Program Review: College of Natural Sciences
University of Hawai‘i, Mānoa
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1 Executive Summary

2 Introduction

A review of the College of Natural Sciences (CNS) was conducted in October 2021 by an external team consisting of senior faculty with experience in university management and leadership. Due to COVID travel restrictions, the review was conducted remotely. It consisted of a series of video meetings with university and college leadership, faculty staff and students, plus recorded videos of the major facilities. Documents ranging from enrollment and graduation data to research funding and planning were also provided. There were also pre-review meetings with campus leadership to discuss the scope of the evaluation.

As part of this evaluation, the UH Mānoa Strategic Plan 2015-2025 was also used by the team to gain an understanding of the role of CNS now and in the vision of the future developed in that plan. We see the overall role of CNS as central to the aspirations for the university as a whole, as illustrated in the following quotes from that plan:

UH Mānoa operates in a global environment, providing future leaders with the skills, knowledge, and values to make a better world possible. UH Mānoa’s future is as a student-centric Research 1 university, a Native Hawaiian place of learning that demonstrates care for our students, faculty and staff. It is a future focused on aloha ‘āina. Our task is to continue to recruit a vibrant student body and prepare them for the future.

There are few human activities more global than natural sciences. As a college at a public university like UH Mānoa, CNS has the obligation to be a doorway into the natural sciences for students who may not easily have access otherwise due to economic or social marginalization. Thus, a major part of this review is an evaluation of how well the college and its individual units are recruiting and educating students at both the undergraduate and graduate level. The Strategic Plan goes on to say:

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1See Appendix A for details
As the largest research enterprise in the state, UH Mānoa’s joint focus on research and education distinguishes it from other campuses of the University of Hawai‘i System and plays a critical role in the education of the Hawaiian workforce, and translating research and innovation to help diversify the state’s economic activity.

The combining of education with research is especially critical in the natural sciences. Effective mentoring requires that it be done by actual researchers in the field and also requires hands-on access to modern, cutting-edge facilities. Thus, the team evaluated CNS in the area of fundamental research, including the relative strength of existing research programs, the level of external support that has been achieved, and the opportunities to move in new directions.

In addition to a review of college-wide issues described in Sec. 3, the team also did extensive reviews of the individual departments - including the recently formed School of Life Sciences and the Department of Computer Science in light of the 2019 review. These are presented in Sec. 4.

Some issues that arose during the review are more of a university-wide scale, where CNS is unlikely to solve the problem on its own given the limited financial resources available. The unrealistically low graduate teaching assistant salaries are an example of such an issue. Sec. 3.9 discusses these in more detail.

One issue that came up is also more of a system-wide problem. There was concern expressed by many faculty of the discussions in the state legislature of ending tenure for research and non-instructional faculty. While this committee is not constituted to examine the issues as to why one would not grant tenure to research faculty at a Research-1 institution, we can comment that such an action would certainly have a negative impact on the ability of the CNS to attract and retain top faculty, and would certainly affect the national reputation of UH Mānoa as a nationally-competitive science institution.

Finally, we would like to thank the CNS and Department leadership for organizing such an extensive and in-depth review in the time of a world-wide pandemic. Our review team’s ultimate goal was to aid the college in identifying areas of concern as well as highlighting areas of excellence (of which there are many!) in order to help achieve the full potential of the faculty and students we met, and fulfill the vision of UH Mānoa outlined in the Strategic Plan.

3 College-Wide Programs and Issues

In general, the committee was impressed by the high level of education and research activity in the College of Natural Sciences. In the area of research in the natural sciences, we note that CNS has several competitive advantages in its favor in comparison to other sciences colleges at institutions of similar size.

Firstly, there is the Mid-Pacific location with a unique environment that hosts many species of plants and animals that are endemic to Hawai‘i. This allows the college to attract faculty into the School of Life Sciences by offering them the rare opportunity to live and work on a Pacific island. Here they can study the ecological and evolutionary processes critical to understand responses to a changing climate. Secondly, there is the advantage of the dark night skies, high mountains, and easy access that make Hawai‘i a premier spot for astronomy. This opportunity is embodied in the Institute for Astronomy, which has attracted top researchers to the state for several decades now. Thirdly, Hawai‘i has a high concentration of federal installations such as communication facilities, oceanographic facilities, military bases, and other institutions that offer the potential for local STEM-related employment for CNS graduates. Since UH Mānoa is the only R1 rated institution in Hawai‘i, for many students in the state the CNS is the only affordable doorway into a career in science.

We note that the college has made significant progress in many areas since the last review, including increased extramural research funding, improved budgetary management, and expanded advising and student
performance tracking. On the other hand, the college is also suffering some significant problems caused by declining faculty and staffing levels, poor communications, and low teaching assistant salaries. Evaluations of individual units are presented in Sec. 3. In this section we cover issues that specifically affect college policy and operations, and where the committee felt that there were actionable recommendations that could be made.

### 3.1 Issues from the Previous Review

The following are CNS-specific, actionable recommendations from the 2014 review, along with the committee’s assessment of progress:

*Previous Recommendation:* The College of Natural Sciences would benefit from increased attention to strategic planning (in concert with the Chancellor and the Vice Chancellor – Academic Affairs). Plans should, among other things: (goes on to list the components of a complete strategic plan).

This is an issue that still needs to be addressed completely. While the committee was provided with documents that taken together have some of the major elements of a college strategic plan (e.g., documents describing six strategic initiatives in research and education and plans for building renovations), there is no central strategic planning document that outlines the goals of the college as a whole, sets quantitative milestones to be achieved, and provides planning guidance for the individual units. This is discussed further in Sec. 3.6.

*Previous Recommendation:* The College and Departments should develop programs that reward and incentivize faculty excellence. These can include allowing differential responsibilities for faculty, instituting a college-level faculty recognition program, and setting up a college-level pre-award grant support center.

While a pre-award specialist was hired in 2015, in discussion with faculty (and especially untenured faculty) there is still work to be done here. This is discussed further in Sec. 3.7.

*Previous Recommendation:* We recommend that the Dean and Vice Chancellor for Academic Affairs identify a few areas in which campus processes can be improved, set specific goals (e.g., generate faculty offer letters within x days), and then achieve those goals.

Progress has been made in this area with the initiation of a document-tracking system in the CNS office. Still, there is significant concern from faculty and students about the time it takes for HR actions to be completed, for proposals to move forward, and for pre-award functions to be handled. This is discussed in more detail in Sec. 3.7. Note that this is an area where a Faculty Steering Committee (see Sec. 3.2) could prove to be very effective if given the appropriate charge and authority to do so.

*Previous Recommendation:* The College of Natural Sciences should carry out a climate survey of students, faculty and staff.

This is still an outstanding and urgent issue both at the college level and in the individual units. See Sec. 3.2 for more discussion.

*Previous Recommendation:* The Dean and Department Chairs should increase their efforts to educate faculty about the need for assessment and the ways assessment can be used to enhance programs.

There has been considerable progress here. The committee was happy to note that departments are now including formal academic assessment in their departmental culture.

*Previous Recommendation:* The College should move as quickly as possible to develop a standalone CNS undergraduate advising system. A single point of contact model in which students can get information on
a range of topics (curriculum planning, financial aid, etc.) would be ideal. The advising structure should ideally achieve an integrated model for student success that addresses internships, research experiences and jobs as well.

The college has done an excellent job in responding to this recommendation. The committee was very impressed by the dedicated team of advisors, and congratulates the CNS academic advisors for winning the 2021 Oikela Award for their outstanding unit performance. Even so, there are still some issues to be worked out - for example the very high case load per advisor. See Sec. 3.5 for further discussion.

3.2 Communications

In meeting with faculty, students, and staff it is clear that there is a need to improve communications at many levels. At the highest level, shared governance needs to be expanded to ensure that the college leadership is getting regular advice and feedback on college policy and major decisions. At many universities this takes the form of a Faculty Steering Committee (FSC). Representatives are typically elected by the departments and meet regularly (i.e., monthly) with the college leadership. The main purpose of a FSC is to advise the Dean on difficult issues, such as budgetary priorities, hiring strategy, or workload policy. A FSC can also be empowered to study and recommend policy on such complex issues such as salary equity, administrative performance, and workplace climate.

A FSC has a different make-up and viewpoint than the department chairs, who are appointment by the Dean and often concerned with day-to-day administration rather than broad policy. The FSC is also more independent of the Dean, and thus can provide very useful advice the Dean may not get from Chairs.

Recommendation: The College should form an elected Faculty Steering Committee to better realize the goal of shared governance, and to foster two-way communications between faculty and the college leadership in areas of college policy, administration, diversity, equity, and strategic planning.

Such a committee could be authorized to formulate recommendations on complex issues such as the logistics and planning of an effective climate survey, handling faculty concerns about paperwork delays, and faculty workload policy - just to name a few. A FSC would also involve more faculty in the management of the college, which is essential for training future academic leaders.

In addition to forming a FSC, we suggest that the Dean meet more frequently and directly with the faculty rather than always going through chairs. Department visits by the Dean at least once or twice per year for open Q&A sessions are not uncommon in many institutions. This would give the Dean a better idea of what is happening “on the ground” and also give him a chance to present his vision and reasoning on major decisions directly to the faculty.

Another serious issue is that of the workplace climate. During this review the committee received credible reports of faculty bullying from some faculty and students in the departments, some of which the college may be aware of but in other cases it might not. During the review it was noted that the staff turnover in the college office has been nearly 100% since the last review, and the committee received nearly a dozen letters from staff members who are unhappy with the workplace environment. These both clearly demonstrate an unhealthy state of affairs which needs to be addressed. A good start would be a thoughtful and well-planned climate survey both of the college administrative staff and the individual units.

Recommendation: The college should immediately plan and execute a climate survey that would clarify potential problems in CNS workplace environment so they can be addressed. Individual units should also be directed to either participate or conduct their own survey as soon as possible, with guidance from the college on methodology and content.
3.3 Graduate Student Salaries

A major issue encountered across the college is the low level of TA salaries. TAs in the CNS are supported at Step G8, which is $18,930 over nine months. In comparison, a beginning TA at UC Davis (a peer institution) is $22,352 over nine months. Given the high cost of living in Honolulu, this makes competition for the best students very difficult.

In some units, summer teaching is also available - but this is not universally guaranteed. In meeting with graduate students, many had anecdotes of TAs supplementing their income by taking on part time jobs - which surely is not good for students they are teaching or the rate of progress they make towards their degree. This situation is mitigated to some degree by that fact that individual faculty can choose to support their RAs at a higher rate (G10-G11) and fortunately many do.

While the Dean is aware of this issue, he pointed out that they simply do not have the funds to raise TA salaries since each $1,000 increase would cost the college $250,000. The committee understands the dilemma, which can only be solved by reducing the number of TAs or increasing funding to the college. The former would reduce the courses available to students, and/or increase section size, which would be undesirable in light of the Strategic Plan goal to enhance educational effectiveness. Thus, increasing in funding is a better option to solve this festering problem, despite the difficulties in doing so.

Recommendation: The current CNS Teaching Assistant salaries are unrealistically low. The college needs to find a way to raise these salaries in order to maintain competitiveness with peer institutions in recruiting the best graduate students.

Sec. 3.9.1 discusses the possibility of raising funds via a direct charge of RA tuition to grants, which is the practice at many institutions.

3.4 Development and Outreach

In general, the committee found that the area of development is not as active as it should be. Coordination with central development at the UH Foundation seems limited, and for two years there was no dedicated person assigned to CNS. Currently, we understand there will be 0.5 FTE assigned and that is a welcome change. For a college of this size, however, a full FTE devoted to development would not be inappropriate. The CNS has been raising roughly $2M-$3M per year, which is respectable but rather low - especially for a university that is the flagship public institution in the state.

As another quantitative comparison, there are seven endowed chairs listed for the UC Irvine School of Physical Sciences (Chemistry, Earth Sciences, Math, and Physics and Astronomy) and another four in the School of Information and Computer Science, and twelve in the School of Biological Sciences - for a total of twenty-three. In contrast, the CNS has only three endowed chairs. While UC Irvine has about 40% larger student enrollment than UH Mānoa, this is still a significant difference and indicates that alumni outreach may need more attention.

Recommendation: The college should seek to increase development funding efforts with the advice of a dedicated, full-time expert who is familiar with the local community and who has access to information on potential commercial, philanthropic, and alumni donors.

The committee notes that while the college has been making some efforts to improve outreach to alumni there is more that could be done by reaching out to the local community more formally. A common way to do this is to form an External Advisory Board of distinguished alumni, local community leaders, and well-known public and business figures in the state who have an interest in the natural sciences. Such a board can provide advice on development activities, and also increase the visibility of the CNS in the state.

\[2\text{For example, the Pilina Ao - Living Links webinar series}\]
Practice has also shown that board members can often be potential donors.

**Recommendation:** Consider establishing an External Advisory Board to improve fundraising efforts, foster more connections to the local community, and serve in an advisory role for alumni outreach.

### 3.5 Advising and Educational Support

Since the last review the college has made excellent progress in providing direct advising to undergraduates via the Student Academic Success Center (SASC). In meeting with the SASC advisors, the committee was impressed by their professionalism and enthusiasm, despite the fact that at 831 students per advisor, they have more than twice the work load that would be considered standard at many institutions. In meeting with students and advisors, some noted that the workload was such that it was not possible to increase the scope of advising much beyond that of checking degree requirements.

As previously mentioned, we also would like to congratulate the SASC team for winning the ‘Oikela Award for “developing and improving a comprehensive Academic Actions Mandatory Advising (AcAc MA) curriculum with “advising as teaching” as the foundation.” While it will take several years to definitively assess the results of this improvement, we would expect to see an improvement in time to degree in future reviews.

The CNS also operates the Learning Emporium, which is a one-stop academic help center that is staffed by paid undergraduate tutors, graduate students, and instructional staff and faculty from the contributing departments (currently all departments except Life Sciences). Due to the pandemic, the Learning Emporium is now providing only remote assistance, but there are plans to re-open in person assistance when that becomes possible.

Finally, during this review period the CNS piloted a Learning Assistants (LA) program adapted from a similar one at the University of Colorado, Boulder through an 2017 initiative from the Department of Physics and Astronomy. The LA program became a campus-wide program in 2019, and is now managed from the Office of the Provost.

Taken together, the college has done exceptionally well in this area, however the committee strongly recommends significantly increasing the number of advisors in the SASC to bring the advisor to student ratio much closer the national norm of 1:300.

**Recommendation:** The current advising load of SASC is about 1 advisor to 750 students. The college should continue to press for resources to bring the number of academic advisors closer to the national norm of 1 advisor per 300 students in order to make the current level of excellence sustainable.

### 3.6 Hiring and Strategic Planning

The number of Instructional Faculty and Lecturers stayed at between 142 and 138 from 2015-2019. This dropped 11% in 2020 to only 124 (presumably due to pandemic-related budget issues). In the same period, the number of SSH delivered and the number of students taking classes in the CNS has stayed fairly constant. Thus, it is expected that CNS will need to hire 15-16 instructional faculty and lecturers in addition to replacing retiring personnel as soon as possible in order to maintain pre-pandemic standards. This is challenging, but it also presents an opportunity for the college to consider hiring faculty in cohorts to move in new directions. Thus, strategic planning becomes even more important for the departments and college as a whole.

Currently, all open positions at UHM revert centrally, and colleges make annual requests for hiring based on instructional needs and/or research priorities. At many institutions, there are formal strategic plans for
hiring that have been prepared in advance by faculty who are experts in the field, sometime augmented by teams of external experts convened by the Dean or Provost to ensure a broad representation. For the most part, the committee found that the departments did not have such strategic plans that represent a consensus of their department, and that there is no formal strategic plan at the college level that departments can refer to in their planning.

**Recommendation:** The Dean should direct the departments to prepare long-term (at least five year) Strategic Plans that document the existing strengths of the department, identify potential opportunities, and propose a numerical plan that balances these priorities.

Such plans should also present details on how departments would establish a large, diverse pool of candidates, and how they would respond to opportunities to increase faculty diversity as an integral part of the plan. A balance between open and directed searches can also be folded into the plan, which can also prove useful.

The committee noted that the most recent round of university hiring left many CNS faculty unhappy in that they have a perception that the Mānoa Budget Team that was influential in making the final decisions had no representation from CNS faculty and did not follow the priorities requested by the departments. This is a situation that is not healthy going forward, so the committee suggests that a more in-depth briefing to Deans on the reasons for making the hiring decisions might be appropriate. A frank discussion of long-term strategic planning could be part of this discussion.

### 3.7 Staffing and Administration

Our evaluation of staffing effectiveness is based on the self-study provided by the dean’s office, a statistical analysis of CNS staffing compared to peer institutions, and on meetings with faculty and staff.

In speaking with students and faculty, a common thread was significant unhappiness with the level of staff support. Examples include only 0.1 FTE of IT support for the advising center (and this appears to be only informal), no regular budget updates provided to faculty, the time for getting answers to inquiries back from the CNS office, and the perceived slow rate of action on HR and pre-award functions. Conversely, there was significant unhappiness expressed by college staff on the workload, the outdated IT equipment, and a perceived lack of effective office management. Indeed, we were provided with information from the dean’s office to the effect that the CNS office has experienced essentially 100% turn-over in the last five years. The committee has already recommended a climate survey to help gather more information on some of these issues, but there are also other actions that could be considered that could prove beneficial to explore.

Currently, faculty do not receive regular updates on research grants that allow them to see expenditures, balances, and encumbered funds. This makes planning difficult, to the extent that many faculty simply keep their own informal accounting systems. This was especially galling to the untenured faculty, who reported that they received little or no regular information on their research grants, or on the balance of their start up funds. They were also confused with their start up funds, which some claimed to come from up to five separate accounts with different rules and expiration dates.

**Recommendation:** Simplify and clarify opaque and confusing startup and grant accounting practices, and provide research account balances to faculty on a regularly-scheduled basis.

Many institutions simply email faculty a computerized report on research account balances on a monthly basis. While the committee did not determine the feasibility of doing this with the current computer system at UHM, this issue should be mitigated to the extent possible - even if it is just a simple manual email generated on a scheduled basis. In addition, the method used to provide start up funds via multiple accounts should be reviewed to see if that could be made more simple. In some institutions, different stakeholders...
contribute a fixed amount of funds to a single account on a regular basis.

In addition, the information provided on the level of staffing compared to staff indicates that compared to peers the number of staff per faculty member is roughly 20-25% lower than at peer institutions, even taking into account that some functions are handled by RCUH. In addition, CNS has the lowest ratio of staff to SSH on campus. These facts may be factors that impact staff morale and the ability to provide adequate grant funding support to faculty. Certainly, lack of sufficient IT support is a noticeable common thread among CNS students, faculty, and staff.

**Recommendation:** The Dean may want to consider convening a blue ribbon faculty committee to investigate where new staff priorities and/or modified administrative procedures would have the most impact on advising, faculty research support, and administrative efficiency and morale.

Finally, many staff were confused about Title IX and reporting protocols (e.g., confidentiality vs. privacy, outside resources, etc). The committee suggests that the college create links that are easier to find and with clear meanings for these topics on their main web page.

### 3.8 Facilities

While an in-person visit to the facilities was not possible, we were given pre-recorded video tours of some buildings, classroom, offices, and laboratories. Many were seen to have issues with aging furnishings, water leaks, mold, and other issues stemming from deferred maintenance. That said, there were also cases where significant improvements had been made by individual faculty with external funds.

**Recommendation:** If not already in place, establish a rank-ordered multi-year plan to address major maintenance needs with the aid of faculty and staff.

One facility that stood out as needing immediate attention was Bilger Hall, which has severe issues with habitability and the ability to conduct research. This is a critical issue for Chemistry that could soon affect their ability to fulfill their mission.

### 3.9 Campus-wide Issues Affecting CNS

Some issues encountered during the review would require changes to policies and procedures outside the authority of the CNS to change. This section reviews these issues and makes suggestions for consideration by campus leadership.

#### 3.9.1 Policy on Tuition Waivers for Research Assistants

As discussed in Sec. 3.3, there is an urgent need to raise graduate teaching assistant salaries from their current low level, as this is having a serious impact on TA morale and also impacts ability to recruit graduate students to CNS.

One possible way to get additional funding for teaching assistants is to charge all or part of the tuition of Research Assistants to external grants, using the additional funds to raise the TA stipends. This is not uncommon at peer institutions, and is allowed by many sponsors, including the Department of Energy and the National Science Foundation. For example, at some University of California campuses the grants are charged 75% of the tuition cost as a direct charge with no overhead. At this rate, and with 80 RAs in the CNS it should be enough to raise TA salaries significantly.
**Suggestion:** The campus should consider phasing in a program of a direct charge to research grants of student tuition, and using the funds generated to raise the salaries of TAs.

This would have to be phased in with new grants over a number of years, and it would have to be clear to faculty that the funds raised are being used solely to raise TA stipends and not for other purposes.

### 3.9.2 Faculty Hiring and Partner Accommodation

In speaking with CNS faculty there was a perception that the recent round of faculty hiring was not transparent, and that the departments played minimal role in prioritizing the final list of approved faculty searches. It was stated that the Mānoa Budget Team (MBT) that made the final decision (at least in their view) had no participation by scientific faculty, and no back-and-forth discussion with Deans and Chairs. While evaluation of a campus hiring procedure is outside the scope of this review, the committee would like to suggest that the campus take this faculty perception into consideration when planning for future hiring.

In addition, the committee notes that in the natural sciences it is not uncommon for top faculty candidates to have partners who are also scientists, or academics in other fields. Thus, many institutions have a formal partner accommodation program that they use as important leverage to recruit them. The committee notes that while the campus has such a policy (instituted in 2012), faculty perceive that the program has no funds to back it up, and thus is not useful as a tool for improving faculty diversity in the college. We suggest that the university leadership re-visit this issue as the financial impacts of the pandemic subside.

**Suggestion:** (Re)-establish a campus-wide partner accommodation policy. We consider this essential particularly for universities in small employment markets. This action may also broaden the applicant pool and thus increase the opportunity to hire more diverse faculty.

### 4 Individual CNS Units

#### 4.1 School of Life Sciences

The School of Life Sciences (SoLS) was formed by the merger of three departments (biology, botany, and microbiology) and began operation in January 2020 as part of the College of Natural Sciences (CNS). The School currently offers nine undergraduate degrees and four graduate programs (Botany, Marine Biology (with SOEST), Microbiology, and Zoology). The merger, involving 35 faculty members as well as staff, was intended to promote the underlying conceptual ties among units and strengthen research collaborations within the School and UHM. The merger also permits the SoLS to strengthen the life science curriculum by reducing redundancies and adding relevant courses needed at all levels.

The SoLS has great potential to contribute to general conceptual areas within the research disciplines of the faculty, both nationally and internationally. It also can be the major research hub and leader for the life sciences in the Pacific region and in Hawai‘i. A greater understanding of the natural environment and the impact of climate change is critical to the economic growth of the state and also to UH as a Hawaiian place of learning. Significant growth in undergraduate enrollment reflects continued interest in the SoLS, but has occurred without a commensurate increase in faculty, staff, and TA positions. Advance planning before the merger for changes in curriculum, research, and governance occurred, but more rapid progress to develop and implement these plans is critical for the SoLS, despite the financial and social constraints of the pandemic. Even with the best of planning, however, the potential of the SoLS will continue to be limited without a greater input of resources. The double whammy of the pandemic and initiation of operations of the SoLS in 2020 continue to present multiple challenges for faculty, staff, and students.

The assessment/climate survey of the students, staff, and faculty recommended by the earlier review team but not yet administered should be given extremely high priority, particularly with the isolating effects of
the pandemic, turnover in administration, the School merger, and the higher workloads of faculty, staff, and TA positions. If necessary for more timely results, the School should move forward with its own survey. This survey could be used to better understand the most important priorities and to guide the input of limited resources and address more quickly areas that are less resource-dependent. See also the recommendation for the College under section 3.2 Communications.

4.1.1 Research, Postdoctoral Scholars, and Graduate Education

Graduate students play a critical role not only in promoting the research agenda of the School but also as a critical link to undergraduate education. The 8 Undergraduates interviewed were highly laudatory of their graduate student teaching assistants, who helped both struggling students to improve and stronger students to find opportunities in research and teaching. Most graduate students interviewed in SoLS (there were 16) reported satisfaction with their research experience within their home labs and the unique opportunities they have to work in Hawai’i. However, there is widespread dissatisfaction with low pay and in some cases, a high workload for TAs within the SoLS, and a desire for better communication about procedures and policies affecting the students.

The extremely low stipends for teaching assistants within SoLS, in absolute amounts and also relative to other units at UHM and to research assistants, hamper further development of research and teaching efforts and progress in diversity, equity, and inclusion (DEI) within the School. In some cases, TA workloads also have increased beyond the normal 20 hr/week without additional pay. As stipends remain stagnant and living costs continue to increase with graduate students struggling for food and housing, the morale of grad students is greatly affected (‘it is unethical to expect a high level of scholarship under these conditions’). Low TA stipends also inhibit faculty recruitment of excellent potential graduate students from a national pool who would otherwise prefer to work with SoLS faculty but cannot afford to do so. Low TA stipends shrink the pool of graduate student applicants, often making it even more difficult to attract students from groups underrepresented in the SoLS, whether native Hawaiians or students from other underrepresented groups nationwide.

Postdoctoral scholars are an integral part of an active research unit. Faculty report that it has been a problem to hire postdocs in a timely fashion. Streamlining processes involving postdocs (e.g., posting ads for postdocs, authorizing job offers, processing purchase orders, etc.) would greatly increase efficiency and allow timely offers. Procedures that permit all postdocs working in CNS (including prestigious NSF postdocs) to be able to access health care and other benefits through UHM should be clarified if problematic. Faculty also report that postdocs often feel isolated and not well integrated into the SoLS community.

Recommendation: Raise the current pay level for TAs in SoLS to a liveable wage and resolve any problems with unpaid work.

This is an extremely high priority item that impacts both teaching and research. It is also critical to monitor TA workloads and establish a way to report problems and resolve them beyond the level of the immediate supervisor. Consider using different pedagogical methods that cover the information and maintain quality, in ways that involve less TA time. See also the College recommendation (Section 3.3 Graduate student salaries).

Recommendation: Hire more TAs with deliberate planning based on anticipated demand for courses as the number of majors increases and move through both lower and upper level courses. This will allow better planning for not only instructors but also graduate students who need to plan both research and finances. Continue to address the ongoing curriculum modifications needed to reduce redundancies and the number of required courses that result from the merger of the three departments into the SoLS.

UHM is the flagship campus of the system with expectations of the type and quality of courses and majors offered by a College of Natural Sciences. The SoLS and its majors serve as a springboard into a number of diverse careers and opportunities, including broad training to be able to compete in areas of life
sciences only now emerging. SoLS is in an enviable position with increasing undergraduate enrollment, but responsibility for teaching the needed courses is impacting faculty, instructors, and particularly the TAs. With updated offerings and more streamlined course sequences within the school, priorities for the number of TAs and faculty should become clear, given the teaching and research missions of the SoLS.

**Recommendation:** Develop a grad student/postdoc handbook that is available online for standard procedures.

With input from grad students, staff, and faculty, suggested topics could include finances (TA positions and workload expectations, fees, payment schedules), residency requirements, fellowships opportunities, funds for graduate students with financial need available at different administrative levels, housing options, professional development workshops offered on NSF GRFP and postdoc proposal preparation, etc.).

**Recommendation:** Appoint a person within the CNS for SoLS and other units who can interface with higher administrative levels and brings together information and responsibilities for postdoc administrative issues and who can work with and advocate for postdocs and their mentors.

As proposed in earlier self-studies, this would include but not be limited to advertising and hiring procedures, setup of health insurance and other benefits, etc.

**Recommendation:** Continue to encourage both social and intellectual activities that foster more interaction within SoLS and related units for researchers at different levels of their careers.

Examples could include a regular SoLS seminar series with speakers from different academic areas within the School, an in-house seminar series organized by grad students/postdocs, professional development workshops, social activities, etc.

**Recommendation:** Continue discussion of field safety issues.

Re-assess whether more training is needed beyond the individual lab in safety issues related to field work or other unique research settings. This training is important to protect participants and UH and should involve other university units as needed (e.g., 4WD training if needed, wilderness first aid, other technical training, clarification of sexual harassment reporting on campus and in the field, safety procedures for night work, etc.).

### 4.1.2 Faculty

The research capabilities of the faculty in the School of Life Sciences have been enhanced by several excellent recent faculty hires, and several senior faculty continue research that takes advantage of the unique marine and terrestrial resources in Hawai‘i, thus enhancing UHM as a Hawaiian place of learning and as leader in Pacific research. The SoLS contributes to greater understanding of the impact of climate change and conservation of natural resources and Hawai‘i’s unique environment, critical for the health of the people and economy of Hawai‘i. Women are well represented on the faculty, although there is much less diversity in other respects and DEI is an area that needs to be addressed as FTE become available. Clustering of most of the junior faculty labs together has fostered good interactions within this cohort. Increased student enrollment in classes without a corresponding increase in faculty, instructor, and TA positions has resulted in a situation where it is difficult to meet the demands for lower and upper level courses required for degree programs, and loss of faculty in critical areas such as microbiology are especially problematic. The cancellation of several job searches during the pandemic and subsequent loss of lab space for those positions has created additional problems in teaching and research collaborations and inequities in teaching loads have become more evident as they impact opportunities for faculty research.

Better communication between faculty, the School, and the College on the shared mission/goals of the
units is critical to improve the morale and trust of the faculty as the School continues to strive for a smooth merger of the departments with an encouraging environment where junior faculty can thrive, undergraduate enrollment is increasing, and with an increasing emphasis on research.

**Recommendation:** Continue work on a shared short term and long term strategic plan and vision for the School.

Such a strategic plan can help to prioritize and guide pragmatic decisions about areas of faculty hires, teaching and course development, facilities, and outreach activities. Consider using a trained facilitator for such sessions for more collegial and productive interactions in discussion of more immediate needs. Suggested areas for discussion include:

1. Re-evaluate research areas and positions identified by faculty and earlier reviews, and prioritize them in the current strategic plan if still relevant. Teaching needs alone should not drive new positions.

2. Continue to update the curriculum and streamline course and degree offerings, with realistic goals of what majors and courses can be offered now (given the available and anticipated resources in staff, TA, instructors, facilities) with the ability to later expand the number of degree options for majors with increased resources. The School currently offers several undergraduate degrees (Molecular and Cell Biology (BS), BS and BA degrees in Biology, Botany, and Microbiology with a Marine Biology degree pending, subject to approval), and with graduate programs in Botany, Marine Biology (with SOEST), Microbiology and Zoology. Depending on the strategic plan goals, consider realigning undergraduate majors to be organized by concept rather than organism.

3. Allocate teaching and administrative responsibilities among faculty more equitably, including re-examination in the current workload plan of the administrative time needed to teach some courses (e.g., large courses, faculty time needed for labs and recitations, training teaching interns, best allocation of TAs). Using clearly communicated criteria, reconsider workload balance (research, teaching, and administration) for each faculty member, and with consideration of the needs of junior faculty to develop their research productivity as well as consideration of time spent by faculty involved in addressing department needs (ex. writing training grants). Consider realistic opportunities for faculty to use grant funds for research buy-outs of teaching responsibilities.

**Recommendation:** Standardize and clarify procedures with better communications within CNS and within SoLS including development of a faculty handbook. (See also Section 3.2 Communications.)

Use of the best practices from the three former departments may result in more efficient operations for both staff and faculty. Such a handbook might also help promote cross-training of the staff and allow faculty to better prepare the information that the staff needs.

Relevant topics that might be especially helpful for new faculty could include discussion of housing options; administrative responsibilities of staff and faculty administrators; how and when to contact Facilities for problems; procedures, forms, and accounting practices to order equipment and supplies, hire students, and process travel reimbursements; teaching resources; expectations for tenure and reviews; graduate program requirements, TA and instructor responsibilities; teaching and research resources (training in teaching and available IT hardware and support; shared UHM research facilities, lab safety training, DEI training, code of conduct, etc.). Although these may seem like a collection of minor issues, they are often very frustrating stumbling blocks for staff and faculty alike, especially within a newly amalgamated unit.

**Recommendation:** Complete the new SoLS website and continue to pursue additional external funds for the School.

The webpage is the public face of the SoLS and provides standard information, but is also the showcase for the SoLS vision, current SoLS news, events, and a place to highlight School members (faculty, students, staff and alumni) for their research, teaching, and/or outreach accomplishments. These activities bring
greater visibility to the School and also promote greater appreciation and potential collaboration among colleagues. (For seminar series, see earlier recommendation.)

Several faculty have been successful in obtaining teaching grants (e.g., NSF REU site grants for undergraduate research, SEA-Phages) in addition to research awards. With help from CNS and UHM offices, continue exploring other sources of funds for undergraduate and graduate training (e.g., NSF RCN-UBE, DOE GAANN funds for graduate education, NSF funds for Alaska Native and Native Hawaiian-Serving Institutions Program and other DEI programs through NIH, NSF) in addition to faculty research proposals to private foundations and state and federal agencies. These types of awards will help increase opportunities for all students, but particularly students from groups underrepresented in STEM. Work on training grant proposals and other departmental needs should be recognized in the workplan for those faculty writing or administering them.

**Recommendation:** Establish an external advisory board for SoLS.

A diverse advisory board could be very useful in several ways. Representatives could be potential donors, potential employers for students, people influential in the community (local science communicators with local news sources, local educators, government leaders), alumni and others from private companies, various federal, state, local agencies, and NGOs. Advisory Board members also might be willing to offer advice/give workshops and talks to students on non-academic careers, give advice on compatible content for applied degrees, and also serve as valuable contacts for students seeking field sites, research problems, internships, and work experience.

### 4.1.3 Undergraduate Education

The 8 undergraduates interviewed were highly enthusiastic about undergrad research (UROP) in faculty labs with opportunities for research and funding, and were highly complimentary of the role graduate students played in encouraging their participation. Great enthusiasm is shown by high enrollments in the collaborative marine biology program of SOEST and SLS, and such coordinated programs (with clearly specified administration and funding arrangements) can benefit both students and SoLS.

Enrollment in SoLS courses in Fall 2021 was up 20% from Fall 2020, with the greatest increases in Biology and Marine Sciences. These increases occurred without comparable growth in number of TAs, staff, or faculty to teach them, leading to staffing problems in both lower level and advanced courses. [See recommendations under Faculty section.]

Non-tenure-track instructors who have been repeatedly hired for years contribute greatly to the teaching mission of the School through both their own teaching as well the mentoring they provide to new faculty. Faculty expressed great concern about the possible loss of these experienced instructors, especially given the uncertainty for the instructors that is associated with only year-to-year employment.

The use of course assessment within different areas of SoLS varies, and the current advice of the Assessment & Curriculum Support Center is that the Life Sciences need to continue to use authentic assessment. They suggest starting with assessing writing with specific rubrics and assessing students in capstone courses. Former departments now in SoLS varied in whether course assessments were given and/or used.

**Recommendation:** The review committee strongly recommends longer term contracts for current non-tenure-track instructors who have been employed for years on year-to-year contracts, recognizing the essential role they play in support of undergraduate education.

**Recommendation:** Continued updating of assessment of courses across SoLS is necessary and should help point out how to improve courses and curriculum.
4.1.4 Staff

Please see section 3.7 for College-wide programs and issues related to staffing that are directly relevant for the SoLS. An issue specific to SoLS is that a significant number of students with majors in SoLS appear to be under-prepared for the rigors of some required STEM classes (e.g., some chemistry and math classes; see document from CNS—Appendix B CNS Early Alert and Intervention Program). It does not appear that sufficient staff has been allocated to be able to test hypotheses about student outcomes and/or collect relevant data to help students succeed in some of the SoLS majors.

Recommendation: Use existing data to help design and implement interventions to improve learning and retain students in the majors.

The committee suggests continued development of mechanisms to track academic progress of students and give them timely notifications of problems. The committee also suggests using available information from UHM records to determine differences between students who succeed vs. do poorly in certain classes required by the majors. This information should allow consideration of how to construct better interventions to help students remain in the major.

4.1.5 Outreach

With the increased engagement of the UH Foundation with the Dean of CNS, the committee suggests continuing to encourage faculty to identify needed items (endowed chairs, named scholarships, etc.) and potential donors (e.g., alumni, others interested in building naming rights) to support targeted fundraising.

The SoLS faculty have already taken important roles in outreach (e.g., leadership in establishment of the international Society of Island Biology, contacts with various government agencies, and leading NSF REU Sites grants to name just a few). Other types of outreach could include collaborations with mainland and international researchers where an equal exchange of ideas and concepts can occur, and the benefits for all investigators are clear. Such arrangements can be strengthened by applying for collaborative awards from various funding agencies and non-governmental organizations. Student and faculty involvement in scientific societies such as SACNAS and of student chapters or DEI committees of scientific societies will also help to broaden the reputation of the SoLS in the local and national scientific community.

The NSF requirement for all proposals to address Broader Impacts also encourages outreach programs for K12 activities and teacher training workshops, particularly working with under-funded, under-resourced schools and other DEI activities. At some mainland R1 institutions, outreach activities have been encouraged that include hosting community college students on campus to work with and participate in poster sessions from the host and visiting institutions (e.g., nearby Kapiolani Community College or students from community colleges with high native Hawaiian enrollments), and participation of faculty and graduate students in Ask-A-Scientist nights for science fair projects, etc. In other cases, greater involvement with the public (e.g., locals and tourists) where they are in public areas and university-managed facilities occurs, with informative talks related to the life sciences, related news items, or natural history or climate change issues related to Hawai‘i may be useful and interesting, especially for those interested in science communication. Collaboration with colleagues in Education or Social Sciences also may be productive for these activities.

4.2 Physics and Astronomy

Physics is a field that is at the intersection of applied mathematics and advanced technology. According to the American Institute of Physical (AIP), about a third of all U.S. physics undergraduate majors go on to graduate school, with the remainder working overwhelmingly in engineering (38%), computer technology (26%), or other STEM-related business (13%). Of those getting a physics PhD, about half go on to work in industry with the rest going into academic or government research. Thus, while much of physics teaching is in service to other majors, an undergraduate and graduate program is a hallmark of nearly all major research
At UH Mānoa, Physics is located in Watanabe Hall on the main campus, while the Institute for Astronomy (IfA) is located on a nearby satellite campus. The scope of this review does not include the IfA beyond the undergraduate degree program (centered in Physics and Astronomy), and meetings with beginning graduate students taking courses in Physics and Astronomy.

There are currently 19 tenured or tenure-track faculty in the department, which makes it about average in size for a university with the enrollment of UH Mānoa. In the period 2015-2020 the department generated $23M in external funding, or about $240k per faculty member per year. As discussed further in section 4.2.2 the funding is mostly generated by faculty in the areas of experimental particle physics and astrophysics.

Most of the teaching in the department is in service courses, which is typical for physics departments in general. The undergraduate program degree in Physics/Astrophysics/Astronomy had an enrollment of 101 majors averaged over FY17-19, a roughly factor of two more majors compared to FY10-12. This increase is mostly due to the introduction of a B.A. program in Astronomy and a B.S. program in Astrophysics in FY15. The graduate program in Physics (excluding Astronomy) has about 40 (most PhD) students enrolled, which is somewhat small for a department of this size. This is discussed further in Sec. 4.2.4.

In the 2018 USN&WR graduate school ranking, the UH Mānoa physics program is ranked 71st in the country, and is thus the highest ranked program in CNS. Other institutions tied for this ranking include William and Mary, Colorado State, LSU, Emory, and Boston College. The 2010 national Research Council also ranked the department very highly (3-20 range) in the criteria selected by scholars to be the most important, but lower (50-116 range) in faculty perceived ranking. This is roughly consistent with the USN&WR ranking.

This review finds the department maintaining this nationally-competitive level of research and education, although some significant issues that were identified that could affect this in the future. These issues involve graduate student support, administrative support, outreach and efforts, and faculty hiring. They are discussed in more detail below.

4.2.1 Previous External Review

The following is a summary of progress on recommendations from the previous review:

Past Recommendation: Assess the departmental climate as it impacts faculty, staff, and students in the Department of Physics and Astronomy. (This can be done as part of a college-wide assessment as recommended above.) Dean Roberts learned that some departmental stakeholders perceive a chilly and hostile climate. The review team could not confirm that this is the case, but it was concerned enough to believe that a careful assessment would be valuable. If serious climate issues are uncovered, the Vice Chancellor should consider hiring an outside facilitator to address the most important issues.

This remains to be completed at both the departmental and college level. It is suggested that the department should not wait for the college to do this, but rather move forward with their own survey.

Past Recommendation: The department should carefully examine its current policies and practices regarding the graduate program. In addition to the college-wide issue of inadequate financial support, two areas are of particular concern. First, graduate students reported a lack of transparency and some unfairness in offer letters written to prospective students, and in the treatment of current graduate students. Second, the department needs to develop a way to address the extreme resentment felt by some graduate students regarding the graduate students support levels offered by IfA. Unless the department is able to meaningfully deal with this issue, perhaps in collaboration with the dean and vice chancellor, it is easy to imagine that student resentment will continue to fester, and that morale problems will increase.
The department has made significant progress in both these areas. They have adopted the offer letter template that was provided by the CNS in 2019, which clearly lays out the salary and states that it is possible to apply for summer teaching, but does not promise that it will be available. For Research Assistants (RA), faculty were encouraged to hire at a higher salary level. The Chair reported that the average RA 12-month salary in the department is now $1,966 per month (roughly Step 13) as compared to the TA salary of $1,577 per month (Step 8). This is a significant improvement, and the Department is to be commended. During the meeting with graduate students, some expressed appreciation of this departmental effort for RAs, but the low TA salary remains a significant issue for them. This needs to be addressed at the college level.

Past Recommendation: The department should develop and implement simple strategies (faculty-advised clubs, social events, journal groups, etc.) that might bring undergraduates and faculty together for informal interactions.

The department has made significant progress in this area thanks to several energetic faculty. This is discussed in more detail in Sec. 4.2.3, but essentially this recommendation should be considered mostly completed.

Past Recommendation: Rethink the current departmentally-focused hiring plan, and consider whether an emphasis on broad “grand challenge” areas involving multiple departments and colleges might be a better route to success than standard disciplinary hiring. There are unrealized opportunities for collaboration within and outside the department. The ability to compete for large multi-investigator grants, to recruit top graduate students, and to grow the department’s stature will require the development of a more collaborative and entrepreneurial faculty culture. The department will continue to be relatively small compared to its aspirational peers for the foreseeable future. This makes it even more important to encourage the growth of scholarly communities that extend beyond the sub-disciplines.

The department has had discussions on this issue, and in meetings with the faculty there is a general consensus that there is a need to have an outward-facing strategy. That said, there is no written departmental strategy document that outlines future goals and priorities. Thus, further action on this recommendation is needed. This is discussed further in Sec. 4.2.2.

Past Recommendation: Develop a comprehensive strategy for recruiting and retaining a more diverse faculty in the Department of Physics and Astronomy. Possible approaches might include additional search committee training and broader search committee membership, avoiding whenever possible narrowly focused searches, and more vigorous efforts to identify potential applicant pools.

The department has made minimal progress in this area, with only three female faculty out of nineteen as compared to two in the last review - and that person was simply a transfer from another department. While the department has perhaps been hampered in part by the low rate of hiring, we note that of the three Assistant Professors on the faculty web page, none are women. This remains an outstanding issue that needs to be addressed.

4.2.2 Research and Hiring

Physics research is usually classified in the two main areas of Theory and Experiment. Theory research is mathematical and/or computational in nature and most PhD graduates go into academia, education, finance, or other industries. Experimental physics research is very much aligned with development of advanced technology needed to perform difficult experiments. Graduates tend to go into the tech industry, medicine, engineering, or in many cases they start their own companies. As an example, of the twenty PhD graduates in experimental particle physics since 2013, ten are now working in industry - four of them in Hawai‘i. Recently, three physics alumni helped to create Nalu Scientific, a local microelectronics company that has generated $11M in the last five years. This is not unusual, since according to the AIP roughly half
of all PhD graduates in physics go into industry.

In general, the physics research program at UH Mānoa is well-supported by external grants. While funding is not the only criterion in assessing a university research program, it is an objective measure of competitiveness, timeliness, and ability to support students in research. The department was awarded roughly $23M in external funding in the period 2015-2020, of which $15M was to support the program in experimental particle physics, and $7M was to support research in experimental astrophysics. Thus, these are by far the two largest research areas in terms of external funding and involve roughly three-quarters of the faculty. Of the thirteen faculty listed as having some external funding in this review period, nine are from one of these two groups. The committee also noted that two of the faculty received nationally-competitive research prizes during this review period: Prof. Varner was awarded the American Physical Society Division of Particles and Fields Instrumentation award in 2016, and Prof. von Doetinchem was received an NSF CAREER award. Such national recognition is another excellent another indicator of a strong program.

Since these two areas are such a major part of the department’s research program, it is critical that strength be maintained when considering future hires. The recent loss of Prof. Nishimura to the tech industry is a serious blow to this core part of the program, which should be addressed as soon as possible.

**Recommendation:** The department should consider the hire a faculty member in the critical core area of advanced instrumentation and electronics as a top priority in order to maintain this nationally unique and highly-visible program. Not only is this important for the scientific life of the department, but it is an area that is in tune with the university-wide goal of expanding research into areas important to diversifying the Hawaiian economy.

The Free Electron Laser (FEL) program has ended since the last review due to the passing of Prof. John Madey in 2016. This essentially ended the third major research program in the department, and they are now discussing options for the future. Options presented in their self-study include: (1) use of the existing FEL facility to initiate a program in Accelerator Physics, (2) found an accredited program in Medical Physics, (3) participation in the planned Electron-Ion Collider (EIC) at Brookhaven National Laboratory, (4) development of a program in Material Science, and (5) expansion of the nascent program in Quantum Information Science (perhaps in collaboration with ICS). Options (1) and (2) would potentially make use of the existing equipment in the now unused FEL laboratory, which represents a considerable investment by the university. Note that the department would like to pursue one or more of these initiatives while also maintaining the present strength in the other two major areas.

While this review is not tasked to evaluate these options for the department, they are to be commended for thinking “outside the box” when it comes to new hiring. We recommend that the department have in-depth internal discussions about which of these options to pursue, as probably no more than one can receive the major support needed to become nationally competitive. This is not an unusual situation for a physics department, and most address it by generating a formal Strategic Plan. This is not only useful in coming to consensus in the department, but also sends a signal to the college and university leadership that you have a clear plan for the future that they can understand and support.

**Recommendation:** The department should generate a formal Strategic Plan that articulates scientific goals, lays out a hiring road map, and relates the proposed plan to department, college, and university priorities. This is especially important in a time of limited hiring and where there are multiple potential opportunities to pursue. The audience of the plan should be the college and university leadership.

As an aside, the committee suggests that the department get advice on starting a medical physics program, perhaps from an external panel familiar with the field or from a university that has successfully initiated such a program. While this could be an exciting path forward, it should be understood that this would be a major undertaking that would require multiple hires and partnership with the medical school and/or a local hospital that has a radiation oncology capability. College and university buy-in to the program would be critical for success.
Teaching loads in the department are also an issue that affects research in addition to recruiting. The workload policy is that research-active faculty teach three courses per academic year, whereas at most peer universities it is two. This impacts research and graduate teaching. It also makes it more difficult to recruit young faculty, as they are quite sensitive to this issue and the best will seek go elsewhere.

The higher teaching workload compared to peers may be due to the fact that the Mānoa campus has a relatively small overall enrollment compared to other peer R1 universities. Thus, while less service teaching is needed, the number of majors courses that need to be covered is the same as that for a university twice the size. Since the size of the faculty is not way out of line with the campus enrollment, simply arguing that the department needs to hire another ten faculty members to reduce the load by one-third is not realistic.

**Recommendation:** The department should prepare a quantitative analysis of why peer institutions can have a lower teaching load and suggest realistic actions to the college to improve the situation based on that analysis.

One way to improve the situation might be to recruit teaching faculty to teach lower division courses. Such faculty at other universities are often assigned to teach 3-4 courses, depending on whether they are assigned service duties. Two such faculty would allow significant teaching relief for those involved in intensive research. The department would have to decide on what has a higher priority: less teaching or more research faculty to expand scope.

There is another minor but important issue in the workload policy. At many universities, buy out of teaching is also common. Essentially, the research grant pays for faculty teaching relief at a rate that is more than sufficient to hire a well-qualified instructor to take over the course for a semester. The current buy-out policy in the department (one-eighth of academic salary) does not generate enough funds to pay a qualified substitute, so such buy outs are rare. Making this a more feasible option could help faculty get periodic teaching relief during periods of intense research activity.

**Recommendation:** The department should look into the current policy on buying out teaching and how that can be changed to make it more realistic. It is important that the buy out amount be sufficient to hire a well-qualified substitute instructor for faculty who are starting new programs, or are in periods of intense research activity.

### 4.2.3 Undergraduate Education

The curriculum for a BS or BA in Physics is designed to prepare students for either entry into the technology-based employment sector, or as preparation for post-graduate studies. A recent study by the American Institute of Physics shows a roughly equal number of students going in each category. The requirements for a degree in Physics at UH Mānoa is very similar to other programs across the country. As previously stated, the program had an enrollment of 101 majors averaged over FY17-19, a roughly factor of two more majors compared to FY10-12. This increase is mostly due to the introduction of a B.A. program in Astronomy/Astrophysics in FY15, which has proven to be very popular. The department awarded 15 BS/BA degrees in 2019, which seems small compared to enrollment - but this is due to the fact that the students in the Astronomy/Astrophysics tracks were just starting to graduate in 2019.

One outstanding achievement noted by the committee is that the department supports an average of around fifty undergraduate research assistants annually, which is an excellent record considering the small number of faculty. This is a result of an active and well-funded research program.

The department provided Student Learning Outcomes (SLO) assessments for 2018 and 2020 (no 2019). Grades and student surveys were used to evaluate the degree to which goals were achieved. The surveys had only moderate participation by students, with about one-third responding. Issues were identified such
as a low rating on *Design experiments and analyze data through electronic instrumentation and devices, and computer control*. It is not clear what changes were made to the program due to the assessments.

One issue that has come up is time to degree, in that there is a considerable fraction of students who take five years. There are certainly issues with course scheduling and availability. Since the number of majors is small, many upper division required courses are only taught once per year. Physics is a subject that is very hierarchical in that many courses must be taken in series, so missing one critical course can cause a year delay in graduation. The department points out that improved advising could help this situation, but this remains to be seen. Physics undergraduate majors are unusual in that roughly half of them go on to graduate school. Admission is very competitive, and thus many students may choose to take an extra year to ensure they have excellent grades and a high Physics GRE subject score. In the experience of the committee, it is not unusual for Physics to have a large number of fifth-year seniors, and the department is not so different than other programs around the country.

One issue cited in that last review was establishing better communications and outreach with the undergraduate majors. These has been considerable activity in this area since the last review. For example, the department has an active Society of Physics Students (SPS) with a designated faculty advisor. The department has assigned the SPS dedicated space in the the forth floor library, and the committee was shown pictures of the students meeting there. Pre-COVID, the SPS also periodically hosted a “Lunch with a Professor” six times. The lunch events are hour long discussions, where the professors talk about their research, how they got started in physics, some pitfalls they have encountered, and why they love physics.

In 2019 the department participated in a 2019 meeting of the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) held in Honolulu and help to sponsor (with money and people) a satellite meeting of the National Society of Hispanic Physicists (Dia de la Fisica). The department also provided travel grants to allow four undergraduate women to attend the Conference for Undergraduate Women in Physics.

Thus, the department has initiated several important efforts in this area and should be commended. That said, the frequency of the lunches and is low and needs to be increased. If each faculty only did it once per year there could be two lunches per month. Although not a formal recommendation, the department should consider increasing the frequency of scheduled meetings of undergraduates with faculty. The Lunch with a Professor program is an excellent way to do this, but there could also be meetings where faculty give a short presentation on their research at the undergraduate level.

As a final note, during the scheduled meeting with undergraduates, no students attended. This is an indicator that there is still some work to be done in better communicating with the undergraduate majors, but in general the department is doing a good job here.

### 4.2.4 Graduate Education

The physics department has had a relatively stable enrollment of about 40 graduate students over the last decade, with a student to faculty ratio of about 2.1. This is modestly low compared to their listed peer institutions, where eight have a higher ratio and four have a lower one.

There are about 35 applications/year for the program and the department makes roughly 10 offers, of which about 8 are enrolled. Applicants are ranked using grades, letters of reference, GRE scores, and the needs of faculty if the student specifies an area where RAs can be supported. A financial incentive of $1,000-$2,000 is offered to top students, and the department provides a fellowship of $5,000-$6,000 for top applicants to do research with a faculty member the summer before the start of classes. In addition, first-year students are guaranteed summer teaching in order to enhance the very low TA salary.

The above procedures are common among physics departments, although some have decided to aban-
don the use general GRE scores (and in some cases, subject scores) in order to widen the pool of possible applicants in an effort to improve diversity. The department may want to consider doing this also, if there is not a good correlation between general and/or subject GRE scores and student success. In addition, the committee notes that the financial incentive amount is actually somewhat low compared to other physics departments we are familiar with. This could also affect the applicant pool and quality of applicants. For a faculty of this size, one would expect a higher number of applications.

**Recommendation:** The department should do a study of financial incentives being offered by peer institutions to determine if they are competitive at the current level. In addition, they should look at the correlation with GRE general and subject scores and consider if that is an effective tool to evaluate applicants in terms of their successful completion of the program.

Students have a curriculum that consists of a series of core courses followed by a written qualifying exam, oral exam, and a research thesis. This is fairly standard, although many universities now use the written exam as more of a diagnostic and/or give it more frequently that once per year. This allows students who did not pass to try again in six months rather than waiting a full year. While this is more work for faculty, the impact on the time students must wait before starting research could be significant.

In the scheduled meeting with graduate students, there were eight attendees (about 20% of the department). The group had a roughly equal mixture of students supported on an RA and students supported on a TA. A major issue raised was poor TA support. This is a college-wide issue and is discussed in Sec. 3. There was a realization that the department had made progress in support of RAs, but some students still thought that they were supported at a lower level than IfA or SOEST. The department may want meet with students to go through the actual data on this issue.

Another issue raised by the students was the consistency of the level of the exam, and whether or not is actually was based on material in the core courses. Several cited a mismatch between what was taught in these courses and what was actually on the exam. Some also asserted that there was inadequate description of what subjects should be studied and at what level, although old exams were generally available.

**Recommendation:** The committee suggests that the department should consider whether the current annual exam schedule is slowing down time to degree significantly, and assess what it would take to give the exam twice a year. In addition, the department should review the goals and scope of the examination make sure that there is faculty consensus on the target level of difficulty.

Finally, it was noted that graduate students do not currently serve on any departmental committees. In many universities there are student representatives on committees such as course scheduling, colloquium, outreach, and diversity. The review committee suggests that the department consider asking students to volunteer to serve on committee where appropriate, as this will improve communications and involve students more in the life of the department.

### 4.2.5 Diversity

The department has taken some actions in this area, such as joining the American Physical Society’s Bridge Program in 2016. This program identifies potential URM graduate student applicants, and the department currently has five such students enrolled in the PhD program. In addition, Prof. Bindi has been active in this area, and we note that she received the Mimosa D’oro Award from the Centro Culturale Guttuso, Italy, for her work in support of the advancement of women’s leadership roles in society and culture.

As previously noted, progress in increasing the fraction of women faculty in the department has been minimal with only one more than the last review, and this from a person who transferred from another department. None of the three Assistant Professors are female. While the ratio is not far from the national average, it would still be good to assess how the department identifies candidates, how they are interviewed,
and to follow-up on why candidates decline if they are offered a position.

4.2.6 Collaboration and Outreach

Much of physics is collaborative in nature, as typically no single university or research institution has all the facilities necessary for cutting edge research. This is a disadvantage in that it can be difficult to evaluate a department’s research program, since much of it may take place off-campus at national or international laboratories. On the other hand, graduates in this field are usually well-trained to work in effective teams and have a “world view” of science in general.

The UHM Physics Department has historically strong international connections to Japan through the Particle Physics Experimental (PEX)\(^4\) group (Belle II, Super-Kamiokande, KamLAND) and these groups remain engaged and effective. Since the last review period the department has also expanded collaboration outside the university through their work on the AMS-2 spectrometer and a new cluster hiring initiative in Astrophysics/Cosmology in collaboration with the IFA.

In addition to academic collaboration, the department has also established ties with the local tech industry through their program in advanced electronics and sensors (see section 4.2.2). Such collaboration not only has a direct benefit to the local economy, but also a broader impact through the training opportunities made available to students outside the classroom in economic areas that would help to diversify Hawai’i’s economy beyond the visitor industry. As an example, the committee was provided with a list of Ph.D.’s awarded through research with the PEX group, and we noted that since 2016 five graduates are now working in the local tech industry. The department is encouraged to further pursue this possibility through establishing closer connections to local businesses and community leaders, perhaps through an advisory board or other formal settings where faculty and students meet with community leaders.

Recomendation: The Department should seek ways to further expand existing connections to business and the local leaders in such a way as to become more visible to the local community and students. A departmental External Advisory Board may be a way to do this, with members drawn from prominent alumni, relevant government leaders, and local educators.

This would not only help make to department more connected locally, but could also improve alumni and potential donor contacts. Currently, the department has no endowed chairs and few student fellowships based on direct contributions. Fund-raising issues are seen as a College and Foundation effort, which is not the most effective way to make improvements in this area.

Another area that is an objective measure of an active and relevant physics research program is direct engagement with U.S. National Laboratories. The department is doing very well in this area, with at least five on-going projects cited. Another suggestion would be to look into the possibility of university-laboratory joint positions in areas of common interest. For example LBNL, FNAL, and ORNL all sponsor such positions, often at the start of major projects centered at the lab. While these positions usually negotiated at the institutional level, they are sparked by grass root interest at the lab and universities.

4.2.7 Facilities and Staff

While an in-person tour of Watanabe Hall was not possible, a recorded video tour was provided. While the building itself is over fifty years old most of the spaces seem in reasonable condition, albeit in many cases the desks and chairs seem of original 1960’s vintage. Laboratory spaces are cramped and old, but some have been upgraded with funds provided by faculty research grants and these look like state-of-the-art facilities.

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\(^4\) Also sometimes referred to as the High Energy Physics group
\(^5\) i.e. inclusion in the annual research budget
\(^6\) Belle II, XRM, DUNE, WATCHMAN, NuLat
The electronics development lab and clean room facilities are particularly impressive.

The shop facility has both semi-obsolete machines from the 1960’s and more modern computer-controlled equipment (provided by individual faculty research grants). This is somewhat below the standard of most modern physics departments at research universities, but it seems the department operates this directly, including managing the support staff of two people. The committee understands that there is now only one person due to the departure of an experienced operator, but it was not clear if this is a temporary situation due to the hiring freeze or more permanent. Most university machine shops have more than a single machinist to ensure continuity in the facility for both research and training.

The committee notes that at many universities, such facilities are part of a shared resource operated by the college or campus. While this does not rise to the level of a formal recommendation, the department might consider joining with other units with similar shop needs to increase the staff head count and also to gain access more machines. Also fairly standard is a small charge to research grants to be able to better maintain the facilities.

Administrative staff support is very weak, with only one senior staff member and two administrative assistants for the whole department. In addition there is only 0.5 staff for IT support. For a department of this size and activity, at least twice this level would be normal in the experience of the committee. While faculty at many universities always express some frustration with the level of staff support, the anecdotes shared with the committee are concerning. While the department cannot simply hire more staff by itself, an objective assessment of the problem and a quantitative comparison with peer departments would at least serve to make the issue clear at the college and campus level. Thus, the committee suggests that the department should quantitatively assess and document the staffing needs, specifically highlighting the limitations this is putting on the educational and research program. This could be combined with a college-wide administrative assessment.

4.3 Mathematics

4.3.1 Undergraduate program

The Department offers both a BA and a BS degree and has recently added a Data Science track within the BS degree. Approximately 2/3 of students are enrolled in the BS option (28 to 59 in AY20-21) and this ratio has remained steady over the last five years. Surprisingly the number of BA and BS degrees awarded is more similar (11 to 15 in AY19-20) and the number of graduates awarded each degree over the past five years is even more similar, perhaps reflecting a shift in student enrollments starting in AY15-16. A new Computational Mathematics track and an Actuarial track are planned and the department is developing new courses to support these tracks. The department is coordinating with the College of Education to create a 5-year BA plus practicum (BAP) which will allow graduates to simultaneously attain a mathematics degree and a teaching licensure.

Relative to the overall size of the university, the number of Mathematics majors at UHM is smaller than its peers. The department has graduated an average of 12 BA and 12 BS students each year over the review period. A broader range of options, including two directly career-oriented options (Actuarial and Education), and a Careers-In-Industry initiative to address the perception of a lack of opportunities for Math majors, should help. Efforts to grow the major are hampered by a lack of support in terms of recruiting efforts, a tiny communications team and by the overburdened advising team who lack the time to identify and encourage potential new math majors and/or potential double majors.

As discussed in §3, the Learning Assistant program is well thought out, as is the training of GTAs and the progression of TA assignments as the students gain experience. It is encouraging that faculty are willing to incorporate new teaching strategies such as active learning. Two new positions, a Director of Undergraduate Studies and a Precalculus Coordinator are valuable additions. It is noted that Mathematics has the highest persistence rate of all undergraduate majors in the college.
MATH 100 is a general education class for non-STEM majors with an average enrollment of over 400 students from AY09-10 to AY18-19, and currently enrolls nearly 1000 students. It is taught by faculty and attempts to connect with UH Mānoa’s mission as a Native Hawaiian place of learning by introducing relevant motivations and examples. The effort expended in this class has resulted in an enviable DFWI (D, Fail, Withdraw and Incomplete) rate of less than 20% over the same 9 year period, and from 2014 onward was less than 15% indicating continuing attention to this important courses. Similar courses at many other universities suffer from large DFWI rates and the success rate of this course reflects an impressive level of effort and expertise.

There is a significant problem with repeatedly hiring instructors at the last minute, making it difficult to maintain consistently high quality instruction and undoubtedly impacting student success. Four, five and six year graduation rates for UHM as a whole lie below those known for peer institutions, but campus wide 4-year graduation rates have made impressive gains over the last 15 years. Median time to graduation in Mathematics is less than both the CNS and UHM median times.

Unfortunately no undergraduate students attended the review session and the impact of the CNS Learning Emporium was unclear.

**Recommendation:** Continue efforts to grow the number of majors. For example, continue to develop and market new concentrations in Actuarial Science, Computational Science, Data Science and Mathematics Education. Develop and advertise a capstone experience or upper division class(es) tailored for each new concentration.

**Recommendation:** Actuarial track: Seek to support students to take the initial professional exams during their undergraduate program. This is ideally accomplished by hiring an alumnus to run a weekly exam preparation seminar.

**Recommendation:** Undergraduate research poses significant challenges in Mathematics, yet is an effective way of increasing student engagement and is widely considered to be a “best practice”. Consider how a small number of such opportunities might be developed and supported.

**Recommendation:** Incentivize summer and distance course offerings for which there is a direct return of a percentage of revenue to the department

### 4.3.2 Graduate program

The graduate program enrolls ~40 students with 30 TA positions and a roughly 3:1 ratio of PhD to MA students. The department graduates on average 5 MA degrees and 3 PhD degrees per year. The median time to graduation is unclear. The demographic composition of the most recent entering class was just under 50% female (5/11), with just over 50% (6/11) non-white and 1 student of Hawaiian descent. Financial support is low, particularly when adjusted for cost of living meaning many students take additional jobs, take out loans or rely on continuing family support. All provide a barrier to increasing diversity.

A small group and energetic group of graduate students attended the review session. As noted above, the department implements a well-designed progression of GTA teaching responsibilities, including a 1-credit TA training course. The new, more flexible PhD qualifying system is well supported by regularly scheduled classes that prepare students for the qualifying exams. However, adequately (and appropriately) supporting the PhD qualifying system coupled with the small number of faculty creates difficulties for providing advanced graduate level classes. Based on the interview with a subset of graduate students there is a healthy balance of PhD students aspiring to research careers and those seeking teaching careers. Private offices for advanced graduate students working on their dissertations are an asset, but there is less than ideal office space for beginning graduate students

**Recommendation:** Seek to create a combined work/study space for junior graduate students to build a cohort. The pandemic which has challenged graduate student sense of community has highlighted the importance of peer learning.

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7A grade of D is included in the DFWI statistic since a grade of D typically does not allow a student to progress to the next course. As a general education class, the ability to progress is not an issue for the majority of MATH 100 students.
4.3.3 Postdoc program

The postdoc program, implemented since the 2014 review, is an excellent addition to the teaching and research missions of the department, greatly enhancing the energy and vitality of the department. It also provides a level of classroom instruction beyond that provided by instructors and graduate students, and affords mentoring and role models for graduate students.

However, the postdoc program has recently shrunk since its peak of 7 in AY 16-17 and AY 17-18 due to an inability to receive permission to hire and replace postdocs coming to the end of their contracts. Continued insecurity around the program and last minute permission to hire a new postdoc limits the ability to build a large, more diverse pool and to attract the best candidates, and hinders the faculty’s ability to promote the program among their peers.

4.3.4 Staff

Adequate staffing and efficient communications between staff and other department members and between staff within different units of the university is essential for the effective operation of any large university. The department is understaffed compared with peers which hampers these important activities.

Advising is organized as a college-wide activity. The observation that the student to advisor ratio in the College of Natural Sciences is 2.5 times the national norm, and the recommendation to seek resources to substantially increase the size of the advising team appears in §3.5.

Recommendation: Obtain permission to hire at least one FTE. The ability to cross-train staff in order to mitigate the effect of a pending retirement has been limited by covid and current workload. It is therefore important to not only replace this position, but to be allowed to hire a replacement before the experienced staff member retires in order to allow for adequate training and transfer of institutional knowledge.

4.3.5 Faculty

Since 2014, 10 faculty have retired and one faculty member has passed away. There are currently 21 faculty in the department, 13 of whom were hired prior to 2014, with the remaining 8 hired since 2014. The department includes 10 full professors, including the Dean, 6 Associate Professors and 5 Assistant Professors. Many of the recently hired faculty work in applied areas, with 7 of the 11 faculty at the assistant and associate level working broadly in applied mathematics and statistics. Nine faculty members have active research collaborations outside the department. Seven are engaged in research directly related to Hawai‘i, its environment, infrastructure and economy. Impressively, 17 of the 21 tenure track faculty have received funding during the review period including prestigious NSF CAREER and NSF FRG awards. Further, faculty productivity as measured by the admittedly single, crude metric of publication rate has increased. The faculty has also organized a number of conferences and the location in Hawai‘i is an attractive incentive for participants to attend. Nearly every TTF member has advised a PhD or MA project during the period since the last review.

The number of TTF faculty has decreased during the review period. Individual faculty workloads increase as faculty shrinks and as student numbers increase, e.g., more internal and external committee service per FTE, larger classes. This drop in FTE and the hiring freeze produce a precipitous drop in number of classes delivered in AY20-21 and AY21-22, and in a 12% decrease in SSH taught in Math from AY18-19 to AY20-21 during a period when the UHM as a whole grew in size by 1%.

Suggestion: An increasing reliance on instructors to deliver certain components of the curriculum need not be a negative development if the instructors are stable from one year to the next, committed to, and skilled in their craft, and where there is mutual respect and acknowledgment that both TTF and instructors are on the same team pursuing overlapping but different aspects of the same vision. Seeking the right balance is a challenge in the best of circumstances but it becomes unlikely if not impossible in the context of rapid turnover of NTTF and given examples of poor performance and student complaints. Late approval to hire and non-competitive working conditions and salary exacerbate any problems and friction. Similarly, a healthy postdoc program provides additional high quality teaching at a level beyond that available from instructors and GTAs, as well as supporting the research mission and the appropriate balance must be struck.
Recommendation: Establish a multi-year hiring plan acknowledging the need to create a critical mass in defined areas of both pure and applied mathematics, including tenure track faculty, postdocs and long term instructors. See discussion in §3

Suggestion: Developing new strengths and including new specialities within a department necessarily causes stress and discomfort. This becomes even more acute when the faculty size is simultaneously shrinking as has occurred within the Mathematics department during the last review period. It is widely understood that there is a need to maintain a critical mass in essential areas in order to maintain and advance educational programs, stimulate research efforts and scholarship, and to populate seminar series. This argument applies equally whether the area in question lies within what are traditionally considered pure fields or those that are traditionally considered to lie within applied mathematics. Neither “pure” nor “applied” mathematics are monolithic entities. It is important to seek agreement among the faculty for which areas within each of these two larger, somewhat arbitrary groupings must be supported to meet the goals of the department, recognizing the inevitable limit on faculty numbers. That said, mathematicians must bring something new and unique when seeking to advance knowledge in applied areas and those skills most commonly rely on their training in traditionally “pure” areas.

4.3.6 Outreach

The department has been running a Math Circles since 2011 which meets approx 8 times per year. A NSF funding program SUPER-M supported graduate students to work in local schools for up to 15 hours per week. While funding through this grant ended in 2016 there is an ongoing partnership with the Institute for Human Services in Iwilei. The department has also supported challenge days addressing restoration projects.

Recommendation: As recognized in the self study, there is a desire to regularize and establish institution to institution relationships rather than relying on person to person interactions, and to construct ways of providing appropriate recognition. Seek to establish a regular sources of funding as well as year-by-year or short term individual initiatives. Perhaps an target for alumni development.

4.3.7 Assessment

Median time to degree is a somewhat unusual metric. Four-, five and six-year graduate rates are more common. However, by this metric, Math is performing slightly better than CNS and UHM as a whole. This is a work in progress. Ensure it is scalable if plans to grow major are successful.

Recommendation: Institute an exit survey for Math majors to complement the capstone course as an assessment tool, particularly given the range of new degree tracks.

4.3.8 Facilities

Sadly, this section must begin with an opportunity lost. A recent remodeling program has ignored several, relatively minor faculty requests. While disagreements over faculty preferences may seem petty, mathematics faculty perform their teaching, research and service roles at a very high level given minimal facilities and minimal budgets, and small decisions and small financial outlays can provide enormous returns in morale. Unfortunately, many offices and classrooms become too hot despite A/C. A modern mathematics department needs a modern computing lab that has a financial model for maintenance and periodic refresh of all equipment. The department struggles with a shortage of space for meetings, group grading of multi-section exams and make up exams. Current makeup exam space is in a janitorial closet next to a refrigerator. This latter in particular seems ripe for student complaints. GA accommodation could use a bullpen (see previous recommendation). There is an opportunity to convert existing faculty bathrooms to an all gender wheelchair accessible bathroom.

Recommendation: Develop a rank-ordered multi-year renovation plan for math department space
4.3.9 Response to recommendations from 2014 review

MATH 1: The Department of Mathematics should receive permission to recruit aggressively in view of the anticipated retirements. One strategy is to allow them to make more offers than there are vacancies during a recruiting cycle. Given that not all offers are successful this will increase the probability of a successful recruiting season. In the unlikely event that too many offers are accepted this will merely decrease the number of recruitments in the subsequent year.

Please see §4.3.5.

MATH 2: The Department should think strategically about how to approach the large number of current and expected recruitments. Ideally the plan should identify areas in which the Department might like to establish or enhance its reputation. The plan should also integrate collaborations with other departments in the college and relevant units outside CNS.

The successful hiring since 2014 has been acknowledged above, but has resulted in a shift in department focus. While 7 of the 11 faculty at the assistant and associate level working broadly in applied mathematics and statistics, only 3 of the 10 professors work in this area. While department composition and focus cannot remain static, this change places a strain on student training at the undergraduate and particularly at the graduate level as described above and leads to a renewed recommendation to create a multi-year plan and to construct more targeted advertisements.

MATH 3: The Department should develop an approach that incorporates differential workload to reward and incentivize faculty achievements in research. The appropriate teaching workload for research active faculty in peer (and aspirational peer) departments is 3 semester courses per year. Currently the workload for all faculty members is 4 semester courses per year.

Following this recommendation the teaching load has been reduced from four to three courses per year for research active faculty. The faculty have responded positively to this reduction and the number of faculty receiving external funding has increased from 7 out of 25 in 2014 to 17 of 21 in 2021 and the average publication rate, admittedly a single, crude metric, has also increased.

MATH 4: The Department will be challenged to meet its teaching obligation and to insure high quality instruction while dealing with faculty vacancies and reducing the teaching load of research active faculty. This can be addressed if the Department explores the use of teaching specialist faculty (these have a variety of titles in other institutions). Such faculty can contribute a great deal to meeting increasing student demand for courses and to enhancing the quality of instruction.

The department has hired a tenure-track specialist (S-3) who serves as the Director of Undergraduate Studies, and a Precalculus Coordinator, which is a permanent, non-tenure-track position. The Coordinator also trains and assists new GTAs.

MATH 5: The review team applauds the Dean’s commitment to initiate a post-doc program in the Department. Such individuals can enhance the research reputation of the Department. We recommend that the build out to three post-docs continue.

The department has implemented a postdoc program with numbers varying from two in AY14-15 to a maximum of seven in AY16-17 and AY17-18, but has since declined to four in AY21-22. Issues with maintaining this successful program are detailed in §4.3.3 with the consequent strain on teaching capacity.

MATH 6: Develop a strategy for recruiting and retaining a diverse faculty. Possible approaches include search committee training (e.g., about implicit biases), broader search committee membership, avoiding narrowly focused searches, and making an effort to identify the broadest possible applicant pool.

The faculty composition has changed such that the proportion of female faculty has increased from 3 in 25 to 7 in 21, and the proportion of minoritized faculty has increased from 2 in 25 to 4 in 21. All such efforts are strongly supported by an official spousal accommodation policy and the university’s decision to suspend this program will be detrimental to this and other initiatives.

MATH 7: The Department of Mathematics needs to quickly fill the staff opening in the Department. Any support that can be provided by CNS administration to enable rapid completion of this recruitment would be welcome.

The department remains one FTE short as noted in §4.3.4, but is subject to a hiring freeze.
### MATH 8: Renovation of Keller Hall

Renovation of Keller Hall should be a high priority for the College of Natural Sciences and the campus.

Keller Hall has been renovated, but with some remaining issues (see §4.3.8) and a lost opportunity to improve faculty morale as some seemingly minor faculty recommendations were not implemented.

### 4.4 Information and Computer Sciences

The Department of Information and Computer Sciences (ICS) contains two distinct programs, one in computer science and the other in library and information science (LIS). In 2022, the LIS program will separate from ICS and join the School of Communication and Information, so LIS is not included in this review. Excluding LIS faculty, ICS has 18 full-time tenured and tenure-track faculty members, of whom only 2 are Assistant Professors. The ICS Dept offers a B.S. degree in Computer Science and a B.A. degree in Information and Computer Sciences. The number of students enrolled in the B.S. degree has increased by 80% (from 248 in 2011-12 to 467 in 2019-20) in the last 8 years, whereas the B.A. degree program has remained the same in size (113 in 2019-20 as well as in 2012-13). The M.S. and Ph.D. program has gone from being nearly equal in size in 2011-13 (about 20-25) to the present day where the number of MS students is double the number of PhD students (36 vs 18). Total research grant expenditure has been over $1.25M in each of the past 3 years with a considerable uptick to over $2.6M in 2020.

During the remote visit, the departmental reviewer Prof. Inderjit Dhillon conducted a review that included meetings with the chair Scott Robertson and associate chair Guylaine Poisson, the graduate chair Dan Suthers, the ICS faculty and students. Attendance was robust — in separate meetings, 11 faculty members, 6 undergraduate students and 8 graduate students attended. In addition to a slide presentation on the ICS space on the 3rd floor of the POST building, a video on the Laboratory for Advanced Visualization & Applications (LAVA) and Hawai’i Data Science Institute (HIDSI) was provided.

Based on the meetings with the faculty and students, and from the written communication (previous review report, responses to the report and chair’s self-study report), the following key issues arose.

#### 4.4.1 Previous External Review and Followup Actions

The ICS Dept was reviewed recently in 2019 as part of a larger review of computing related programs at the university, including the computer engineering activity in the Dept of Electrical Engineering (EE) in the College of Engineering. The 2019 review noted the the strength of the ICS faculty, and the importance of computer science at the university to serve the increasing student enrollment as well as its role in inter-disciplinary research. The review also identified weaknesses in terms of under-performance in terms of student-faculty ratios, amount of research funding, and quality of graduating students. To fix these weaknesses, the review made several recommendations for the ICS curriculum, its faculty, and its structure and leadership.

The department has responded positively to some of these recommendations and formed a “Change Team” within the department. Among other changes, the following steps are being taken. A curriculum review team is streamlining the ICS curriculum and coordinating with offerings in the College of Engineering. To improve the software skills of students in a project setting, a senior-year capstone requirement has been approved and implemented. Assessment instructions of early ICS courses are being developed, and an annual student survey is being designed. Finally, an external advisory board has been formed to connect ICS with the local business, defense and government sectors.

In general, the department has responded positively to the recommendations to improve the undergraduate program, especially with a goal to produce students adept at project software development. The 2019 review also recommended mandatory annual reviews of all faculty members, and recruitment of new faculty with a more practical bent. For the long term, the 2019 review gave various options for structural changes to the organization of ICS and possible consolidation with the EE department in the College of Engineering. This review did not evaluate the EE dept and so there are no recommendations in this report regarding any structural change.

**Recommendation:** The department should make sure that the changes to the undergraduate program are completed, and have a process by which feedback from the student body and the external advisory board is taken into account to further improve the quality and employability of the graduating students. Faculty
evaluations, in terms of contributions to research, science and service should be done on an annual basis, and meaningful incentives should be given to high performing faculty members. Urgency should be shown in the hiring of new faculty in selected areas of excellence. The by-product should be an increase in research funding and more inter-disciplinary research with other departments. In the short to medium term, the student-faculty ratio is unlikely to decrease, and the department will continue to face the current challenges of large undergraduate enrollments. So irrespective of the decision to merge with other computing departments on campus, ICS should offer more joint courses with EE and Mathematics, and encourage faculty to cross-list courses with other departments. With the new programs in Data Science and Security, faculty in other departments should also be encouraged to crosslist relevant courses in computer science.

4.4.2 Undergraduate Education

As mentioned above, the B.S. degree enrollment has increased significantly over the last 9 years while the B.A. degree enrollment has stayed the same. Meanwhile, the faculty size has remained about the same. While steps such as a new capstone project requirement and the new interdisciplinary concentration in Data Science and Creative Computational Media are positive, the students are facing many challenges. Graduate Teaching Assistant (GTA) support for courses is inadequate, and the small GTA pool means that sometimes the course GTA does not have the requisite background, for example, students complained of a GTA being unable to program in the programming language being taught and tested in the course. Students were also frustrated with inadequate course offerings, and being thrown in at the deep end in courses whose prerequisites were not properly specified and/or conveyed to them, for example, for courses in the Data Science concentration area that require math background. Students expressed interest in being exposed to internship opportunities, especially in industry.

Recommendation: The department needs to increase the quantity and quality of GTA support. It should be ensured that the GTAs know the course material well. A dedicated faculty specialist/advisor should ensure that courses are planned and sequenced in advance, and course prerequisites are clearly specified to the students, especially in the new concentration areas of data science and security. Since the differences with the B.S. degree have disappeared over the years, either the B.A. program should be removed, or changes should be made to the B.A. degree by working backwards from the desired student outcomes but without “watering” down its quality. Students should be advised about internship opportunities, career fairs, and be exposed to research opportunities.

4.4.3 Research and Graduate Education

In 2018, the ICS Department ranked 119 out of 188 schools in the U.S. News and World Report Best Graduate Schools in Computer Science, and is ranked in nine specialized areas in CS rankings (according to www.csrankings.org). The department has made some excellent hires lately, and research funding is on the uptick and has exceeded $2.6M in new external awards in 2020. However, more than 70% of the funding comes from only 2 professors. The department is very top heavy, with only 2 out of its 18 faculty being Assistant Professors. The number of PhD students has declined by 25% in the last 4 years (24 in 2016-17 to 18 in 2019-20), and the time to completion of the PhD degree is rather long (8.1 years without MS, and 6.9 years after MS). Due to the low TA salaries, many PhD students end up taking up external jobs to supplement their income and become part-time students. Graduate students indicated that they felt isolated and “on their own” during their studies.

Recommendation: Hiring high-quality junior faculty is of the utmost importance. The department should also increase the size of its Ph.D. and M.S. programs. To fund this increase, more research funding should be brought in by more of the faculty. The department should provide administrative support for grant preparation and management. The increased RA funding would allow students to concentrate on their dissertation research, and decrease the time to get their Ph.D. Increasing the number of junior faculty and the size of the PhD program, while decreasing the time to get a PhD, are needed to regularly inject “new blood” into the department, which is a very important component of a successful research program in a rapidly changing field like computer science. To spur research, professors should be freed up to teach more advanced graduate research-oriented courses; this could be done by hiring more instructional faculty to teach
the service courses, possibly by tapping into the local industry. This would give a greater choice of courses to the graduate students, a current source of frustration. The department should take steps to increase well-being and a community feeling among students, for example, by having a department funded weekly tea/snack gathering where graduate students as well as faculty participate.

4.4.4 Facilities

The ICS Department occupies the third floor of the POST building on campus. The office and teaching spaces are adequate. There is a central social space but it is windowless and students have tended not to use it (recently due to covid). The Laboratory for Advanced Visualization and Applications (LAVA) has excellent space and facilities in Keller Hall.

**Recommendation:** The teaching labs have aging desktop PCs which should be removed. Since most students bring their own devices, it might be better to replace the PCs with monitors and docking stations. A more welcoming social space should be made available for students to mingle and interact with each other and with faculty.

4.4.5 Diversity

The department has made strides in increasing the number of women students as well as faculty. Representation of women in ICS is just over 20% among undergraduate as well as graduate students. Over 80% of the undergraduates are from the state of Hawai‘i.

**Recommendation:** The ICS department should continue its work on outreach to local high schools, and making scholarships available to native Hawaiian and women students in their activities, for example, their summer boot camp.

4.5 Chemistry

The mission of the Department of Chemistry is to train students and explore new frontiers in the fields of Chemistry and Biochemistry. The Department is at an intersection of biotechnology, materials and planetary sciences and has an opportunity for strong engagement across UH Mānoa. The role the department plays in undergraduate education is critical, as it is responsible for a number of gateway courses for a range of degree programs. Six degree programs are offered—the B.A. and B.S. in Chemistry, the B.A. and B.S. in Biochemistry, and the M.S. and Ph.D. in Chemistry. The Department is comprised of 12 tenure-line faculty members, with seven tenured (full) Professors, one tenured Associate Professor, three untenured Assistant Professors, and one untenured Assistant Specialist.

During the remote visit, the departmental reviewer Prof. John MacMillan conducted a review that included meetings with the chair Philip Williams, the graduate chair (and Associate Department Chair) Joseph Jarrett, the faculty and students. With the exception of undergraduate students, attendance was robust—in separate meetings, 8 faculty members and 11 graduate students attended. No undergraduate students attended the scheduled meeting time. In addition to the meetings, a video of Bilger Hall, the location of all of the Chemistry Department was provided. The external review team was also provided with material about the Department of Chemistry prior to the campus visit, including: a self-study report, faculty curriculum vitae, data around student success, assessment reports dating back to 2014.

Over the course of the virtual visit, it was clear that there are substantial issues faced by the department that are driven by the small faculty, facility limitations and lack of resources to pay adequate salaries to graduate students. A strategic plan around faculty hiring that takes into account growing areas of federal funding for chemistry along with new career opportunities for trainees would be of high value.

4.5.1 Previous External Review and Followup Actions

Since the previous review there has been positive attention given to undergraduate education. This includes reworking a number of lower division courses that are beneficial to student success. Furthermore, the continued development of the B.A and B.S in Biochemistry has been highly welcomed and has emerged as a
desired major that will continue to grow in interest.

Past Recommendation: Continue addressing low success rates in gateway courses, such as General Chemistry and Organic Chemistry.

There have been modest improvements in both general chemistry and organic chemistry courses. The results are attributed to innovations and improvements in the classroom, such as increased use of Learning Assistants and mandatory scheduled recitation sections. A major addition was the hiring of a specialist to focus on enhancing the General Chemistry experience (classroom and labs).

As a result, the DFWI rate in Organic Chemistry was the lowest it has been in some time, 7% lower than historic norms and 20% lower than its peak a few years ago. While this is a positive improvement, there were significant concerns raised from multiple groups in CNS that further work is needed to improve the DFWI rate in organic chemistry. While the high DFWI rate emerges in Organic Chemistry, many of the issues are related to preparation in previous coursework.

The use of the ACS Organic Chemistry I Final exam as an assessment for the transition from Organic I to Organic II demonstrates the challenge faced by the faculty. Administration of the exam at the start of Organic Chemistry II in Spring 2021 resulted in more than 2/3 of the class scoring below the 40th percentile. Scores on this assessment exam of Organic Chemistry I material directly correlated with final scores in Organic Chemistry II. This is a valuable assessment to continue.

There have been improved class averages in GenChem II with the most significant impact in the ratio of “D” to “C” students.

While there have been improvements, there is a hesitancy by a portion of the Chemistry faculty to engage in modern teaching practices and take advantage of the resources being developed on campus.

Past Recommendation: Collaborate with faculty outside of Chemistry on research and a faculty-hiring plan to develop broader connections on campus.

The department has connections and references to submitted grants with other Departments in CNS (School of Life Sciences, Institute for Astronomy, Dept of Physics), the UH Cancer Center, Hawai’i National Energy Institute, Dept of Engineering, Pacific Biomedical Research Center, Hawai’i Institute for Geophysics, and the John A. Burns School of Medicine. However, there were no specific joint grants referenced. With the changing funding landscape and emerging opportunities from NSF, DOE, NASA, DOD, building multi-disciplinary research programs should continue to be an important area of focus.

Past Recommendation: Improve engagement with Undergraduate Majors.

Unfortunately no undergraduate students showed up for the meeting with the review team, so little can be said on progress in this regard.

Past Recommendation: Increase the number of externally supported research assistants to enable the growth of the Department

There has been some improvement in this regard, with 25% of graduate students supported as research assistants. At the same time, the need for teaching assistants to support the undergraduate curriculum limits the number of students that can be supported as research assistants. To increase the number of externally supported research assistants will require growth of the graduate program to support both the education and research missions of the department.

4.5.2 Undergraduate Education

The Chemistry department continues to offer six programs, as outlined above, with a goal to prepare students to have careers in a variety of different employment sectors or as preparation for professional or post-graduate programs. The degree requirements are in line with the standards set forth by the American Chemical Society. Enrollment in degree within the department has increased by over 10 percent since academic year 15-16, as well-trained Chemistry and Biochemistry graduates continue to be in high demand for STEM jobs. There
are currently 259 majors in the undergraduate degree programs. In line with national trends, there has been a shift towards more students as biochemistry majors (nearly 2/3).

There have been some areas of progress in terms of student success: The median time-to-degree over the last 11 years for students in the Chemistry department is 3.82 years, with a low of 3.66 years in 2020. This is compared to 4.77 years at the previous review. There is some variability year-to-year with cohorts, however, the trend is generally positive. This is a result of well designed curricular improvements that allow for the third and fourth year to be completed interchangeably based on completion of prerequisites. Proactive advising by tenure-track faculty of all Chem/Biochem majors on an annual basis has also made an impact.

The development of new upper level courses for chemistry majors to expand their opportunities is a positive. As an example, the Experimental Methods in Material Research (Chem 435), is an excellent hands-on course in a critical area of growth in career opportunities. This course could serve as a central point in the development of a Materials Science Track, however, it will require significant resources to further development. Importantly, this would be in line with the strategic plan of the university.

Given the large number of SSH that the department is responsible for teaching (7500 Fall, 6700 Spring), which is the second highest of all departments on campus, and the small faculty size, there will be challenges to continue to offer the full range of courses necessary for accreditation.

**Recommendation:** As part of a comprehensive faculty hiring plan (also discussed below), take into consideration the range of courses that need to be taught in the different degree requirements and evaluate hires that can teach in a range of courses.

The persistence rates for Chemistry degree programs are lower than other physical science disciplines, with recent years having persistence rates between 65-70 percent. There are no clear answers provided for where students go when they leave a chemistry degree program.

**Recommendation:** Work with MIRO to understand the cause for attrition from Chemistry degree programs and where these students matriculate.

### 4.5.3 Research and Graduate Education

Faculty in the Department of Chemistry have demonstrated good productivity, as observed by publication rates and external funding. Nearly all tenure-line faculty are supported with some level of external funding, with a total of $13.4M of contract and grants in the review period. This is highlighted by a number of early career faculty receiving NSF Career awards. It should also be noted that 42% of external funding can be attributed to a single faculty member.

During the time period, the US News and World Report ranking of the department dropped to #145 out of 204, which is a decrease since the previous review, and down from a high of #80 in the early 2000’s.

The size of the faculty (12 tenure-track faculty FTE’s) is not sufficient to support the teaching and research goals of the department. In the 2014 report, there was an outlined plan to grow the faculty from 10 tenure-line faculty members to 20, however after an anticipated retirement at the end of this year, the faculty size will only be at 11. This is significantly below the norm for an R1 Chemistry Department (exacerbated if a combined Chemistry and Biochemistry Department). While the faculty have covered all of their responsibilities, the large teaching and service loads have an impact on the ability to devote time to research. There was an identification of an immediate need of two or three tenure-track FTE with a commitment to grow to the 2014 plan. There was a strong feeling by the faculty that support for the needed hires was lacking.

There are varying levels of dissatisfaction amongst faculty with the internal process and selection of focus areas for new faculty hires. Not all faculty members feel the process is inconclusive and takes into consideration emerging areas in chemistry and funding growth.

**Recommendation:** Develop a comprehensive a FTE growth strategy that is supported by the Department, Dean and Provost. The faculty has been effective and efficient at meeting it’s core teaching mission despite the small size, however with larger enrollments and new demands, it is not sustainable and there is a risk of the department losing American Chemical Society (CS) accreditation.
The faculty hiring plan should be developed that addresses: 1) emerging areas of chemical science that can be supported by a greater range of funding agencies, such as NSF, DOE, DOD, etc; 2) build on opportunities of collaborative science in areas of strength at UH (SOEST, Astrophysics and Astronomy). 3) due to small faculty size, new hires that have a range of flexibility for courses that can be covered.

**Recommendation:** Develop a teaching workload policy that takes into account highly active and funded research programs.

With the small number of faculty FTE, all faculty are called upon for heavy service and teaching loads, however supporting research excellence is critical to raising the departments profile internally and externally.

**Recommendation:** Improve the efficiency of the faculty hiring process. The process for making formal offers leaves the department at a competitive disadvantage to other schools that move forward on offers more quickly. This is particularly true for DEI hires.

The size of the graduate program has been consistently around 40 students, with an average of 10 new students per year. There continue to be limits on the number of highly qualified applicants in the pool for graduate students. This has a large range of effects on the number/quality of TA’s and the number of students that can be assigned to RA positions. Much like the small number of faculty members, a small number of graduate students has a negative impact on the ability to deliver the high student semester hours.

A variety of strategies for graduate student recruiting has been tried over the years with limited success. However, as addressed throughout this report, the low graduate student stipends (particularly for GTA’s), number of years spent in TAships and high workload are major limitation for the recruitment and advancement of graduate students. The level of stipends lead to challenges in meeting basic housing and food needs, increased length to degree and a large number of students leaving the program.

**Recommendation:** As addressed throughout the document, the level of the graduate student stipends needs to be addressed. This is a critical issues to the well-being of students.

### 4.5.4 Facilities

The Chemistry Department occupies Bilger Hall. As was observed in the videos provided of Bilger hall, conversations with graduate students and faculty, there are significant safety and operational concerns around Bilger Hall. This has an impact on the research and teaching mission of the department and hinders the ability to recruit faculty, students and post-docs. Some specific items include significant water leaks, asbestos flooring that contains holes, and flooring not capable of supporting research infrastructure. Campus leadership and the Office of Research are aware of many of the problems around the building.

One major issue that has been raised is the relocation of the 600 MHz NMR to the main campus. Evaluation of Bilger Hall has determined that the floor of the building is not able to support the weight of the instrument.

There has been attrition of research support staff (electronics repair, facility support, IT support) that is necessary for operation of a modern chemistry department. This has been the result of the retirement of long serving staff members and the subsequent loss of the positions.

**Recommendation:** There is a clear need for a new building or a major renovation of Bilger Hall. There need to be short term solutions to support instrumentation in close proximity to Bilger Hall. As this was a virtual visit, it is difficult to give a perspective on alternative options.

**Recommendation:** Development of a long term strategy for committed staff support of research infrastructure. Some positions, such as IT support, could be centralized within CNS, but other specialized position
4.5.5 Diversity

The department has made some strides in increasing faculty diversity, with the hire of two female tenure-track positions since the last review, however more work in this area is needed.

Overall, the Department did not address issues around diversity within the undergraduate and graduate student population in the written document or in meetings. The committee encountered hostility from at least one member of the faculty for bringing up diversity, equity and inclusion issues, stating that such topics are irrelevant. Unfortunately, this made it very difficult for other faculty to have an open conversation of issues that the department is facing around this topic. As previously noted, a climate survey of the college is highly recommended.
A The Review Process

Following initial kickoff meetings with the Vice-Provost for Academic Excellence and her leadership team, a remote review was conducted over a three-day period from October 4-6, 2021. This review consisted of:

- a meeting with the College of Natural Sciences Dean and Associate Dean
- a meeting with the Chief Budget Officer
- a meeting with the college student advisors
- a meeting with the college office staff
- individual meetings with the Department Chairs and Associate Chairs
- individual meetings with the graduate students in each Department
- individual meetings with the undergraduate students in each Department
- two meetings with un-tenured faculty in the college
- a meeting with representatives from the UH foundation
- a meeting with the college student assessment team

In addition, the committee was provided with self-study documents from all the departments and units (with the exception of the Institute for Astronomy), plus detailed data on student graduation and persistence rates, data on research funding, strategic initiative documents, plus other documents pertaining to student advising, graduate student stipends, faculty hiring, and college overhead return. In addition, recorded video presentations of college classroom and research facilities were also made available.

The review team had extensive discussions and writing sessions outside the formal review meetings. Each individual college unit had a primary reviewer who is an expert in the field on that unit, but a second reader was also assigned from a related area. In summary, this review reflects the consensus opinion of the review team and not any individual reviewer.