful because we don't make a lot of money as grad students.
- The pandemic worsened my anxiety for a period of time, and this made it difficult to be productive.
- The pandemic worsened my anxiety.
- The sense of loneliness (both personal and in work) I think has negatively impacted me and the level of interest in research
- The social isolation and lack of tangible productivity while in grad school has led to pretty severe anxiety issues with being able to graduate with a fully rounded CV.
- There has been an increase in stress and a feeling of social responsibility when dealing with my own health and choices
- With much less certainty in access to resources, poor stipend and less savings, less financial security in terms of savings and jobs, mental health is a constant struggle alongside physical vulnerability.
- After getting contaminated by the covid-19 virus at the same time of my parents, I got extremely afraid of losing them and getting contaminated again during the year. I was afraid of getting out of my home to solve different points related to my routine because my mother almost died during her period at the hospital to treat covid-19 symptoms. My

PhD scholarship was canceled during the pandemic and my graduate program doesn't have any perspective about giving another scholarship.

- I can't afford to be a graduate student. For half a cart of groceries we spend close to \$200. Financial and mental stress are boiling over.
- The increased vigilance about mask wearing and social distancing have worn on my mental health. Additionally, with pandemic slowing businesses some of the donors for grants have slowed down in their funding. One of my research grants got cancelled.
- Unrelated to my program, I'm nervous about the job market after I finish my program
- At the time, I lived alone so it was difficult to have social interactions causing my mental illnesses to become worse.
- In the graduate program the act of "always thinking about your research, even in the background" is considered necessary to succeed. This requirement for success is in direct contrast with the global results of the pandemic: food and financial scarcity and stress, losses of support systems, and other destabilizing results of the traumatic stress we all collectively experienced.
- Staying at home for 2 years doomed me to obesity, slowing down my career progress, losing few of my relatives due to covid and financial insecurity. I got funded for two projects in material chemistry but couldn't work on any one of these, due to the confusions and restrictions of covid. I feel sad to think of this fact that I could have done some interesting research works or working on my own ideas and obviously could have explored more about my research interest and potentials, if covid was not there.....
- So I started my masters in my home country but we could never have any equipment or chemicals delivered on time so it delayed my degree to 3 years. By the time I got admission in US I was so anxious about my masters degree
- In addition to general upward trend of mental health problem severity, I have also felt like I have lost the ability to perform some non-physical tasks at the same level as I could previously. Tasks include reading literature and less scientific writing, both of which seem to take me longer and have worse performance than before and during the first year of the pandemic.
- Pandemic has set back my plans about my career. It has cost me a couple of years primarily by taking a toll on my mental health and set my preparations of joining a grad school back by couple of years.
- At first it had a negative impact mentally which resulted in negative impacts in education. Then healing came. The negative financial impact, however, persisted.
- Mentally I find myself much more anxious collaborating with peers and visiting professors in person, in case either of us are sick.
- I was unable to complete my first PhD program and left with a Master's which then left me extremely burnt out. Took over a year to recover enough to be able to start applying to grad schools again. This has delayed my career plans by two years.

9e. Negative Physical Health Affected

- A permanent disability caused by a COVID infection has completely changed my career path and there is little to no support for myself and others to succeed in science. I will likely leave the field in the future.
- A sudden and unexpected increase in responsibilities and independent work during and after the pandemic has really contributed to physical and mental burnout with my personal projects and lab work in general
- As an international student, the pandemic and its impact on global political and economic status has increased my financial burden regarding traveling internationally and living abroad. They also stirred more mental health issues and physical health issues
- As stated before, I think long-COVID effects from repeated exposure to infected students will drastically impact both my life expectancy and my general quality of living.
- Being forced to stay out of the lab for 6 months and not knowing when I was able to return was mentally exhausting. I stayed at home and didn't leave my house for all of those months. The lack of sun, the removal of a daily routine, and the minimization of socialization risk forced me into a bad mental and thus physical state. I eat when I am stressed and I became obese in graduate school, but the tip of the iceberg was having a gallstone attack and having to have surgery when we were out of lab because of the pandemic.
- COVID-19 affected my heart, and as such, I had a heart monitor surgically implanted. I was no longer able to perform NMR experiments because there would be an issue with the magnetic field and my monitor. By not being to perform NMRs, I was reliant on other researchers and decreased the time periods that I could perform certain reactions..
- Did not exercise as often, stressed as my experiments were delayed and had more financial responsibilities
- Due to the lockdown in the country during this period, my siblings, and other members of the family including myself were forced to stay at home in order not to contact the virus and during this period, the care-responsibility increased and there was not enough finances to foot these bills and life became worst because even the food was barely enough to take care of the family, so most times we resorts to allowing the younger ones eat most meals and this made my physical health to be threaten. And after the pandemic, the family business crashed and uptil now we are still suffering the impact of the pandemic. Issues of tuition fees has become a problem for me including my siblings, who are still in their high school. So i must confess Life has been hard and dropping out of school is the solution for now since we barely feed talkless of paying tuition
- During the pandemic, I had to start taking care of my father who fell ill. This hard mentally and physically on myself and my family. During this time the cost of living has been increasing, and finding places to live on a grad student wage has been difficult. This along with student loans have been a big stressor in my day-to-day life outside the lab.
- I developed an eating disorder during the pandemic because of the stress of my graduate program, life, and pandemic concerns. I now have to monitor how much I eat

because I lost weight so quickly. I'm also now on multiple anti-anxiety medications to ensure that I am able to function in graduate school as if nothing happened to me or those I know during the pandemic

- I found that my sleeping schedule has been drastically changed. I assume this has to do with mental health, lack of exercise, and more screen-time, which were all heavily affected by the pandemic.
- I got covid two times, which affected my mental and physical health
- I had covid-19 at the start of the pandemic which has had long lasting effects on my health
- In the start it was just fear, but later it turned into depression and waste of time. Staying home caused obesity and depression
- It's very complicated. In a lot of ways my mental and physical health have improved to levels even better than before the pandemic. However, that is largely due to very personal circumstances that don't necessarily reflect the general experience. I do get tired quicker and need more rest still than before the pandemic. Working from home has given me the flexibility to take care of my health but has also caused a lot of anxiety and guilt as I often felt that I was not working enough. The personal circumstances which resulted in my mental health improving significantly also carry a high probability of negatively impacting my career.
- I've had COVID three times, which has kept me out of work and feeling unhealthy quite a bit. But I did benefit from completing a project related to COVID as part of my PhD research.
- Lack of access to gyms led to weight gain.
- My physical health has deteriorated from the stress of the pandemic and graduate school. I now have chronic pain issues that affect my working hours and abilities. As well as mental health issues that do the same.
- Personally, I got ill because my immune system was probably compromised due to COVID19. For the future, I think things will fall in place soon, so I do not have very huge concerns.
- Physical and mental health problem affect the productivity of my work.
- Staying at home for 2 years doomed me to obesity, slowing down my career progress, losing few of my relatives due to covid and financial insecurity. I got funded for two projects in material chemistry but couldn't work on any one of these, due to the confusions and restrictions of covid. I feel sad to think of this fact that I could have done some interesting research works or working on my own ideas and obviously could have explored more about my research interest and potentials, if covid was not there.....
- I started feeling headaches frequently which wasn't so pre-pandemic

9f. Sudden Childcare / Caretaking Responsibilities

- Childcare has become more expensive and more limited making it difficult to have time to work on school and career development. For the future, this lack of childcare means that I am limited to part-time work which is difficult to find in the chemical sciences.

- Due to the lockdown in the country during this period, my siblings, and other members of the family including myself were forced to stay at home in order not to contact the virus and during this period, the care-responsibility increased and there was not enough finances to foot these bills and life became worst because even the food was barely enough to take care of the family, so most times we resorts to allowing the younger ones eat most meals and this made my physical health to be threaten. And after the pandemic, the family business crashed and uptil now we are still suffering the impact of the pandemic. Issues of tuition fees has become a problem for me including my siblings, who are still in their high school. So i must confess Life has been hard and dropping out of school is the solution for now since we barely feed talkless of paying tuition
- During the pandemic, I had to start taking care of my father who fell ill. This hard mentally and physically on myself and my family. During this time the cost of living has been increasing, and finding places to live on a grad student wage has been difficult. This along with student loans have been a big stressor in my day-to-day life outside the lab.
- Have to spend more time tutoring my children at home
- I am currently teaching high school chemistry to be able to take care of my father, who has blood clots and a pacemaker now from COVID, and my autistic brother. Not fun. I hate it here.
- My brother's health failed and I became his primary caretaker/financial support; I am taking more time to graduate and considering leaving the field so I can be close to and care for him
- the pandemic brought more responsibilities in term of care taking and financially but that has been my source of motivation to complete my program in due time
- The pandemic has affected my family and I by increasing my care-taking responsibilities and financial insecurity. Prices of basic necessities have risen drastically throughout the pandemic and continue to do so making it difficult to meet daily needs, which has been detrimental to my mental health. Often, institutions do not take into account these extenuating circumstances and only focus on their academics and finances. It has been very difficult to pursue my graduate degree in the chemical sciences, something that I have been very passionate about, in these circumstances where institutions are not offering the flexibility needed during this time.

9g. Negative Familial Effects

- After having COVID multiple times I was forced to miss work which set me behind for graduation. Family members passed away forcing me to drive home (5 hours away). My partner lost their job and relied on me as the main financial provider for months, the impact of that is something we are still struggling to overcome. The stress and mental impacts have forced me to seek treatment for a debilitating anxiety order.
- Due to the lockdown in the country during this period, my siblings, and other members of the family including myself were forced to stay at home in order not to contact the virus and during this period, the care-responsibility increased and there was not enough finances to foot these bills and life became worst because even the food was barely

enough to take care of the family, so most times we resorts to allowing the younger ones eat most meals and this made my physical health to be threaten. And after the pandemic, the family business crashed and uptil now we are still suffering the impact of the pandemic. Issues of tuition fees has become a problem for me including my siblings, who are still in their high school. So i must confess Life has been hard and dropping out of school is the solution for now since we barely feed talkless of paying tuition

- During the pandemic, I had to start taking care of my father who fell ill. This hard mentally and physically on myself and my family. During this time the cost of living has been increasing, and finding places to live on a grad student wage has been difficult. This along with student loans have been a big stressor in my day-to-day life outside the lab.
- I had familial and financial obligations which increased due to the pandemic. This compelled me to spend more time tending to those duties, instead of focusing on my research responsibilities.
- My father passed away in July 2020 because of the COVID-19. My father's death impacted my life and my family's life financially more than I can say in words. My father was admitted to a hospital in July'2020 and passed away after two weeks. It cost our family more than \$11,000. I have been sending \$1000/semester since then, from my savings to support my mother and to take care of the things back at home. We had to borrow quite an amount of money to pay for the hospital bills, despite all the effort we put, we could not save my father. I am married and I need to support my wife also. The two past years were very stressful because of my financial situation and the events associated with it. Right now, I financially support my wife, my mother in India, and myself from the savings I have. Any help will help me to focus more on completing my graduate studies/research by next year which also mean I can get a job, become financially stable and take care of my family.
- My husband (a fellow chemistry graduate student) passed away from a heart attack due to the long-term effects of COVID. I took a 2-month break from the program to take care of him in the hospital, and then arrange his memorial and grieve. This time severely diminished my research progress, and I feel I lost a lot of my previous knowledge/skills during the time outside of the lab and the grieving period afterwards.
- My husband lost his job during the pandemic so we were living off my stipend and despite everyone saying "no one wants to work" the only job application of his that has been accepted was for a part time manual labor position with no benefits. We also have a small immunocompromised child at home so we have to act as if every sneeze or cough around us could be COVID but everyone else wants to move on and stop wearing masks. In our local area there's been an uptick in COVID cases again but no one is taking any precautions any more its just become up to the individual.
- My mental health issues prior to the pandemic included a massive fear of germs and of hurting people I care for. So a worldwide pandemic was basically the perfect storm of real-life events that seriously challenged my health and views of the world. My family doesn't actually believe there is a pandemic, so ties have been strained and discussions can be far more intense and stressful than ever before, especially as a chemist. It

personally bothers me to the point that I've basically shifted my interest to searching for jobs in areas of chemistry that involve ideas my family doesn't believe to be true or even exist.

- Ruined relationships with colleagues, stressed marriage, lacked hope in future and research project
- Since the pandemic I have lost many relatives and loved ones from either COVID complications or other illnesses and I wasn't even able to mourn their deaths properly due to closed funeral services. I was responsible for making sure my parents who are elder and smokers got everything they needed by going to the store for them. I was dealing with a lot of stress and mental instability and my work productivity was definitely negatively impacted and never fully got restored.
- The Pandemic affected my family income significantly. That's why I need to see my whole family now including my mother and sister. Also, the expenses have increased significantly which is very tough to manage with Grad fund
- With my homosexual marriage, the pandemic further prolonged the time for the already difficult intergovernmental processes with one side of strict suppressions. Also this has impacted on my possibilities of getting real laboratory experiences.
- After getting contaminated by the covid-19 virus at the same time of my parents, I got extremely afraid of losing them and getting contaminated again during the year. I was afraid of getting out of my home to solve different points related to my routine because my mother almost died during her period at the hospital to treat covid-19 symptoms. My PhD scholarship was canceled during the pandemic and my graduate program doesn't have any perspective about giving another scholarship.
- Staying at home for 2 years doomed me to obesity, slowing down my career progress, losing few of my relatives due to covid and financial insecurity. I got funded for two projects in material chemistry but couldn't work on any one of these, due to the confusions and restrictions of covid. I feel sad to think of this fact that I could have done some interesting research works or working on my own ideas and obviously could have explored more about my research interest and potentials, if covid was not there.....
- The pandemic has affected my family and I by increasing my care-taking responsibilities and financial insecurity. Prices of basic necessities have risen drastically throughout the pandemic and continue to do so making it difficult to meet daily needs, which has been detrimental to my mental health. Often, institutions do not take into account these extenuating circumstances and only focus on their academics and finances. It has been very difficult to pursue my graduate degree in the chemical sciences, something that I have been very passionate about, in these circumstances where institutions are not offering the flexibility needed during this time.

9h. Negative Professional / Career Effects

- A permanent disability caused by a COVID infection has completely changed my career path and there is little to no support for myself and others to succeed in science. I will likely leave the field in the future.

- Childcare has become more expensive and more limited making it difficult to have time to work on school and career development. For the future, this lack of childcare means that I am limited to part-time work which is difficult to find in the chemical sciences.
- Extra costs made living/paying rent harder. Mental health deteriorated quite a bit during the pandemic itself. This has placed a shadow over my career moving forward.
- Financial concerns for sure, as an international grad student on a stipend, things have just been more difficult since interest rate went up. My mental health was not great during the pandemic itself, but it's been better over time. My major concern is how much time I lost during the pandemic of work in the lab, which can make me look as a weak candidate for a post-doc position
- Funding source are decreased and available faculty positions are decreased
- I am immuno-compromised, so it has been difficult trying to balance being safe for my health with the networking/in-person event/social aspects of grad school. Also, the pandemic started in the first year I was planning on attending my first conferences, which resulted in them either being canceled or moved to a virtual platform. I did not have any opportunity to present/network in person at a conference until 2022 at the end of my graduate studies.
- I believe I lost a great deal of lab hours and possibility to grow due to the pandemic. This gap in my phd would not be fulfilled in the future in terms of publication and etc in career preparation.
- I face additional stress in the face of degree progression delays and knowing I may take longer to achieve goals or will suffer from lack of preparation for next career steps
- I have found that my anxiety has risen, which has made it challenging to continue to pursue my career goals.
- I have lost social skills needed to network.
- I lost a lot of research time in my first year so I felt less prepared professionally and as a researcher. I felt that some of my qualification exams were not the best as I didn't have time to develop them. It also took longer to form important relationships with faculty and students
- I struggled with mental health pre-pandemic, but the pandemic made it worse and very difficult to do tasks needed for graduate school. I also could not be in lab for several months and lost valuable time learning skills and making progress on my projects. Additionally, I was not really able to interact with fellow students or my PI which hurt my development as a scientist.
- I used to be a much more social person, but now suffer from some social anxiety. I get stage fright when I present now and have a hard time networking
- I work from home a lot as I finish my degree. I feel like I lost out on a lot of networking events (conferences, informal meetings) that make me feel less prepared as I get ready to enter my career.
- It has made it very clear that academia does not have the tools to support workers or students, making me lose faith that there will be gainful academic employment in the future

- It has negatively affected social interactions, and I feel like I am 2 years behind in making social connections (both personal and professional)
- It reduced the chances of interacting with other students/colleagues, and it might influence the following job application.
- It was extremely bad for a while, to the point where I nearly quit my program. I think a large part of that was due to a bad workplace situation that was only made worse by the pandemic. Since finding a better work environment, I think I am astronomically more likely to remain in the chemical sciences field. For me it is a weird situation of getting so bad it legitimately circled back around to a net positive impact on my future career in chemistry.
- It's very complicated. In a lot of ways my mental and physical health have improved to levels even better than before the pandemic. However, that is largely due to very personal circumstances that don't necessarily reflect the general experience. I do get tired quicker and need more rest still than before the pandemic. Working from home has given me the flexibility to take care of my health but has also caused a lot of anxiety and guilt as I often felt that I was not working enough. The personal circumstances which resulted in my mental health improving significantly also carry a high probability of negatively impacting my career.
- My mental health really dropped due to the stress and lack of socialization at the beginning of the pandemic. My social web still hasn't really recovered from this. My mental health has improved, since then but I could see it affecting my motivation to pursue and maintain my career.
- My mental health was severely impacted by the pandemic. It's improved slightly since things are returning to normal, but I'm still significantly more anxious, depressed, and generally strange than I was before. At the moment, I'm functioning alright because most of the people around me are in the same boat, but I worry that my concerns won't be taken seriously as I progress further in my career. How will someone with all this baggage ever be a better candidate for jobs than someone who is more functional, whose brain didn't snap in half two years ago? My memory has also severely worsened, as has my attention span, so I also just feel like a significantly worse chemist than I used to be - I'm having a harder time keeping up with the literature and thinking of how to execute new reactions.
- My PI doesn't take into account the effect of the pandemic, and complains that students in the lab are not as productive as before. He doesn't realize the effect it had on graduation timelines of most students. Consequently I am getting a poorer recommendation letter from him
- My program has a 5-year cap, and I am behind due to the pandemic. I feel like I should have had more time to develop my professional prospects
- Our department relies heavily on interpersonal relations outside the lab to stay in touch with other peers. The pandemic reduced social interaction to a minimum, thus limiting scope for me to learn cultural cues as an international student and become a part of the informal lives of my colleagues where I would hear more about their daily lives and academic struggles, thus limiting my growth in some way

- Our institution refuses to increase stipends to keep up with cost of living increases associated with the work-from-home needs or the resulting inflation. I have had to take out additional jobs to afford food which will diminish my ability to be a competitive candidate after graduation.
- Ruined relationships with colleagues, stressed marriage, lacked hope in future and research project
- Staying home was a large mental challenge, I was removed from all areas of my life I enjoyed, including research experiences. I feel that the pandemic slowed my progress as a scientist. If there was no shutdown I could have achieved many more things,. I lost time for research, I have no authorship on any papers, and I have no experience giving presentations at conferences. I feel this will negatively impact my eligibility for future opportunities like fellowships.
- The halt in research activities during the beginning of the pandemic has held back my degree progression by more than the simple time away from the lab, such that it can't be truly measured. The inability to attend conferences to present research in person and network with potential employers or postdoc mentors has detrimentally affected my future prospects post-graduation.
- The pandemic eradicated my confidence as a researcher and will delay my graduation. I lost a lot of my love of science and feel less motivated to succeed.
- the pandemic removed any in-person meetings, interactions, lab recruitment events, visitations, in person interviews, lab rotations, campus and department visits, and all the very important social and educational events that are normally at the beginning of the graduate career. I personally became to know how important it is to have these events to expose the graduate students to all the research and career opportunities within the program. without these events, graduate students are left to fend for themselves and make relatively blind decisions that will have profound impacts on their careers.
- The social isolation and lack of tangible productivity while in grad school has led to pretty severe anxiety issues with being able to graduate with a fully rounded CV.
- The virus itself is the feature of the pandemic that has *least* affected me (and everyone I know). The lock-downs, decline of the job market, and vaccine mandates did way more damage to me.
- usual issues about work progress and research , plus planning on graduation and job searches!
- We will be forever the generation that had a big hole in their CV due to lack of interaction and a significant slowdown in all activities regarding training
- When pandemic was at it peak I was still a second year graduate student, learning new things in my lab. Many senior students didnot get chance to do any in-person conferences and meetings. Due to which I never talked to people who have had same experience before me when I went to last ACS meeting. I think due to pandemic, people did not experience lot of things which could have been great learning experience for them. I think listening to people's experience is really helpful for me because I can picture myself in that situation and think through things before that happen.

- This has decreased the career opportunities in academia since there will be a complete lot of 2 or 3 year researchers for applying to the academic positions since they were not been admitted during pandemic Thus causing big career instability
- Unrelated to my program, I'm nervous about the job market after I finish my program
- The pandemic stopped the job market at the time I graduated. This led me to a job that eventually led me back to graduate school. The only affects I see from the pandemic having on my life in the future is how it continues to change the economy, and how those changes will effect my life.
- With the current rate of inflation, living on a graduate student stipend has become increasingly difficult. Also, having worked in industry post-pandemic (prior to beginning my graduate studies), I could see the toll it had on company finances, job openings, and supply chain issues.
- Pandemic has set back my plans about my career. It has cost me a couple of years primarily by taking a toll on my mental health and set my preparations of joining a grad school back by couple of years.
- I was laid off from a solar company as their job has been affected by covid. Finding stable job has been hard since then.
- The pandemic delayed my enrollement year to graduate school by two years and i feel this has delayed my future goals and directions in my career
- I was unable to complete my first PhD program and left with a Master's which then left me extremely burnt out. Took over a year to recover enough to be able to start applying to grad schools again. This has delayed my career plans by two years.

9i. No Negative Effect

- As an introvert it did not affect my personal life much
- It made me more cautious about my health but I don't feel scared about it as I used to feel before. I don't think it will affect my chemical studies negatively or positively in the future. We all have got used to living with that.
- Pandemic didn't effect me a lot
- The pandemic did not affect me in a way that would hinder my career.

9j. Positive Effect Reported

- Being completely alone in foreign country, the time during the pandemic improved my life, as: 1) I got to know myself, 2) I started appreciating much more my health and my loved ones, 3) I started to be even more grateful for what I have. 4) I learned a foreign language. This will impact very positive my future in chemical sciences since now I am stronger person and able to give my time to the priorities for the humanity
- I now socialize less than I did before. But I also drink less.
- I started exercising during the pandemic and this has led to a lasting positive effect on my life
- I took the pandemic as a period to reflect on my relationship with my PI and it highlighted a lot of negative aspects of our working relationship. As such, I switched groups during the pandemic which led to a much greater research productivity,

improved mental health, and more defined career prospects due to functional mentorship obtained from my new/current PI.

- I went to therapy, am in a much better mental space in numerous areas not only related to pandemic stress, so that will help me deal with the future
- In many ways, I had to learn to be independent and take care of myself during the pandemic. Overall, it has made me a better person, and I hope that these positive changes spill over into my career in chemistry.
- It was extremely bad for a while, to the point where I nearly quit my program. I think a large part of that was due to a bad workplace situation that was only made worse by the pandemic. Since finding a better work environment, I think I am astronomically more likely to remain in the chemical sciences field. For me it is a weird situation of getting so bad it legitimately circled back around to a net positive impact on my future career in chemistry.
- It's very complicated. In a lot of ways my mental and physical health have improved to levels even better than before the pandemic. However, that is largely due to very personal circumstances that don't necessarily reflect the general experience. I do get tired quicker and need more rest still than before the pandemic. Working from home has given me the flexibility to take care of my health but has also caused a lot of anxiety and guilt as I often felt that I was not working enough. The personal circumstances which resulted in my mental health improving significantly also carry a high probability of negatively impacting my career.
- I've had COVID three times, which has kept me out of work and feeling unhealthy quite a bit. But I did benefit from completing a project related to COVID as part of my PhD research.
- Tbh, it has motivated me to be more productive in the lab to ensure that I graduate on-time or early
- The first year the pandemic hit, the University essentially went virtual and coming in to do research was an "at your own risk/comfort level". My PI helped set up research rotations to limit the number of people in the lab and potential exposures and they understood students not being comfortable coming in to do research. The first year was actually a benefit to my mental health because for the first time I could finally focus and implement a good work life balance. I felt like I was finally able to manage and work on my mental health issues. However when the University started ramping back up my PI and the university tried playing it like nothing happened and we were all able to be as productive during the shutdown compared to pre-pandemic times which was and is incredibly stressful. now a year later I feel like I'm still trying to play catchup. This takes a MAJOR toll on my mental health
- The isolation I experienced turned me towards interacting with friends online, but also encouraged me to join online meetings and career development mixers. I would encourage the continuing of both in person and online events, as meeting people outside my local section broadened my professional network
- the pandemic brought more responsibilities in term of care taking and financially but that has been my source of motivation to complete my program in due time

- The pandemic caused me to reach rock bottom in terms of my mental health which caused me to finally take the time to get the help I needed and I am now in a much better place personally and professionally
- The pandemic fully committed me into chemical theory because I was able to continue undergraduate research and successfully get admitted to graduate school; however, post-pandemic inflation is making it unsustainable to attend graduate school
- There are definitely less social interactions among chemists in the department. However, I like how I can easily virtually attend seminars at different institutions.
- As a PhD student focused in Natural Products Chemistry, I think that the pandemic boosted my interest in Natural Products' biomedical applications
- I was diagnosed with adhd over the pandemic which helped bring to light much of my previous academic struggles
- I lost my job during the pandemic. This depleted my savings and I have never really been able to catch up due to now being in a recession. I am just feeling more secure knowing that I do not have to worry about job security and that I have opportunities to make more money through scholarships and fellowships.
- I think research related to biology will expand more rapidly - I am currently not interested in biology however, I could some day so I think the covid pandemic brought positive results to the chemical sciences.

9k. Negative Effect Routine/Livelihood

- A couple of occasions I had to isolate away from classes and lab work because I was in contact with a Covid 19 positive individual or I was ill
- A permanent disability caused by a COVID infection has completely changed my career path and there is little to no support for myself and others to succeed in science. I will likely leave the field in the future.
- As stated before, I think long-COVID effects from repeated exposure to infected students will drastically impact both my life expectancy and my general quality of living.
- Being forced to stay out of the lab for 6 months and not knowing when I was able to return was mentally exhausting. I stayed at home and didn't leave my house for all of those months. The lack of sun, the removal of a daily routine, and the minimization of socialization risk forced me into a bad mental and thus physical state. I eat when I am stressed and I became obese in graduate school, but the tip of the iceberg was having a gallstone attack and having to have surgery when we were out of lab because of the pandemic.
- Due to the lockdown in the country during this period, my siblings, and other members of the family including myself were forced to stay at home in order not to contact the virus and during this period, the care-responsibility increased and there was not enough finances to foot these bills and life became worst because even the food was barely enough to take care of the family, so most times we resorted to allowing the younger ones eat most meals and this made my physical health to be threaten. And after the pandemic, the family business crashed and up to now we are still suffering the impact of the pandemic. Issues of tuition fees has become a problem for me including my siblings,

who are still in their high school. So I must confess Life has been hard and dropping out of school is the solution for now since we barely feed ourselves of paying tuition

- During the pandemic, I had to start taking care of my father who fell ill. This hard mentally and physically on myself and my family. During this time the cost of living has been increasing, and finding places to live on a grad student wage has been difficult. This along with student loans have been a big stressor in my day-to-day life outside the lab.
- From a mental health perspective, I had almost no interaction with students going through the same program (in my case during first year). I had no idea of my standing in the program in comparison to others and more importantly found it difficult to make connections in a virtual format. Financially, the rapid rise in inflation has significantly eaten into my comparatively small stipend. While I had some money saved for emergencies, that is now in jeopardy of going towards rent, groceries, and other basic necessities it really shouldn't go towards.
- high risk and chronically ill students such as myself now have to manage the social and professional implications of pandemic mitigation. Wearing a mask signals that I am chronically ill and my risk level for attending most seminars and classrooms is incredibly high. I worry about discrimination in the job market.
- I am afraid to go out and use public transport. Feel unsafe to visit new place, if I see anyone coughing around me I get worried.
- I am immuno-compromised, so it has been difficult trying to balance being safe for my health with the networking/in-person event/social aspects of grad school. Also, the pandemic started in the first year I was planning on attending my first conferences, which resulted in them either being canceled or moved to a virtual platform. I did not have any opportunity to present/network in person at a conference until 2022 at the end of my graduate studies.
- I developed an eating disorder during the pandemic because of the stress of my graduate program, life, and pandemic concerns. I now have to monitor how much I eat because I lost weight so quickly. I'm also now on multiple anti-anxiety medications to ensure that I am able to function in graduate school as if nothing happened to me or those I know during the pandemic
- I don't know, I'm just a lot more scared of public places now. And my brain hasn't been the same since before I had covid last January. It's just rough. The exhaustion placed on society to have to justify the existence and significance of a threat to national health has killed my drive to understand people with differing views.
- I found that my sleeping schedule has been drastically changed. I assume this has to do with mental health, lack of exercise, and more screen-time, which were all heavily affected by the pandemic.
- I had covid-19 at the start of the pandemic which has had long lasting effects on my health
- I lost connections with my community and those around me, my anxiety and agoraphobia increased massively, and I feel any progress I had made before the pandemic mentally was lost and now I have to learn to be an operational human again

- It was my first year to UMN, and I needed to get rested against anxiety maybe by meeting people in campus. But the pandemic didn't allow me for it. I had to be isolated in my apartment with my unfriendly roommate. Since I entered my PhD program, I didn't have anyone to know, interact with, and spend time with - except for my psychiatrist
- Largely, the pandemic isolated me for the first years of my graduate school experience. I moved across the country in the middle of the pandemic, and it worsened many of my anxieties around social interactions. This has overall made it difficult for me to re-enter these spaces with confidence and has overall weakened my confidence in my ability as a researcher. Fiscally, these issues have been closer related to the recent inflation issues and relatively stagnant pay, which is related but not entirely caused by the pandemic.
- More stress, memory loss, trouble focusing none of this is good for my future
- My mental health was severely impacted by the pandemic. It's improved slightly since things are returning to normal, but I'm still significantly more anxious, depressed, and generally strange than I was before. At the moment, I'm functioning alright because most of the people around me are in the same boat, but I worry that my concerns won't be taken seriously as I progress further in my career. How will someone with all this baggage ever be a better candidate for jobs than someone who is more functional, whose brain didn't snap in half two years ago? My memory has also severely worsened, as has my attention span, so I also just feel like a significantly worse chemist than I used to be - I'm having a harder time keeping up with the literature and thinking of how to execute new reactions.
- My personality changed and sometimes I'm scared to talk to other people.
- Pandemic affected on my personality as I started worrying about my research development and was pretty stressed at the beginning of COVID.
- Pandemic decreased the sense of community in PhD programs and this made it feel lonely at times.
- Pandemic increased the prices of almost everything which caused a financial burdens. Also the supply chain of many things has broken which results in timely unavailability of necessary items.
- The pandemic changed the lab staffing hours. Instead of 8 hours a day, we had to work 10 hour days and four days a week, with no 3 days off in a row. We added weekends to our schedule. This was a poor move because we could not fully rest when we did not have three full days off in a row. It affected how lab results were reported and often other people had to finish work someone else started. It was a poor business decision for a lab environment.
- The pandemic led to isolation when I was just starting my program. I am still not quite over it and have many down days that affect my motivation. I still feel like I haven't gotten my old self and old work ethic back.
- The pandemic was a very isolating experience for me. Moving to graduate school during the summer of 2020 meant difficulty in connecting with others in my program.

- The virus itself is the feature of the pandemic that has *least* affected me (and everyone I know). The lock-downs, decline of the job market, and vaccine mandates did way more damage to me.
- With much less certainty in access to resources, poor stipend and less savings, less financial security in terms of savings and jobs, mental health is a constant struggle alongside physical vulnerability.
- After getting contaminated by the covid-19 virus at the same time of my parents, I got extremely afraid of loosing them and geeting contaminted again during the year. I was afraid of getting out of my home to solve differents poits related to my routine because my mother almost died during her period at the hospital to treat covid-19 sintoms. My PhD scholarship was canceled during the pandemic and my graduate program doesn't have any perspective about giving another scholarship.
- I was working during covid and wanted to switch for better opportunities as I couldn't fly for higher studies but the switch couldn't happen, so life got stagnant

9l. Negative View of Field/Scientists

- Burnout. No longer interested in academia.
- Finances were not meant causing stress due to the universoty not meeting the salary to survive, mental due to the more hostile environment in lab as well as with instructors, NO actual help with menatl health and used against you, and overall no one really focusing on someone who is struggling ans used it against them.
- I have lost a lot of faith in scientists; they lashed out at each other and became cold
- I lost confidence in interactions with colleagues. Everything is less collborative and FREE FLOWING
- I was developing anxiety due to the working conditions at the university, but since the pandemic started I've seen blatant examples of reckless and dangerous behavior from many scientists who have become conspiracy theorists and deniers of the same science they claim to value so much. This has disillusioned me significantly to the idea that those seeking to better themselves are open-minded and willing to challenge their own views within their field and others. I see no reason to desire to be in the chemical sciences anymore if these people are indicative of those who also go into the chemical sciences.
- Literally not sure if I want to continue in my degree based on this and the stress I am now under due to university policies not really changing timelines and still expecting the same out of me even though 6 months of my degree was essentially lost.
- My motivation for research and my interest in the chemical sciences has dwindled because of the personal stressors caused by the pandemic. I have little motivation because I am drained due to mental health struggles, but must work regardless in order to keep up with finances. I feel forced to work more to keep up financially, rather than working because I want to. This mindset has caused me to develop a disdain for the chemical sciences that I don't think will ever fully dissipate.
- Ruined relationships with colleagues, stressed marriage, lacked hope in future and research project

- See my last explanation. You do not deserve to call yourselves scientists and should have your PhDs revoked. Our governments are out-of-control and something out of a totalitarian nightmare and my fellow "scientists" treated people like me less than human because we dared to protest the covid restrictions.
- The pandemic eradicated my confidence as a researcher and will delay my graduation. I lost a lot of my love of science and feel less motivated to succeed.
- the pandemic taught me how professors gaslight students - they say they care about our physical health and wellbeing but then pressure us to work in the lab even before the vaccine came out. I learned that professors care about productivity over students based on their actions (even if their words say they care). I plan to leave science and academia after I graduate because of the behavior of professors.
- The sense of loneliness (both personal and in work) I think has negatively impacted me and the level of interest in research

9m. Other/Vague

- A permanent disability caused by a COVID infection has completely changed my career path and there is little to no support for myself and others to succeed in science. I will likely leave the field in the future.
- As an international student, the pandemic and its impact on global political and economic status has increased my financial burden regarding traveling internationally and living abroad. They also stirred more mental health issues and physical health issues
- Decided I do not want to live in the United States long term
- Due to the lockdown in the country during this period, my siblings, and other members of the family including myself were forced to stay at home in order not to contact the virus and during this period, the care-responsibility increased and there was not enough finances to foot these bills and life became worst because even the food was barely enough to take care of the family, so most times we resorts to allowing the younger ones eat most meals and this made my physical health to be threaten. And after the pandemic, the family business crashed and uptil now we are still suffering the impact of the pandemic. Issues of tuition fees has become a problem for me including my siblings, who are still in their high school. So i must confess Life has been hard and dropping out of school is the solution for now since we barely feed talkless of paying tuition
- During the period of the pandemic there were no social or academic meetings or gathering, interaction with colleagues on researches and collaboration weren't attainable. So during this period i was a sit at home would could build herself, her career and achieve her goals.
- Everything is a mess and there really is no support
- Finances were not meant causing stress due to the universoty not meeting the salary to survive, mental due to the more hostile environment in lab as well as with instructors, NO actual help with menatl health and used against you, and overall no one really focusing on someone who is struggling ans used it against them.

- Given the additionally financial strains incurred on me during the pandemic I no longer view a career in chemical sciences a viable option to me, in regards to staying in the place I want to live. This consequently has increased stress on my mental health.
- I was extremely isolated during the pandemic. The isolation has taken a huge toll on my mental health. There were times when I felt unsupported and alone. It was also extremely hard to meet people because graduate school has not had any events.
- I almost quit graduate school because I felt so isolated and depressed during the pandemic.
- I don't know, I'm just a lot more scared of public places now. And my brain hasn't been the same since before I had covid last January. It's just rough. The exhaustion placed on society to have to justify the existence and significance of a threat to national health has killed my drive to understand people with differing views.
- It was a tough time trying to move around the country from undergrad to grad all while remaining quarantined and alone. A very isolating experience that affected mental health and social skills
- My mental health issues prior to the pandemic included a massive fear of germs and of hurting people I care for. So a worldwide pandemic was basically the perfect storm of real-life events that seriously challenged my health and views of the world. My family doesn't actually believe there is a pandemic, so ties have been strained and discussions can be far more intense and stressful than ever before, especially as a chemist. It personally bothers me to the point that I've basically shifted my interest to searching for jobs in areas of chemistry that involve ideas my family doesn't believe to be true or even exist.
- Our institution refuses to increase stipends to keep up with cost of living increases associated with the work-from-home needs or the resulting inflation. I have had to take out additional jobs to afford food which will diminish my ability to be a competitive candidate after graduation.
- Our lab adopted a shift schedule to accommodate occupancy restrictions. For six months, I was only allowed to be present in the lab between 3:00pm-3:00am. I petitioned my advisor once a month for six months to be changed to the day shift, but was denied each time. Other students began bullying me because of my lack of research progress; they also worked together to preserve their own spots on the day shift and make sure I stayed on the night shift.
- Since the pandemic I have lost many relatives and loved ones from either COVID complications or other illnesses and I wasn't even able to mourn their deaths properly due to closed funeral services. I was responsible for making sure my parents who are elder and smokers got everything they needed by going to the store for them. I was dealing with alot of stress adn mental instability and my work productivity was definitely negatively impacted and never fully got restored.
- The pandemic and how poorly UCR pays has made it impossible for me to advance my life in any meaningful way that doesn't directly benefit the UC system. Many of my nongraduate peers are already buying houses and getting married, but not me, not for many years to come.

- The university doesn't pay us a wage high enough to cover cost of living in this town. The department does not support its graduate students
- The virus itself is the feature of the pandemic that has *least* affected me (and everyone I know). The lock-downs, decline of the job market, and vaccine mandates did way more damage to me.
- With my homosexual marriage, the pandemic further prolonged the time for the already difficult intergovernmental processes with one side of strict suppressions. Also this has impacted on my possibilities of getting real laboratory experiences.
- After getting contaminated by the covid-19 virus at the same time of my parents, I got extremely afraid of losing them and getting contaminated again during the year. I was afraid of getting out of my home to solve different points related to my routine because my mother almost died during her period at the hospital to treat covid-19 symptoms. My PhD scholarship was canceled during the pandemic and my graduate program doesn't have any perspective about giving another scholarship.
- The increased vigilance about mask wearing and social distancing have worn on my mental health. Additionally, with pandemic slowing businesses some of the donors for grants have slowed down in their funding. One of my research grants got cancelled.
- Yes it would help during their interaction with people in the field
- The pandemic stopped the job market at the time I graduated. This led me to a job that eventually led me back to graduate school. The only affects I see from the pandemic having on my life in the future is how it continues to change the economy, and how those changes will effect my life.
- Traveling for seminars and presentations

The Impact of COVID-19 on Chemistry Graduate Students

Focus Group Results

Cecilia Primo, MPA Candidate, University of Oregon

Introduction

The COACH organization sponsored a focus group in February 2022 involving graduate students in chemical sciences at the University of Oregon. It was designed to inform the development of a survey regarding the effect of the COVID-19 pandemic on graduate students' career and academic lives and ways in which the ACS might provide assistance.

Methodology

Participant in the focus group were recruited by one of the COACH Directors. Two students in the 3rd year of their PhD program participated. The discussion was guided by twelve open-ended questions, with five minutes allotted for discussion of each question. The author led the discussion and a second researcher observed and occasionally ask follow-up questions.

The discussion was designed to gather information from the students regarding the following areas:

1. How the COVID-19 pandemic has affected graduate students' careers and academic lives.
2. Students' greatest challenge to their success during the pandemic.
3. Students' well-being during the pandemic.
4. Financial impact of the pandemic.
5. Campus resources that helped students during the pandemic.
6. Both positive and negative experiences students faced during the COVID-19 pandemic.
7. What ACS could do to help improve career and academic life during the pandemic.

The session was conducted via zoom and was recorded. Review and analysis summarized below involved systemic review of the zoom recording and notes from the session.

Results

Outcome 1: How the COVID-19 pandemic has affected graduate students' careers and academic lives.

Q. How does the COVID-19 pandemic affect students' overall career/academic life experience at school?

Students rated their overall experience of the pandemic in their career/academic lives as "fair". They shared only a few changes to their academic plans and careers. But they stressed that PhD students experienced different effects from the pandemic than master's students and that impact could vary by academic specialty. For example, a student shared he spend most of his time in the lab doing experimental work, which requires him to be physically in the lab and increases potential exposure to COVID. Both students shared they were taken care of and did not interact much with other students because their lab holds few students.

Outcome 2: Students greatest challenge to their success during the pandemic.

Q. What has been your greatest challenge to your success during the COVID-19 pandemic? What are some of the negative/positive aspects of remote learning or hybrid learning during the COVID-19 pandemic?

Following are some of the positive and negative experiences students shared during the pandemic.

Positives

- They are not taking any courses to graduate which means they only stay in labs to work and do not interact with other students
- The number of students enrolled in the Ph.D. program was less and have a small cohort
- Online classes were flexible; classes were recorded giving students chance to review back on lectures
- Students were not concerned about jobs yet and plan to look for jobs after graduation
- Not worried about jobs because they feel confident their degree will get them a job

Negative

- Delay graduation date
- Supply shortages also take months to arrive such as material and equipment for lab projects.
- Students felt lonely and depressed not interacting with other students physically
- Sometimes Wi-Fi connection affects their attendance.

Outcome 3: Students' well-being during the pandemic.

Q. How would you describe your health/well-being during the pandemic?

In response to the question of health and well-being, one student responded as fair and shared that there was a small effect on his health and well-being but was not open in discussing this question. In contrast, the other student openly shared that there were loneliness and anxiety experiences during the years of the pandemic, both personal and career/academic day-to-day life.

Outcome 4: Financial impact of the pandemic.

Q. Does the COVID-19 pandemic affect you financially?

In response to a question on financial concerns, both students shared their concerns on inflation and strongly suggest ACS support an increase of allowance to help cover some of their school expenses.

Outcome 5: To understand some of the resources on campus that help students during the pandemic.

Q. What are some of the resources that were helpful during the pandemic?

Students shared a few resources on campus that were helpful to their needs which includes social events hosted by the schools or school clubs. However, a student also reported he did not use them for different reasons. Lab rooms were the main resources on campus that were strongly shared by students that help them focus and help them work well.

Outcome 6: To understand how students are concerned about the pandemic and what ACS can *help improve their career and academic life during the pandemic.*

Q. What can the school or ACS do to help?

Students shared inflation as one of the concerns to their academic career and hope the ACS can help some of the areas in need such as supply grants and raising stipends monthly by providing support to budget decisions. Some of the reasons for their concerns come from lack of salary increase. They also noted that some students were not eligible for scholarships awarded at UO.

Implications for Construction of a Survey

Based on the focus group evaluation discussion, below are list of areas to consider in development of the survey.

Dependent Variables

- Student graduate level
- Number of classes student enrolled
- Career and academic satisfaction

Independent and control variables

- Students' status on graduation date.
- Students gender identity
- Types of resources student receive during the pandemic

- Academic resources
 - Financial resources
 - Health care
- Type of work environment
 - Remote
 - Hybrid