ANNUAL PROGRAM REPORT

College	College of Science
Department	Physics
Program	Physics
Reporting for Academic Year	2020-2021
Last 5-Year Review	2018
Next 5-Year Review	2023
Department Chair	Erik Helgren
Author of Review	Erik Helgren
Date Submitted	September 30, 2021

I. SELF-STUDY *(suggested length of 1-2 pages)*

A. Five-Year Review Planning Goals

Five Year Plan (2018 – 2023) Summary

The planning goals set forth for the Department of Physics include:

1. **Implement, assess and revise as necessary the semester courses offered by the Physics program**.

2. **Develop a department-specific Retention, Tenure and Promotion (RTP) manual**.

3. **Continue to provide strong General Education and service course offerings**.

4. **Develop a department strategy to support all faculty with incorporating high impact practices, such as research based instructional strategies, into their curriculum**.

5. **Develop and implement a strategic plan to promote sustainable and measured growth in the number of majors in the program**. We specifically wish to target growth in traditionally underserved student populations in the field of Physics and STEM. This strategic plan needs to take into account current and new resources and should also take into account best-practice marketing strategies.

6. **Request the addition of at least two new tenure-track hires**. Tenured/tenure-track (TT) faculty teach major, GE and service courses and we expect growth in all these categories over the coming years. The TT faculty are also needs to provide more research opportunities and hands-on experiential learning for our students. Any new approved TT hires need to have a plan to incorporate undergraduate research opportunities and at least one new TT hire needs to be in the field of Astronomy.

7. **Continue to promote and strengthen the Physics seminar series**. This seminar series serves as a means to strategically grow our number of majors but also provide a sense of community among all Physics enthusiasts and everyone interested in

science. For instance, the seminar series will be held during the University Hour, but we will need to monitor and assess the impact on attendance and the availability of outside speakers.

8. **Continue to provide undergraduate research experiences for all interested majors, and other STEM majors where possible**.

9. **Invest in upgraded and state-of-the-art laboratory and hands on learning equipment for teaching and research**. Furthermore, the program needs to develop a plan to improve the storage and proper use of lab and demonstration equipment.

10. **Monitor and support the newly designed Astronomy minor to assess the possibility of growth**.

B. Progress Toward Five-Year Review Planning Goals

Report on your progress toward achievement of the 5-Year Plan. Include discussion of problems reaching each goal, revised goals, and any new initiatives taken with respect to each goal.

1. **Implement, assess and revise as necessary the semester courses offered by the Physics program.**

   For the 2020-2021 AY, the department revised ALL of its courses and developed online curriculum for all of its offerings in due to the distance learning modality required by the COVID epidemic. However, for the most part classes are expected to return to pre-pandemic modality in the following academic year (AY 21-22)

   No assessment was performed due to the switch to online modality required because of the COVID pandemic.

2. **Develop a department-specific Retention, Tenure and Promotion (RTP) manual.**

   A draft of the Department-specific RTP manual that was circulated to the tenure-track faculty in last year was found to need more specific details regarding details for professional development activities in a wider array of Physics subfields. This work is ongoing. However, the draft was shared with the new first-year tenure-track faculty member, Dr. Arran Phipps who joined our department faculty in August 2020 and it provided additional guidance, even in draft form, as it is intended to do.

3. **Continue to provide strong General Education and service course offerings.**

   It is fair to say that the department faculty at times struggled in certain cases with the emergency shift to online teaching on March 13, 2020. However, our faculty leaned in during that semester and especially in the summer of 2020 to learn best practices for online teaching for all of the myriad types of courses we were asked to offer online for the AY 2020-21; large lecture, seminars, discussion sections, labs, etc. Faculty used the resources provided by the university, e.g., online professional development workshops hosted by the Office of Faculty Development and the Office of Online Campus, CSU-wide workshops and courses, like "The Introduction to Teaching Online using the Quality Learning and Teaching (QLT) Instrument," to develop quality online curriculum.

   In AY 20-21 we analyzed our department DFW rates[1], and specifically focused on illuminating Equity Gaps in some of our GE and service course offerings. Below we show part of that analysis, e.g., department-wide Equity Gap and DFW rate information by term/annum:

[1] https://csusuccess.dashboards.calstate.edu/public/faculty-dashboard/where-do-they-struggle accessed Sept. 2020

	URM total	*URM DFW*	*Non-URM total*	*Non-URM DFW*	*Equity Gap*	*Overall DFW rate*
Fall 2020	319	64	363	39	-9.3%	15.1%
Spr. 2020	256	17	252	19	0.9%	7.1%
Fall 2019	333	55	340	37	-5.6%	13.7%
AY 19-20	589	72	592	56	-2.8%	10.8%
Spr. 2019	334	45	411	28	-6.7%	9.8%
Fall 2018	371	55	429	20	-10.1%	9.4%
AY 18-19	705	100	840	48	-8.5%	9.6%
Spr. 2018	304	42	400	43	-3.1%	12.1%
W 2018	335	54	452	55	-4.0%	13.9%
Fall 2017	336	50	444	49	-3.8%	12.7%
AY 17-18	975	146	1296	147	-3.6%	12.9%

Table 1 - Red shading denotes online modality due to COVID. Blue shading denotes Quarter system.

Observable trends:

- First year under semesters, the non-passing rate (referred to as DFW rate), fell from the last year under Quarters, climbing in Fall 2019, with large fluctuations during COVID.
- The Equity Gap increased in the first year of Semesters, even though the overall DFW rate dropped, as compared to the last year under Quarters. A noticeable drop in the Equity Gap is noted in Fall 2019 as compared to AY 18-19. Again large fluctuations are seen during COVID.

The Equity Gap data was further analyzed down to the course and instructor level, as shown for our Spring 2020 course offerings (note that is the term when we switched to online teaching mid-term).

Course	Instructor	Equity Gap %
PHYS 339-01	Asztalos	-2%
PHYS 104-01	Barsky	9%
PHYS 136-01	Furniss	10%
PHYS 125-01	Grimm	-13%
PHYS 126-01	Ouedraogo	0%
PHYS 126-03	Obolu	-1%
PHYS 138-02	Villanueva	-2%
PHYS 303-01	Villanueva	6%
PHYS 108-01	Kimball	7%
PHYS 126-02	Smith	3%
PHYS 115-01	Wedding	0%
PHYS 139-01	Villanueva/Ryan	0%
PHYS 139-02	Villanueva/Ryan	0%
PHYS 351-01	Grimm	0%

These results are shared each term with instructors. In an effort to address these Equity Gap issues and other DEI concerns, the department developed a Department Diversity, Equity and Inclusion Action Plan, which addresses issues related to this five-year review

planning goal but also many other ones (and will be referred to in subsequent points). The **Department of Physics DEI Action Plan** is as follows:

Executive Summary

The Department of Physics is committed to improving and sustaining diversity, equity and inclusion in all aspects of our community. Our plan focuses on two areas in particular,

1) **DEI in the classroom**, i.e., a focus on decreasing equity gaps in the Physics General Education and Physics service courses that we teach, and

2) **DEI in the department**, i.e., a focus on courses and student in our major, as well as the general Physics community, including faculty, and staff.

Specific programs, efforts and actions that the physics Department will undertake in the coming year are listed below. Many of these actions address both DEI in the classroom and in the department.

- **Review equity gap data** in our service courses as well as in our major courses regularly with faculty at department meetings, e.g., at department meetings, at least once a semester, update the faculty regarding past-semester results and trends in equity gaps. In Spring semester 2021 the equity gap data for our department was shared with faculty at a department meeting to initiate the discussion of a greater focus on equity gaps in our classes.

- Make faculty more aware of **campus resources** and programs that are aimed at supporting students, e.g., provide faculty with a summary of campus resources to be included on syllabus.

- Encourage faculty to join *Improving STEM Teaching Faculty Learning Programs*, and share **best/high-impact practices** with faculty at **department pedagogy meetings**.

- Encourage faculty participation and support for CSUEB **peer-mentoring programs**, e.g., STEM Lab Learning Assistants and SCAA tutoring.

- Continue our department's efforts in **Communities of Practice**, e.g., in 2019 our department faculty and staff joined the American Physical Society (APS), Inclusion Diversity and Equity Alliance (IDEA) Network. The **APS – IDEA network** is focused empowering and supporting physics departments to identify and enact strategies for improving equity, diversity, and inclusion (EDI).

- Continue our department's support of providing hands-on meaningful research experiences to our diverse Physics majors, with support from:

- the NSF-funded UC-CSU **Cal-Bridge program**. The Cal-Bridge program directly funds and supports, through intrusive advising, underserved students in Physics to achieve the goal of graduating and going on to graduate school in Physics or Astronomy.
- the CSUEB **Center for Student Research**, and in particular the **NSF-funded Louis Stokes Alliance for Minority Participation (LSAMP) program**.
- **faculty-grants** from NSF and other funding agencies.

- Continue making DEI an integral part of our **weekly Physics Spritzer Seminar Series**. This past year, during COVID, we proudly continued our weekly Spitzer seminar series and found that we could host a wide array of speakers using Zoom. We plan to continue using Zoom in the future even when we are back on campus to provide a wider array of non-traditional/non-stereotypical role models in Physics and Astronomy.

- Continue holding annual **Imposter Syndrome & Implicit Bias workshop** to foster a greater sense of community.

- Maintain a commitment to make a focus on diversity a high priority in all **faculty and staff hiring** that occurs.

- Continue outreach efforts to **Physics and Astronomy departments at local Community Colleges** to foster the pipeline of traditionally underserved students transferring to CSUEB to complete their degrees in Physics. This past year, through our use of Zoom we hosted students and faculty from the Physics department at Chabot Community College during our weekly Spitzer Seminar series, highlighting the inclusive, community-based program we offer here at CSUEB in the department of Physics.

4. **Develop a department strategy to support all faculty with incorporating high impact practices, such as research based instructional strategies, into their curriculum.**

   In order to hold more frequent discussions regarding best-practices in teaching our Physics courses, we continue to hold monthly department meeting. The more frequent meeting have allowed greater opportunity to discuss not only DEI efforts, as is called out in our department DEI Action Plan, but also pedagogy and curricular matters with both tenure-track and lecturer faculty in the room. For instance at onemeeting, we reviewed Equity Gap numbers in our Physics courses and discussed best practices and support resources that faculty could share with students who were struggling.

Also, in AY 20-21, due to switching to online modality, we had numerous open forums in Physics sharing best practices regarding how to deliver high quality online synchronous and asynchronous classes. For instance faculty were instructed on using department issued iPads and Apple pencils to serve as a digital whiteboards in lectures which mimics the in-class ability to write out complex Physics equations on chalkboards/whiteboards, and provide sketches and graphs for students to visualize the concepts.

In AY 20-21, the Physics department continued its use of Slack channels, one specifically including all lecturer, tenured and tenure-track faculty to provide a resource for sharing ideas and best-practices including on the subject of online teaching, DEI efforts and overall methods to support student success.

5. **Develop and implement a strategic plan to promote sustainable and measured growth in the number of majors in the program.**

The department is still committed to formulating a coherent plan to promote sustainable and measured growth. This point is also consistent with our department's DEI Action Plan. Within the department, discussions have centered on reaching out to local community colleges, e.g., Contra Costa College, Diablo Valley College, Los Medanos, Chabot, Ohlone, and Las Positas, specifically to the chairs of the Physics departments to advertise the support structures, the sense of community our department offers and the research opportunities we have here at CSUEB.

One area of achievement that we use to promote the Physics department at CSUEB, is the fact that Dr. Amy Furniss continues as the co-director of the **Cal-Bridge**, NSF funded mentorship program. This program provides "intrusive" advising for underserved populations of Physics students at all CSU campuses with the goal of increasing the number of diverse students earning Ph.Ds. in Physics and Astronomy. Benefits include the weekly mentoring/advising from CSU and UC faculty, up to $10,000 per AY and support in applying for graduate school. In this past AY, two women Cal-Bridge scholars graduated and are now attending graduate school. DEI efforts often focus on BIPOC students, but in Physics there is also a dramatic underrepresentation of women in the field at the doctorate level. As a department we are taking pride in helping to support more women joining the graduate ranks!

In 2017, under 4% of the bachelor's degrees awarded in the U.S. in the field of Physics were earned by African Americans, and only 10% of the bachelor's degrees awarded in the U.S. in the field of Physics were earned by Hispanic Americans.[2] In AY 2019-2020 the CSUEB Physics Faculty applied for and were accepted as a pilot institution for the American Physical Society's Inclusion, Diversity and Equity Alliance (**APS IDEA**), and we continue to be active members of this Community of Transformation.. The APS IDEA is a new initiative with a mission of empowering and supporting Physics departments,

[2] https://www.aps.org/programs/minorities/resources/statistics.cfm accessed Sept. 2020

laboratories, and other organizations to identify and enact strategies for improving equity, diversity, and inclusion (EDI). It will do so by establishing a community of transformation. We continue to be active members in the APS IDEA network and have made it a point of emphasis in our department DEI Action Plan. Through this Community of Practice, we hope to find pathways for more students from traditionally underserved populations to earn a degree in Physics.

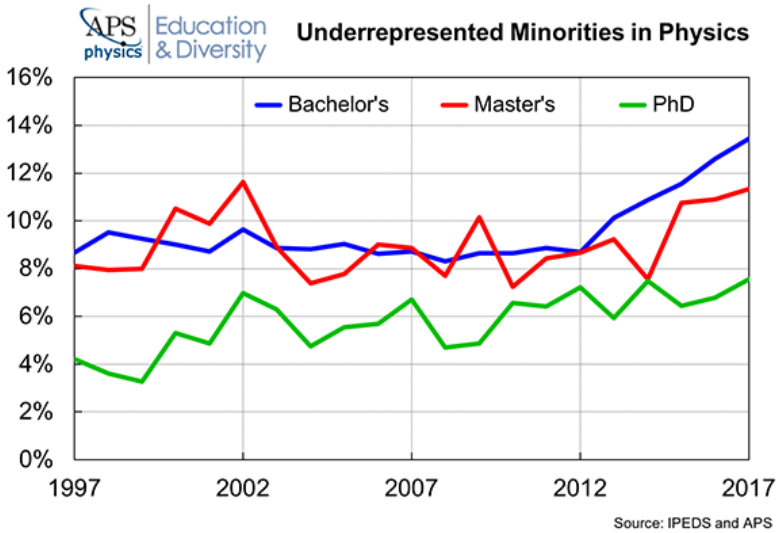

Figure 1 - This graph shows the percentage of bachelor's, master's, and doctoral degrees awarded to underrepresented ethnic and racial minorities (URMs) in physics at U.S. institutions. In this case, URMs include African Americans, Hispanic Americans, American Indian/Alaska Natives and Native Hawaiians. (This report from APS came out in 2017 so these are the most up to date statistics). In 2017, a total of 1097 Doctoral degrees in Physics were conferred in the U.S. and 83 were conferred on URM students (19 Black/African American and 62 Hispanic/Latino). In 2017, a total of 8102 Bachelor degrees in Physics were conferred in the U.S. and 1090 were conferred on URM students (263 Black/African American and 800 Hispanic/Latino). In 2017, CSUEB graduated awarded 2 Physics B.S. degrees to Black/African American students accounting for 1% of the nation's total.

6. **Request the addition of at least two new tenure-track hires.**

Dr. Arran Phipps, (post-doc. From Stanford & Ph.D. in Physics from UC Berkeley) joined the tenure-track faculty in the department of Physics in the Fall of 2020. It was an unusual, virtual start for Dr. Phipps, but he has handled the situation with aplomb.

We plan on requesting another tenure-track hire for the next cycle.

7. **Continue to promote and strengthen the Physics seminar series.**

The Spitzer seminar series continues to be very popular with students faculty and staff. The shift to an all online format has had both its detriments and benefits. In AY 20-21, we missed meeting with all of our community on Fridays at noon on campus, however, we pivoted" and started holding our weekly seminar series by Zoom. Thus in fact, we were

able to invite a broader, more diverse group of outside speakers. In Ay 2021-22, we plan on continuing hosting our seminar series in a co-synch fashion so that people can congregate in the seminar room in the Science building and also join us to listen to our speakers on Zoom. Speakers too will sometimes be on-ground and sometimes via Zoom.

As part of our department DEI Action Plan, we continue to place a focus on Diversity, Equity and Inclusion. We have made efforts to ask non-academic Physicists to speak at our seminar series this year to provide role-models for our students on non-traditional career paths for Science majors. For each speaker, we ask that they spend some time sharing what drew them into the field they are in and how their career arc changed over time. We hope that these experiential stories inspire our students to see that there is no one traditional pathway to success in STEM fields and that "*through not just through adversity but also diversity we reach the stars*."

8. **Continue to provide undergraduate research experiences for all interested majors, and other STEM majors where possible.**

- Dr. Grimm continues to engage undergraduates and graduate students from CSUEB working on projects associated with the large Hadron Collider (LHC). Highlights include students working at Stanford performing technical work associated with new sensors to be installed at the LHC.

- Dr. Furniss continues to mentor CSUEB students in conjunction with her work at the VERITAS gamma ray observatory in Arizona and other partnerships. She works with both Physics majors and other STEM majors year-round.

- Dr. Kimball continues to lead international dark matter search collaborations GNOME and CASPER. CSUEB students, both Physics and other STEM majors, work with him year-round in his CSUEB research labs.

- Dr. Ryan Smith was on sabbatical during the AY 2021-22 and spent much of his time in Berlin Germany at the Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy .

Due to COVID, many of the on-campus research activities were curtailed when the shelter in place orders were issued in March of 2020. However, the faculty continued to hold group meetings and switched their efforts to activities amenable to online/remote work, e.g., data analysis, coding, writing up progress reports, etc.

9. **Invest in upgraded and state-of-the-art laboratory and hands on learning equipment for teaching and research.**

Hands-on learning equipment and material purchasing was curtailed during AY 20-21 due to COVID restrictions to being on campus. Furthermore, our department Instructional Service Technician (IST) of over 20 years, Mr. Mohammad Ali, retired. We are excited to finally ne on-boarding a new IST, Andre Li and in the upcoming year we plan on having our new IST update our inventory, and develop a plan for investing in upgraded and state-of-the-art lab equipment for teaching and research.

10. **Monitor and support the newly designed Astronomy minor to assess the possibility of growth.**

    The Astronomy minor continues to draw interest. We will continue to advertise the minor and track the number of students in the years to come. The prefix ASTR was approved by the CSUEB Senate in the Fall 2020 and our plan is to officially list many of the Astronomy related courses with this prefix rather than PHYS in order to draw more attention to the Astronomy minor, with a long-term goal of developing an Astronomy B.S. program.

C. Program Changes and Needs

Report on changes and emerging needs not already discussed above. Include any changes related to SB1440, significant events which have occurred or are imminent, program demand projections, notable changes in resources, retirements/new hires, curricular changes, honors received, etc., and their implications for attaining program goals. Organize your discussion using the following subheadings.

Overview:

The Department of Physics strives to offer a welcoming, community-oriented environment that is welcome to all. Faculty and staff are dedicated to providing a supportive, and enriching educational experience to all students, both majors and any student enrolled in a Physics or Astronomy GE or service course. In AY 2021-22 the regular faculty created our Department DEI Action Plan in an effort to codify how we as a department plan on affecting change with respect to DEI issues in our Physics in general and for our CSUEB student population.

The faculty truly make the department exceptional and unique. Our tenure-track faculty are extremely research-active and excel at garnering external funding support, but always with a mind towards providing meaningful research and experiential learning opportunities for our majors and for students from outside our major who are interested in doing research. Even during this past year under COVID, faculty continued to engage CSUEB undergraduate students in research.

Curriculum:

In AY 2020-21 we anticipate a "return to normal" for offering most of our Physics courses on-ground.

In the Fall of 2020, the Physics department offered every one of its lab courses on ground as well as all of our upper division major courses, and in fact every faculty member had at least one on-ground class they were teaching in the Fall semester. Large lecture courses were still mainly offered online. Safety and COVID precautions and guidance were reviewed at our monthly department meetings to reduce the anxiety of teaching on ground, and many faculty were very happy to be back on ground teaching labs in-person to students.

We anticipate that almost all of our course offerings in the Spring 2022 semester will be on-ground, except for the few GE classes which were already approved and taught online pre-pandemic.

The department faculty have become well-versed in quality online teaching. In recognition of meeting our students' needs, respecting alternative teaching methods that accommodate different learning styles and for DEI efforts, many of our faculty are preparing Curriculog proposals to gain approval from GEOC and CIC to have the option to teach Physics and Astronomy courses online or in a hybrid format in the future.

Students:

Even during COVID, our Physics students are successfully finding positions in industry and continuing on to graduate programs.

For instance, of our seven graduating seniors:

- Madalyn Johnson, winner of the department's Outstanding Student of the year award in 2021, and Cal-Bridge Scholar (B.S. 2021 and Astronomy minor) is attending graduate school in Astrophysics at UC Santa Cruz
- Kenneth Couberly, winner of the department's Outstanding Student of the year award in 2020 (B.S. 2021) is attending graduate school in Physics at University of Kansas
- Tatum Wilson, winner of the department's Outstanding Student of the year award in 2019, and Cal-Bridge Scholar (B.S. 2021) is attending graduate school in Quantum Optic Physics at University of Illinois Urbana-Champaign.
- Jay Rodriguez (B.S. 2021) is planning on enrolling in the CSUEB Teacher Credential Program.

Faculty:

In the Fall of 2020, just in time for COVID and all online teaching, we were happy to have our new Assistant Professor, Dr. Arran Phipps join the Regular Faculty for AY 2020-21. The remaining regular faculty consist of one Assistant Professor (Dr. Kathyrn Grimm) two Associate Professor (Drs. Furniss and Smith), two Full Professors (Drs. Kimball and Helgren) and eight Lecturers working in the department by headcount.

From Pioneer Insights the Fall semester 2020, only 31% of the classes were taught by Regular Faculty. This low number was in part due to sabbatical leave but also because numerous faculty in the Department of Physics are adept at grant-writing and have grant–paid release time. Starting in Fall 2020, Dr. Erik Helgren started serving as the Assistant Dean in the College of Science which comes with partial (two per term) course release which comes on top of the release for the chair duties in the department. As such there are still effectively then only five TT faculty in AY 2020-21 with two of those on sabbatical (Smith, full-year & Kimball, half-year). Thus in AY 2020-21 the department has two Assistant professors each with probationary faculty release time and a third just-tenured professor (with exceptional level of service to students release time) teaching in the department for the full 20-21 academic year.

In the past year, AY 20-21, the tenured/tenure-track faculty, as PIs or co-PIs wrote the following grants to the National Science Foundation (NSF) and NASA, all of which have now been funded (these are great achievements, and fall under the category of **honors received**):

- Helgren – 2021-2025. Title: NSF ITEST Climate Empowerment Learning Initiative (awarded) – Total Funding, $1,496,828 (IDC $333461),
- Kimball – 2021-2024. Title: NSF PM: Collaborative Research (RUI) -- Searches for Ultralight Bosonic Dark Matter with Atomic Magnetometer Networks (awarded) – Total Funding, $315,013 (IDC $94,591),
- Furniss – 2021-2024. Title: NSF Thorough Investigation of Target of Opportunity Observations of Flaring Gamma-ray Blazars (awarded) – Total Funding, $293,261 (IDC $93,083),
- Furniss – 2021-22. Title: NASA Defining the Spectral Transition Between Synchrotron and Inverse-Compton Emission in the ISP Blazar 3C 66A (awarded) – Total Funding, $56,946 (IDC $18,075),
- Grimm – 2021-24. Title: NSF Experimental studies into the nature of the Higgs Mechanism and searches for new physics with the ATLAS Experiment (awarded) – Total Funding $500,000 (IDC $142,000).

In AY 2021-22, Dr. Furniss is on sabbatical for the whole year, Dr. Helgren continues in his dual role as Assistant Dean and Department chair, and one faculty member has applied for parental leave for the Spring 2022 term. Thus, we anticipate that once again for the AY 2021-22 the Department of Physics, the percentage of classes taught by Regular (i.e., Tenured or Tenure-Track) faculty will be well under 50%.

We do not anticipate any imminent retirements or departures in the Regular Faculty ranks.

Staff:

Prior to COVID, the Department of Physics shared an Office Manager (ASC I), Jacqueline Adams with the School of Engineering and Mohammad Ali was our Equipment Technician (IST II). Both of our these staff members were extremely helpful and collegial, always going the extra mile to help our faculty and most importantly students.

Mr. Ali accepted the Early Exit program in 2020 and due to a vacancy in the Department of Public Health nee Health Sciences, Jacqueline Adams was reassigned to that

department in February 2021. The department was without any staff support until a temporary Office Manager, Jacquelyne (Jacqui) Gonzalez was hired in the summer of 2021. The permanent replacement for our lost IST II was not accomplished until September 2021, when we were able to hire Andre Li (though HR was not able to get him his NetID for a few weeks so the on-boarding lasted for an extended period). Because of the overly-bureaucratic policies on this campus, we were not allowed to advertise for a permanent replacement Office Manager until October. This was highly problematic because, again due to the overly-bureaucratic policies on campus, our temporary Office Manager was not allowed to "do" certain fundamental things that an Office Manager needs to do to support aa department, e.g., obtain a P-Card, or access certain PeopleSoft systems. Instead the office staff in the CSCI Dean's Office had to support entering contracts for faculty in the Fall, etc.

Hiring and maintaining staff should be a high priority for the University Administration. Currently the process is overly-onerous and the low compensation makes recruiting and retaining quality candidates extremely difficult.

Resources: *(facilities, space, equipment, etc.)*

We are extremely constrained on how many Physics lab course we can offer as service to other departments and for GE B3 purposes.

Prior to the semester conversion, we had anticipated continued growth in the number of lab-based sections we would need to teach for the PHYS 125-126 Algebra-based Introductory Physics sequence as well as the PHYS 135-136-137 Calculus-based Introductory Physics Sequence. The anticipated extra enrollment for the 125-126 was expected from a new Public Health nee Health Science, Environmental Safety concentration, and the extra enrollment in 135-136-137 was expected from Computer Science majors being required to take part of the sequence as well as overall growth of the School of Engineering.

This anticipated growth would have left us very constrained on our ability to offer the accompanying lab sessions as we only have three lab classrooms for our department. Two of these are dedicated to our lower division labs, i.e., PHYS 125-126 and 135-136-137. The third lab classroom is dedicated to our upper division lab courses (lab equipment needs to remain set-up for the semester for some of the more complex experiments). As such the two lower division lab classrooms would have needed to be booked from Monday through Friday 8:00 a.m. until after 10 p.m. every day. (basically at capacity).

The enrollment increase in the PHYS 135-136-137 series has indeed been observed, and we anticipate even more growth in the future with the newly proposed Civil Engineering program. However, as discussed below, the enrollment in the PHYS 125-126 did not occur and as such we have some flexibility in our lab classroom scheduling (which was

needed this Fall term because we could not schedule Monday labs due to the three Monday holiday situation). However if the enrollments do bounce back or continue to increase, as expected, we will once again be space-constrained on how much we can offer/grow.

Assessment:

Due to COVID, assessment activities in our department were not possible for AY 2020-21, specifically because of the switch to online teaching. We were not able to perform any of our in-class assessments because of the online modality. However, every effort was made to continue to deliver pedagogical content that focused on helping students master the core learning objectives associated with each course.

Other: *(e.g., major program modifications)*

We do not anticipate any major program modifications this year.

II. <u>SUMMARY OF ASSESSMENT</u> *(suggested length of 1-2 pages)*

A. Program Learning Outcomes (PLO)

List all your PLO in this box. Indicate for each PLO its alignment with one or more institutional learning outcomes (ILO). For example: "PLO 1. Apply advanced computer science theory to computation problems (ILO 2 & 6)." Program Learning Outcome(S) Assessed. *List the PLO(s) assessed. Provide a brief background on your program's history of assessing the PLO(s) (e.g., annually, first time, part of other assessments, etc.)*

Physics B.S. Program Learning Objectives:

1. ***Explain*** *the fundamental principles of Physics and be able to apply these core ideas to analyze physical processes (ILO 1)*
2. ***Apply*** *quantitative reasoning and critical thinking to solve complex problems, both theoretical and experimental in nature; (ILO 1)*
3. ***Independently*** *learn new technical subjects and skills; (ILO 1)*
4. ***Design****, construct, assess and troubleshoot experiments, quantitatively analyze the results using appropriate statistical procedures and tests of systematic errors, and draw meaningful conclusions; (ILO 1)*
5. *Effectively discuss scientific ideas, both theoretical and experimental, to diverse audiences through written and oral presentations, both formal and informal; (ILO 2)*
6. *Work professionally, effectively, and inclusively as a member of diverse collaborations to solve problems. (ILO 3 & 4)*

Physics B.A. Program Learning Objectives:

1. *Describe the fundamental principles of Physics and be able to apply these core ideas to analyze physical processes; (ILO 1)*
2. *Use quantitative reasoning and critical thinking to solve problems, both theoretical and experimental in nature; (ILO 1)*
3. *Learn new technical subjects and skills; (ILO 1)*
4. *Construct, assess and troubleshoot experiments, quantitatively analyze the results using appropriate statistical procedures and tests of systematic errors, and draw meaningful conclusions; (ILO 1)*
5. *Effectively explain scientific ideas, both theoretical and experimental, to diverse audiences through written and oral presentations, both formal and informal; (ILO 2)*
6. *Work professionally, effectively, and inclusively as a member of diverse collaborations to solve problems. (ILO 3 & 4)*

The CSUEB Institutional Learning Outcome (ILO) numbers referred to above correspond to the following:

(1) **Thinking and Reasoning:** think critically and creatively and apply analytical and quantitative reasoning to address complex challenges and everyday problems.

(2) **Communication:** communicate ideas, perspectives, and values clearly and persuasively while listening openly to others.

(3) **Diversity:** apply knowledge of diversity and multicultural competencies to promote equity and social justice in our communities.

(4) **Collaboration**: work collaboratively and respectfully as members and leaders of diverse teams and communities.

(5) **Sustainability**: act responsibly and sustainably at local, national, and global levels.

B. Summary of Assessment Process

Summarize your assessment process briefly using the following sub-headings.

Instrument(s):

In 2021-22 the department plans to review and suggest modifications to our assessment instruments and rubrics using an Equity, Diversity and Inclusion lens.

We utilize standardized tests (FCI, BEMA and ETS Physics Exam) to assess PLOs 1 and 2. These exams have multiple choice questions on introductory and advanced physics concepts, and are accepted as standard measures of content within the physics field. For example, the Force Concept Inventory (FCI) instrument is designed to assess student understanding of the most basic concepts in Newtonian physics. This forced-choice instrument has 30 questions and looks at six areas of understanding: kinematics, Newton's First, Second, and Third Laws, the superposition principle, and types of forces (such as gravitation, friction). Each question offers only one correct Newtonian solution, with common-sense distractors (incorrect possible answers) that are based upon student's misconceptions about that topic, gained from interviews. Moreover, the Brief Electricity and Magnetism Assessment (BEMA) assesses what students know about the most basic and central concepts of the calculus-based introductory E&M course. It is comprehensive, covering topics from the Coulomb force law to magnetic induction, but omitting radiation because it is very common for the introductory course not to get that far. It has been used by various instructors in various settings and has been judged an appropriate and fair assessment of introductory E&M by physicists experienced in teaching E&M at various levels. It is not aimed at any particular curriculum but contains only those elements common to all calculus-based introductory courses.

In order to assess PLOs 3 and 5 we have utilized writing and oral presentation rubrics that have been created by CSU East Bay Physics faculty and have been adopted as standard within the Physics Department. The Rubrics allow a scaling of specific measures of quality written problem solutions, written research papers and presentations. The rubrics, each of which is provided to the students as part of the introduction to the assignment, were developed by the physics faculty

independently, through a collaborative comparison of assessment criteria utilized within their own grading policies.

Sampling Procedure: The standardized testing assessments are given to the students in class with scantrons provided. Note, the assessments can only be provided in on-ground classes (i.e., not to be distributed online, per agreements with the instrument developers) and as such the FCI, BEMA and ETS assessment instruments could not be used during 2020-21.

The rubric assessments are applied to the student final presentations and research papers at the end of the term. It is important to note that the students have access to these rubrics ahead of the assignment deadline, but do not have any access to the standardized tests in any form aside from when given during the class meeting.

Sample Characteristics: The standardized testing sample is a specific percentage of correct answers at the end of the term as compared to correct answers at the beginning of the term. The overall improvement is used as an assessment of the effectiveness of the teaching methodologies utilized to communicate the specific PLOs.

Data Collection: The data is collected on scantron for the standardized tests, and recorded in rubrics.

Data Analysis: Comparison of improvements in content retention and quality of research papers and presentation are completed from one year to the next year.

C. Summary of Assessment Results

Summarize your assessment results briefly using the following sub-headings**.**

Main Findings: No assessments were performed in AY 2020-21

Recommendations for Program Improvement: *(changes in course content, course sequence, student advising):* None

Next Step(s) for Closing the Loop: *(recommendations to address findings, how & when)*
Other Reflections: None

D. Assessment Plans for Next Year

Summarize your assessment plans for the next year, including the PLO(s) you plan to assess, any revisions to the program assessment plan presented in your last five-year plan self-study, and any other relevant information.

The original plan for assessment for the B.S. in AY 2021-22 was the following:

- *Physics 135 (Fall 2021) – PLO 1; FCI at start and end*
- *Physics 136 (Spring 2022) – PLO 1; BEMA at start and end*
- *Physics 230 (Spring 2022) – PLO 2; problem solving rubric + writing rubric*
- *Physics 351 (Spring 2022) – PLO 2; problem solving rubric + writing rubric*
- *Physics 480 (Fall 2021) – PLO 3 and 5; apply writing rubric to lab write ups*
- *Physics 481 (Spring 2022) – PLO 1, 2 with ETS Physics Exam and PLO 5 with rubric assessments of end of term research projects and presentations*

However, due to restrictions associated with teaching certain courses online only during the Fall 2021 semester the following plan for assessment will take place in AY 2021-22:

- *Physics 135 (Spring 2022) – PLO 1; FCI at start and end*
- *Physics 136 (Spring 2022) – PLO 1; BEMA at start and end*
- *Physics 230 (Spring 2022) – PLO 2; problem solving rubric + writing rubric*
- *Physics 351 (Spring 2022) – PLO 2; problem solving rubric + writing rubric*
- *Physics 480 (Fall 2021) – PLO 3 and 5; apply writing rubric to lab write ups*
- *Physics 481 (Spring 2022) – PLO 1, 2 with ETS Physics Exam and PLO 5 with rubric assessments of end of term research projects and presentations*

Note, that because the FCI is an assessment administered for in-person classes only it cannot be administered in the Fall semester 2020, so we will instead administer the assessment in the Spring semester of 2022.

III. DISCUSSION OF PROGRAM DATA & RESOURCE REQUESTS *(suggested length of 2 pages)*

Each program should provide a one-page discussion of the program data available through University Dashboard. This discussion should include an analysis of trends and areas of concern. Programs should also include in this discussion requests for additional resources including space and tenure- track hires. Resource requests must be supported by reference to University Dashboard data.

Requests for tenure-track hires should indicate the area and rank that the program is requesting to hire. If a program is not requesting resources in that year, indicate that no resources are requested.

A. Discussion of Trends & Reflections Notable Trends;

Summarize and discuss any notable trends occurring in your program over the past 3-5 years based on program statistics (1-2 paragraphs). You may include 1-2 pages of supplemental information as appendices to this report (e.g., graphs and tables).

The number of Physics majors continues to be close to the national average for undergraduate Physics programs. The Physics major continues to be one of the smaller programs on campus. This is neither surprising nor unusual. In fact, in 2016, the average number of upper division students enrolled in Physics programs nationwide, including both B.S. and Ph.D. granting institutions was 34.8 (www.aip.org/statistics). This data is from the 684 institutions, of a total of 750, that reported their data. This average is considerably lower, only 21.3, when considering only the 508 B.S. granting institutions that reported their data. At CSUEB, in Fall 2020, according to CSUEB Program Enrollment dashboard, the number of Physics majors at CSUEB was 21, and we had 8 graduates from the department in AY 2019-20.

Physics: Sex

		Fall 2016		Fall 2017		Fall 2018		Fall 2019		Fall 2020	
		n	%	n	%	n	%	n	%	n	%
Undergraduate	Female	6	19%	3	14%	3	14%	3	14%	7	27%
	Male	25	81%	19	86%	19	86%	18	86%	19	73%
	Total	31	100%	22	100%	22	100%	21	100%	26	100%
Grand Total		31	100%	22	100%	22	100%	21	100%	26	100%

Table 1 - Number and percentage of Dept. of Physics number of majors by gender.

Physics: Race/Ethnicity

		Fall 2016		Fall 2017		Fall 2018		Fall 2019		Fall 2020	
		n	%	n	%	n	%	n	%	n	%
Undergraduate	Asian	5	16%	3	14%	4	18%	4	19%	3	12%
	Black	3	10%	1	5%	2	9%	2	10%	1	4%
	International	1	3%	1	5%	1	5%	1	5%		
	Latinx	11	35%	7	32%	6	27%	5	24%	8	31%
	Multirace	1	3%			1	5%	3	14%	7	27%
	Native American									1	4%
	Unknown	2	6%	2	9%	3	14%	3	14%	2	8%
	White	8	26%	8	36%	5	23%	3	14%	4	15%
	Total	31	100%	22	100%	22	100%	21	100%	26	100%

Table 2 - Number and Percentage of Dept. of Physics majors y race/ethnicity.

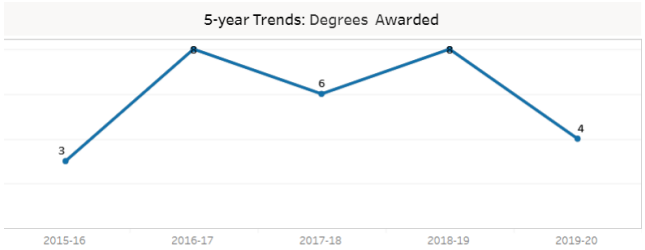

Table 3 - Number of Bachelor's degrees conferred annually in the Dept. of Physics from 2015- 20120

A notable trend in the Department of Physics has been a fall–off in the number of FTES (enrollment) and FTEF from the quarter system through the first two years of semesters with a slight increase now in AY 2020-21.[3]

APR Coursework Data: Summary: Fall Term as of Census

FTES, FTEF (instruction), and SFR of all state-side coursework

		Term & Year														
		Fall 2016			Fall 2017			Fall 2018			Fall 2019			Fall 2020		
College	Department	FTES	FTEF	SFR	FTES	FTEF	SFR	FTES	FTEF	SFR	FTES	FTEF	SFR	FTES	FTEF	SFR
CSCI	PHYS	227.6	8.4	27.0	211.8	7.8	27.2	196.0	6.6	29.7	162.4	6.4	25.3	170.9	6.9	24.8
	Total	227.6	8.4	27.0	211.8	7.8	27.2	196.0	6.6	29.7	162.4	6.4	25.3	170.9	6.9	24.8
Grand Total		227.6	8.4	27.0	211.8	7.8	27.2	196.0	6.6	29.7	162.4	6.4	25.3	170.9	6.9	24.8

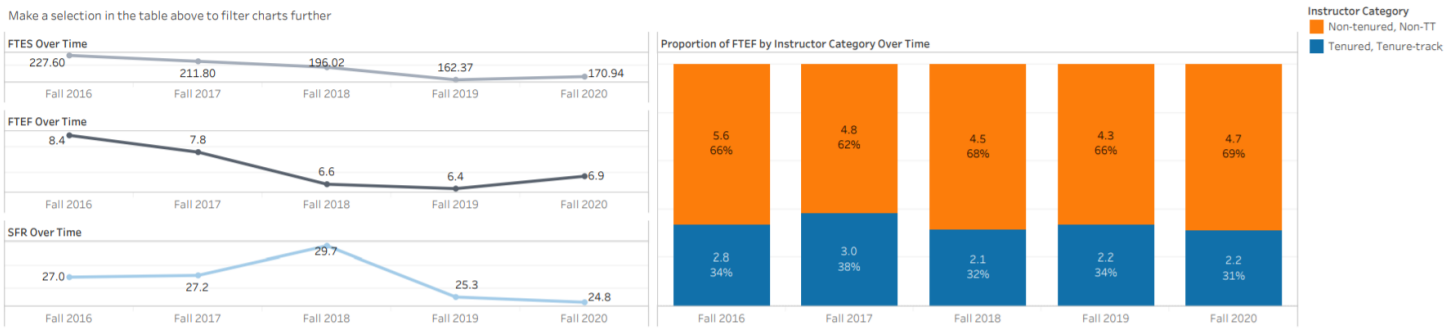

Table 4 - Dept. of Physics FTES, FTEF and SFR from 2016 - 2020

Below we show the data for our Calculus-based Introductory Physics sequence's initial class, PHYS 135 (which under quarters was PHYS 1001). There is a clear trend of increasing enrolment after the start of semesters, so much so that for the first time ever, we offered a section of PHYS 135 in the Spring term in 2021 and the enrollment was substantial. Previously we had always started the sequence in the Fall such that for majors requiring two semesters of calculus-based introductory Physics the sequence started in the Fall with e.g., PHYS 135, and ended in the Spring with PHYS 136.

	Course	Instructor(s)	Enrollment
Fall 2015	PHYS 1001	Kimball	87
Fall 2016	PHYS 1001	Kimball	107

[3] Data from Pioneer Insights Dashboard – Academic Program Review (APR) for Physics, accessed Sept. 2021

Fall 2017	PHYS 1001	Furniss	76
Fall 2018	PHYS 135	Kimball	97
Fall 2019	PHYS 135	Furniss	93
Fall 2020	PHYS 135	Furniss	168
Spring 2021	PHYS 135	Furniss	82
Fall 2021	PHYS 135	Kimball & Phipps	171

Table 5- Enrollment in Introductory Calculus-based Physics service course PHYS 135

Below we show the data for our Algebra-based Introductory Physics sequence's initial class, PHYS 125 (which under quarters was PHYS 2701). Last year we were concerned about a decline in the overall enrollment of the course since the quarter to semester conversion, but similar to the case with PHYS 135, we started offering the PHYS 125 course in the Spring term (whereas under quarters we only ever offered the sequence's first course in the Fall term). As such, the enrollment total in the AY 20-21 of 212 seems to have increased once again up from the total of 160 from AY 19-20.

	Course	Total Enrollment
Fall 2015	PHYS 2701	261
Fall 2016	PHYS 2701	271
Fall 2017	PHYS 2701	280
Fall 2018	PHYS 125	295
Spring 2019	PHYS 125	90
Fall 2019	PHYS 125	194
Spring 2020	PHYS 125	66
Fall 2020	PHYS 125	196
Spring 2021	PHYS 125	106
Fall 2021	PHYS 125	150

Table 6 – Total Enrollment in introductory Algebra-based Physics service course PHYS 125

Reflections on Trends and Program Statistics:
Provide your reflections on the trends discussed above and statistics and supplemental information presented in this report.

The department is committed to growing the number of majors and continuing our efforts to increase the number of traditionally underserved student populations in Physics.

We are concerned about decrease in the enrollment in GE Physics courses. We have been in discussion with the director of General Education regarding changes in the way advisors will block enroll Freshmen in the Fall of 2020 as compared to 2019. We hope to learn what prevented the advisors from enrolling Freshmen into Physics classes. If however incoming native freshmen students were steered away from their B1 and B3 requirements in their first year, then perhaps we

will see a natural rebound in the enrollments of these classes in this cohort's second year at CSUEB.

In the PHYS 125-126, noting that many students seem to be starting the sequence in the Spring term, we are encouraged to see an increase in the number of student served in AY 20-21 as compared to AY 19-20. One area to note is that the new semester roadmap for Kinesiology students does not include Physics any more. Having reached out to the Kinesiology advisors, students who express interest in PT or OT graduate work are verbally steered into taking the pre-requisites for those graduate programs, which includes Physics and Chemistry. We will continue to monitor the trends in the coming years.

In the PHYS 125-136-137 sequence, we are experiencing a huge increase in the number of students starting this series, and we actually anticipate this growth to continue into the future. The growth is due to a combination of growing enrollments in Chemistry & Engineering and also due to the fact that during quarter to semester conversion, the Computer Science department elected to require PHYS 135 as part of their required B.S. roadmap.

B. Request for Resources *(suggested length of 1 page)*

1. Request for Tenure-Track Hires: provide evidence from trends provided

We are requesting a tenure-track hire for the upcoming academic cycle. As per our five-year plan, we had anticipated needing two new hires during the subsequent five years, i.e., 2018 – 2023. We made one hire who started in the Fall of 2020 and if we were allocated a new hire, this second faculty member would be able to join the department in the Fall of 2023.

As indicated above in the Program Changes and Needs section, according to Pioneer Insights the percentage of Regular Faculty Teaching courses over the past five academic years are as follows

Fall 2016	34%
Fall 2017	38%
Fall 2018	32%
Fall 2019	34%
Fall 2020	31%

Table - Percentage of courses taught by Physics TT Faculty

Even though, in the Fall of 2020 Dr. Arran Phipps joined the department as a new Assistant Professor, the percentage of courses taught by Regular Faculty went down and stays extremely low. Further, given the growing numbers of Chemistry, Computer Science and Engineering majors as well as the newly proposed Civil Engineering Program, we anticipate that the demand for Physics service courses and labs will continue to increase in the future. Given these trends and this anticipated growth we are respectfully requesting a new Tenure-Track hire during the next cycle. We are hopeful that a newly approved search will offer our department the opportunity to further increase the diversity and gender equity in our ranks in order to provide a

broader diversity of role-models for aspiring students passionate about Physics and Astronomy.

2. Request for Other Resources

Of greatest concern to the Physics Department is the quality of the hands-on lab experience for students both in the introductory Physics courses and the upper division courses. These hands-on laboratory course and the interatve, in-class activities we can offer with these resources is critical as we are able to provide diverse/engaging teaching strategies that create an inclusive learning environment. A2E2 funding is used to pay for basic necessities in lab-based sciences. We are encouraged that the administration acknowledges the higher cost of lab based curriculum and provides more funding to the college of Science on a per FTES basis due to the high proportion of laboratory based courses, and we hope that this continues into the future.

It is also strongly hoped for that the administration try to understand the lengths to which the Physics faculty and other faculty in the CSCI go in order to "make things work" in the outdated/inadequate Science building. Historically the Science building, along with A&E, was one of the first buildings on campus. The plans were borrowed from another, pre-approved building from another CSU. The building is ill-suited for having offices or research labs for the faculty. The heating is inadequate and there is no air conditioning. We are encouraged by the progress made towards obtaining the final funding for the Applied Sciences Center (ASC)and urge the Administration to do all it can to finalize that project.

Appendix B: Checklist for CAPR liaison who reviews the APR and guiding checklist for author of the annual program report.

NOTE TO CAPR REVIEWER:
Read the Annual Program Review submitted by the program by visiting the Five-year Reviews and Annual Reports by Department page on the Academic Senate website. Find the CAPR document that pertains to the last five year review (e.g. 08-09 CAPR 42). Read this document and identify the main issues raised by CAPR with respect to the five-year plan and the goals set for this program in the intervening five years to the next program review. Report back on the program and the degree to which the Annual Report a) addresses the five year planning horizon as appropriate, and b) addresses the specific elements as parsed out below (questions 1-4).

CAPR liaisons: please check the Annual Program Review, and identify whether the following information is included in the submitted report:

1. Does the Annual Program Review have a self-study?
   Yes__*(support with evidence starting with recommendations from last 5 year review, program learning outcomes, assessment strategies and results)*
   No__*(provide rationale for not including a self-study)*

2. Does the Annual Program Review record progress with departmental planning and review? Does it describe progress toward the program's defined goals, any problems reaching its goals, any revisions to goals, and any new initiatives taken with respect to goals?
   Yes__*(support with evidence)*
   No__*(support with rationale for not reporting in this section)*

3. Does the Annual Program Review detail progress on fulfilling programmatic needs? Does it record significant events which have occurred or are imminent, such as changes to resources, retirements, new hires, curricular changes, honors received, online programs, loss of faculty, changes in enrollment, etc.?
   Yes__*(support with evidence)*
   No__*(support with rationale for not reporting in this section)*

4. Does the Annual Program Review have a summary of assessment results and ensuing or necessary revisions?
   Yes__*(support with evidence)*
   No__*(support with rationale for not reporting in this section)*

5. Program learning outcome(s) (PLO) was/ were assessed:
   Yes__*(support with evidence)*
   No__*(support with rationale for not reporting in this section)*

6. Assessment instrument(s) was/ were used to measure this PLO and clearly indicated:
   Yes__*(support with evidence)*
   No__*(support with rationale for not reporting in this section)*

7. Participants/ courses were sampled to assess this PLO and clearly indicated:

Yes___*(support with evidence)*
No___*(support with rationale for not reporting in this section)*

8. Assessment results were obtained, highlighting important findings from the data collected:
   Yes___*(support with evidence)*
   No___*(support with rationale for not reporting in this section)*

9. Assessment results were (or will be) used as well as any revisions to the assessment process are clearly indicated:
   Yes___*(support with evidence)*
   No___*(support with rationale for not reporting in this section)*

10. Annual Program Review contains a reflection upon progress made and changes with respect to the program learning outcomes assessment plan that is reported on in the five-year review self-study.
    Yes___*(support with evidence)*
    No___*(support with rationale for not reporting in this section)*

11. Annual Program Review includes information about any associated minor(s).
    Yes___*(support with evidence)*
    No___*(support with rationale for not reporting in this section)*

12. Annual Program Review includes a discussion of program data?
    Yes___*(support with evidence)*
    No___*(support with rationale for not reporting in this section)*

13. Annual Program Review includes a request for additional resources including tenure-track hiring requests with support from program data. (Note: for programs submitting a 5-Year Academic Review in the same academic year, this is the only section required to be submitted by October 1st).
    Yes___*(support with evidence)*
    No___*(support with rationale for not reporting in this section)*