Department of Biology
Program Review Self-Study Report

Based on
Version 1.1
10/21/2015

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Instructions

Please use the data provided and the guiding questions to prepare your program review self-study. Please note that the data provided is not all of the data available to you and a more complete set of program review data will also be provided by the IE office. Also note that there may be a few questions that are not relevant to your academic unit and you can simply write "NA" in those text boxes where this is the case. Finally, the text boxes are intended for the reflective answers to the guiding questions and the summaries of your analyses. If there are related documents that contain data or more detailed information that will help the reviewers better understand your narratives, feel free to add these as appendices at the end. Please do not include anything in the appendices that is not necessary or referenced and discussed in the self-study itself.

Technical Note: For your convenience, fillable text boxes have been inserted after each question. If you have non-text items (e.g. tables, charts, etc.) you would like to insert into the document, feel free to remove and replace the textbox placeholder with your information.

Department Level Analysis

A) Introduction (context for department)

1. Name of Academic Unit, Program(s), and Center(s) that are included in this self-study: Include graduate and undergraduate, undergraduate majors, minors and concentrations, etc.

Biology Department
4 undergraduate degrees: Biology-BA, Biology-BS, Biology-Chemistry-BS, Environmental Science-BS
2 graduate degrees: Biology-MS-non-thesis, Biology-MS-thesis (former graduate degree: Biology-MA)
Minors: Cell & Molecular Biology, Environmental Biology, Organismal Biology, Science-Business, Science-Marketing

2. This document will be read by both the PLNU Program Review Committee and external reviewers. What do these reviewers need to know about your current programs to understand their context and how they function within the department and across the university? (500 word maximum)

The Biology Program is recognized among Christian universities for its academic effectiveness and thriving undergraduate research program, which have been supported by grants from national funding agencies. Students can become co-authors on scientific publications and make professional presentations at research conferences, such as the West Coast Biological Science Undergraduate Research Conference, which is periodically hosted by our department. Since innovative science today is interdisciplinary, we collaborate with the other STEM (Science Technology Engineering Math) departments to foster academic programs and research initiatives.

Locally, we support outreach to disadvantaged high school students (University NOW), and offer science teachers a seminar series visited by world-class scientists (Perspectives on Science). Our graduate program in General Biology serves teachers from throughout southern California.

We work to engage a diverse population of students in learning the practice of science and the critical thinking and quantitative skills they will need in professional careers, and three of our faculty are experts in science education. We interact with our students both inside and outside the classroom to provide advice, mentoring, and insight into how faith, calling, and science interact in experience. Finally, we have developed a system of learning outcomes and rubrics to provide assessment and accountability.

3. If you believe that it will help the reviewers to understand your context, provide a brief history of what has led to your department's current structure and program offerings.

Although founded in 1902, PLNU did not produce its first biology graduate until 1939. PLNU began purposefully hiring faculty with advanced degrees in biology in the 1940's and as a result, the department blossomed, producing 264 graduates from 1940-1978. In 1978, the biology and chemistry departments together created the Biology-Chemistry major, which is designed to prepare students for careers in science and the health professions. In 2007, the biology and chemistry departments created another joint major, Environmental Science, in response to the increasing demand for students who are prepared to solve modern challenges faced by our global ecosystems. In 2006, we also began offering graduate degrees. The graduate program was originally designed for working K-12 teachers, but is now being used as a post-baccalaureate degree by some students as well.

B) Alignment with Mission

Please answer the following questions for all student populations served by your department: residential, graduate and extended learning:

1. Briefly describe how your department contributes to the intellectual and professional development of PLNU students.

Few Christian universities are known for having strong science departments, yet our Biology Program is recognized for its academic effectiveness and thriving undergraduate research program, which have been supported by large grants from national funding agencies. Moreover, approximately 40% of students admitted to PLNU choose one of the science or allied health majors, all of which are serviced by the biology department. One of PLNU's strategic priorities is to increase educational access. The biology department has increased ethnic diversity each year, despite nationwide trends in the difficulty of attracting diverse students to STEM fields. We work to engage a diverse population of students in learning the practice of science and the critical thinking and quantitative skills they will need in professional careers. Our faculty engage in the process of research with more than 50% of the Biology majors. We are also known for our high acceptance rate into graduate school and health professional schools.

The Biology Department has also supported pre-college science education since the late 1990's with two successful programs: University Now for students and Perspectives on Science for teachers. Our master's program was established in 2006 as an additional means of improving science education by offering middle and high school teachers an opportunity to a earn a graduate degree in biology while continuing to teach. This program is currently the only graduate program in biology offered by a Christian university in the western United States, and offers the only part-time graduate degree in general biology for working teachers in California. The program includes hybrid courses that are taught in the fall and spring and intensive face-to-face laboratory-based courses that run in the summer.

2. Review your department's mission, purpose and practice and discuss how your programs contribute to your student's spiritual formation, character development, and discernment of call.

Supporting the continued spiritual formation of our undergraduates is an important calling for our department. For many of our Christian students it is the first time they openly wrestle with difficult ideas such as creation and evolution, bioethics and science, and environmental stewardship. As faculty committed to Christ, we initiate and encourage these conversations both inside and outside of the classroom. This is enacted through specific modules inserted throughout the four-year curriculum where students engage in a variety of science and faith discussions. These modules are further augmented by in-class devotionals, guest speakers, personal chapel testimonies from faculty, a science and religion student club, and regular department meetings that focus on student spiritual development. This development is furthered by our focus on students' vocation. The vast majority of our majors start their college careers as pre-health, but many have not properly discerned their call or possible career options. Our one-on-one advising helps students explore the many possibilities for their future. Moreover, we provide research opportunities, lab assisting positions, tutoring positions, outside internships, and shadowing experiences for them to experience different possible professions. The faculty is also actively engaged in reading and discussing books focusing on vocation in an effort to more effectively guide our students in discerning their own call.

Because our graduate program is the only one of its kind in California, it attracts students from a wide variety of backgrounds, including approximately 50% who have no/minimal religious affiliation. For the first time, these students have the chance to learn biology concepts from Christian professors, and to discuss a variety of issues at the intersection of faith and science. For Christian students in the program, it is often the first time in their lives that they have had a chance to explore these same faith/science topics since nearly all of them earned their undergraduate degree from a non-Christian university. With 51 alums to date, and most of those teaching at least 100 students each day, over 4200 students are being influenced by PLNU every single day. Many of these students are in low-income, high diversity schools all over southern California. These teachers are also some of our best recruiters as they encourage their own students to consider the high quality programs at PLNU, and some of our current PLNU undergraduates are students of these teachers.

C) Quality, Qualifications and Productivity of Department Faculty

Current Full-Time Faculty				
Faculty Name	**Rank**	**Tenure**	**Degree**	**PLNU Service Years**
Anderson, Dianne	Professor	Tenured	PhD	10
Cho, Walter	Assistant	Tenure-track	PhD	3
Cummings, David	Professor	Tenured	PhD	11
Dorrell, Michael	Associate	Tenure-track	PhD	6
Elson, Robert	Associate	Tenure-track	PhD	12
Flietstra, Rebecca	Professor	Tenured	PhD	18
Koudelka, Kristopher	Assistant	Tenure-track	PhD	1
Maskiewicz, April	Professor	Tenured	PhD	8
Mooring, Michael	Professor	Tenured	PhD	18
Page, Dawne	Professor	Tenured	PhD	13
Department percent of full-time faculty with doctorate (terminal) degree				**100%**
PLNU percent of full-time faculty with doctorate (terminal) degree (Fall 2014)				**82%**

1. Summarize the most recent scholarly and creative activities of the faculty in this department. If desired, include information about peer reviewed scholarship.

Most of the faculty in the department are involved in scholarly research, either with undergraduates or with graduate students. From 2010 to present, the Biology faculty have published 39 peer-reviewed articles, reviews, or book chapters (see CVs for details). In addition, Cho, a marine biologist, participated in two research expeditions. Dorrell holds 3 patents and took a 15 month leave of absence from PLNU to establish the Lowy Medical Research Institute (LMRI) for the study of degenerative eye disease. Our students have been doing research at LMRI – both as undergraduates and as a career after graduation.

2. Summarize the grants/awards received by the faculty.

Since 2010, the faculty have obtained the following grants (totaling ~ $1.8 million):

1) Principal Investigator D. Allen, with A. Maskiewicz as Co-PI. Faculty Development Network for Undergraduate Biology. National Science Foundation. $498,753
2) Principal Investigator J. Batzli, with A. Maskiewicz as Co-PI. Meeting at the Threshold: Generating hypotheses for classroom research that investigates how current curricula and learning progressions address threshold concepts in genetics and evolution. National Science Foundation. $2000
3) Principal Investigator L. Hartley with A. Maskiewicz as Co-PI. Identifying differences in discourse and teaching about matter and energy in biology, chemistry, and physics courses, and the challenges this poses for learners of biology. Introductory Biology Project Catalytic Mini Grant, National Science Foundation. $2000
4) Principal Investigator A. Maskiewicz. Oxford Interdisciplinary Seminars in Science and Religion: Bridging the Two Cultures of Science and the Humanities, organized by Scholarship and Christianity in Oxford with funding from Templeton Religion Trust. $17,500
5) Principal Investigator K. Maloney with D. Page as Co-PI. Scholarships to Support STEM majors and Computational Sciences Minors. S-STEM, National Science Foundation. $576,750
6) Principal Investigator D. Page. B cell development and activation in Danio rerio. National Science Foundation. $466,000.
7) Principal Investigator D. Cummings. "Capture and Characterization of Self-Transmissible Plasmids from Urban Wetlands Encoding Clinically Relevant Antibiotic Resistance Genes." National Institutes of Health. $253,000

3. Describe how the scholarly and creative activities of the faculty impact the mission and quality of your department.

Scholarly activity is an important part of both the mission and quality of the Biology department. Research helps faculty members stay current in their discipline and with the techniques and research paradigms of modern Biology, which translate directly into teaching in both the classroom and laboratory courses. Since all of our faculty also do their research with PLNU students, the students are able to become immersed in modern Biology. As discussed below, about 50% of our students do an intensive research project with the faculty. These experiences help our students gain admittance to careers, graduate schools and health professional schools.

4. Comment on the adequacy and availability of institutional support and outside funding for professional development and travel.

Institutional support for professional development is excellent. Between the CTL and support for local conferences, our faculty members have been able to learn about and implement student-centered pedagogies into our curriculum.

Institutional support for travel is lacking. Professional development money from the Provost's office is sufficient for journal subscriptions and local travel, but not for national conferences. We must nearly always obtain outside funding in order to attend national meetings in our discipline.

Department Faculty Instructional Loads (FT, PT, and Adjuncts) (excludes release time and independent studies)				
	2012/13	**2013/14**	**2014/15**	**3-yr Average**
SCH per IFTE	**513**	**521**	**484**	**505**
PLNU SCH per IFTE	*TBD*	*TBD*	*TBD*	*TBD*
SFTE per IFTE	**16.09**	**16.37**	**15.18**	**15.87**
PLNU SFTE per IFTE	*TBD*	*TBD*	*TBD*	*TBD*
Independent Studies Units Generated	1	0	1	0.7

Individual Faculty Instructional Loads

	2012/13			2013/14			2014/15			3-Yr
Full-Time Faculty	**IU**	**SCH**	**SCH/ IU**	**IU**	**SCH**	**SCH/ IU**	**IU**	**SCH**	**SCH/ IU**	**SCH/IU**
Anderson, Dianne	13.3	200	15.0	21.8	411	18.8	21.7	318.5	14.7	16.4
Cho, Walter	20.0	405.6	20.3	25.0	517	20.7	23.0	335	14.6	18.5
Cummings, David	24.0	617.3	25.7	20.0	545	27.3	20.0	542	27.1	26.6
Dorrell, Michael	24.0	533	22.2				19.0	397	20.9	21.6
Elson, Robert	13.0	335	25.8	25.5	598	23.5	23.5	639.5	27.2	25.4
Falk, Darrel				2.0	47	23.5				23.5
Flietstra, Rebecca	31.0	785	25.3	23.0	580	25.2	27.0	567	21.0	23.9
Jansma, Ariane							7.6	122.9	16.2	16.2
Koudelka, Kristopher							19.9	291.1	14.7	14.7
Maskiewicz, April	22.5	386.4	17.2	12.0	163	13.6	21.4	429	20.0	17.5
McConnell, Michael	14.7	269	18.3	15.9	253	16.0				17.1
Mooring, Michael	20.0	517.7	25.9	24.0	636	26.5	23.0	487	21.2	24.5
Page, Dawne	13.3	211	15.9	16.4	276	16.8	14.5	235	16.2	16.3
Sawyer, Brandon				13.0	424	32.6	17.0	480	28.2	30.1
Total Full-Time Faculty	195.8	4,260.0	21.8	198.6	4,450.0	22.4	237.5	4,844.0	20.4	21.4
Total Part-Time Faculty	--	--	--	23.5	481.0	20.5	19.0	302.0	15.9	18.4
Total Adjunct Faculty	83.0	1,696.0	20.4	47.0	910.0	19.4	28.0	595.0	21.3	20.3

- Links to complete reports that include part-time and adjunct faculty
  - 2014-15
  - 2013-14
  - 2012-13

IU = Instructional Units: Generated faculty workload units excluding release time
IFTE = Instructional Full-Time Equivalent: Total Instructional workload units divided by 24
SCH = Student Credit Hours: Generated student credit hours associated with the faculty member
SFTE = Student Full-Time Equivalent: Total Student Credit hours divided by 32 for undergraduates/24 for graduate students

5. Compare the SCH load of each faculty member against the departmental average. What does this tell you about the distribution of faculty workload within the department? What changes, if any, might be appropriate?

We are not planning any changes in faculty loading. The faculty that are underloaded can be explained by being new (Koudelka), having administrative responsibilities/grants (Anderson, Cummings, Dorrell, Maskiewicz, McConnell, Page), or by having a joint appointment in another department (Sawyer). {Note: Ariane Jansma is a Chemistry department faculty member who teaches a course that is cross-listed in both Biology & Chemistry, so I'm not sure why she is included on our summary.}

6. Does looking at the SCH and SFTE to IFTE ratios compared to PLNU averages provide any insights for your program? Explain.

Data not provided.

7. Looking at the longitudinal history of independent study units generated in this program, does this provide any insights that might be worth looking into? Explain.

No, as we rarely offer independent study units.

8. What role do part time and adjunct faculty play in the quality and success of the department.

Part-time faculty have been critical to the success of the department. In particular, we have been relying more and more on Dr. Heidi Woelbern (part-time) to teach critical classes for us as the department has grown. We have had several disastrous experiences with adjunct faculty teaching freshman and service courses, so Heidi has been able to fill this role for us for the past two years. It remains extremely difficult to find qualified, Christian biologists who can fill in as adjuncts, especially in the area of Anatomy & Physiology, where we have a continuous need.

D) Progress on Recommendations from Previous Program Review

1. List the findings from the previous program review and discuss how each finding has been addressed.

Our previous program review was in 2008-09. These were the recommendations:
1. Hire a Marine Biologist/ Marine Ecologist. (DONE: WALTER CHO.)
2. Split BIO215 (Animal Biology) into two courses: Ecological & Evolutionary Systems and Organismal Biology. (DONE: BIO211 and BIO212.)
3. Restructure BIO300 (Bioinformatics) to a Research Methodology course with a Bioinformatics component. Advise Biology and Environmental Science majors to take this course their sophomore year. (DONE: BIO301.)
4. Recommend MTH203 or MTH362 for BIO310 (Botany), BIO360 (Ecology), and BIO420 (Vertebrate Physiology). (DONE.)
5. Use an assessment matrix that maps goals and outcomes for the Biology majors onto our Biology courses to determine possible means of assessment. As the first step in a multi-year undertaking, test out a rubric on three assessment goals. (REPLACED BY NEWER ASSESSMENT STRATEGIES.)

2. What additional significant changes have been made in department programs since the last program review? (e.g. introduction of new major or minor, significant reshaping of a program, etc.)

The Environmental Science-BS major and the Biology graduate program were relatively new at the last program review, so this will be our first major review of those programs.

E) General Education and Service Classes

Link(s) to the Department's GE data stored on the GE assessment wheel:

- Assessment Results GELOs 2014-15

Reflection on longitudinal assessment of general education student learning data: (If you don't have longitudinal data, use the data that you do have)

1. What have you learned from your general education assessment data?

Written communication (GELO1a), critical thinking (1d) and quantitative reasoning (1e) were assessed in BIO101, 103, 105, 130, 210, and 211. Written communication and information literacy (1c) were assessed in BIO102 and BIO104. For most groups, the criterion of 70% at or above "developed" was met or nearly met, however students tended to perform less well on critical thinking, quantitative reasoning, and information literacy.

2. What changes (curricular and others) have you made based on the assessment data?

The poor performance by BIO 130 students in critical thinking, BIO 105 students in quantitative reasoning, and BIO102 students in information literacy will need to be investigated further to determine if these are real areas for improvement, or if there is a disconnect between the signature assignment, the rubric, and the use of the rubric, since this was the first year of implementation.

3. What additional changes are you recommending based on your review of the assessment data?

First, we will be meeting as a department to assess our GE students, instead of having each instructor assess their own students. Second, we will likely not assess quantitative reasoning anymore, as it has been determined that a university assessment will suffice for this GELO.

4. How do the pedagogical features of your GE courses compare with the best practices for teaching GE in your discipline?

Note: This is the same answer for all of our undergraduate programs.
In 2011, the National Science Foundation (NSF) and the American Association for the Advancement of Science (AAAS) issued a report articulating much needed changes in biology education across the country. The document, titled "Vision and Change in Undergraduate Biology Education: A Call to Action," argued for a transition from faculty-centered education to student-centered education. As a Department, we have chosen the guidance in this document as our benchmarks for best practices in the discipline. Below, we describe each Vision and Change benchmark and then discuss how our program falls short, meets, or exceeds the standard.

The student-centered classroom, sometimes called active learning, is one that is "interactive, inquiry-driven, cooperative, collaborative, and relevant." In short, it is designed with student learning in mind rather than faculty teaching in mind. One approach to accomplishing a student-centered classroom is by way of what is commonly referred to as "scientific teaching", or sometimes "backward design." This strategy for designing a course starts not with the teacher's favorite topics or what they will say in class. Instead, careful time and attention are given to developing and precisely articulating learning outcomes. Once the learning outcomes are clear, the teacher designs the best assessments to determine if the students have achieved the desired outcomes. Finally, teaching methods are considered that can provide the best opportunity for the students to achieve the stated learning outcomes.

PLNU Biology Department faculty members have been proactive in learning new techniques for student-centered teaching. We have three Ph.D.-trained science educators in our department who consult with each of us frequently and regularly offer training sessions. Many of us have attended workshops on active learning, such as the National Academies Summer Institute on Undergraduate Education in Biology offered by HHMI and NSF. We participate in a twice-monthly Faculty Learning Community focused on teaching in the STEM disciplines. Many of us take advantage of (and sometimes help lead) training opportunities offered by the Center for Teaching and Learning, such as the hugely successful Teachers Noticing Teachers program. We meet every Thursday for lunch to discuss teaching issues, and have read books (e.g., *Scientific Teaching* by Handelsman et al.) and journal articles (e.g., *Active Learning Increases Student Performance in Science, Engineering, and Mathematics* by Freeman et al. PNAS 2013) together on active learning.

Some of the student-centered teaching techniques recommended in the Vision and Change document include authentic research experiences, case studies, immediate feedback assessment technique, personal response systems, inquiry-driven learning, concept mapping, peer-led team learning, problem-based learning, process-oriented guided inquiry learning, and team-based learning. We have already implemented many of these techniques and are in the process of experimenting with others.

Several Biology professors further make use of flipped classrooms, case studies, online adaptive learning tools, personal response systems (clickers), concept mapping, peer-led team learning, and team-based learning, to name a few.

5. What new pedagogical practices have been tried in GE and service classes by members of your department in the last few years? What has your department learned from these experiments?

See above.

6. Are there changes that you could make that would make your part of the GE more efficient and effective (e.g. reducing the number of low-enrollment sections, resequencing of classes, reallocation of units, increase interdisciplinary efforts, etc…)?

Our GE courses are generally full or over-full, so we have no changes to suggest here.

7. What service courses (non-GE courses that primarily support a program in another department) does your department teach? Are there changes that you could make that would make your service courses more efficient and effective?

Our service courses are BIO130, BIO140, BIO210, and BIO220. These courses are generally full or over-full. We have managed to reduce the lecture sections in BIO210 and BIO220 to a maximum of 48. We would like to do the same for BIO130 and BIO140, which each have 2 lecture sections of 72, but we do not have the faculty expertise to accomplish this. It would require an extra 6 units of faculty load (for another lecture section of BIO130 in the fall and BIO140 in the spring). We would need to find a long-term adjunct to accomplish this split, but it would definitely be better pedagogically for the students.

********** Future: find a way to include a GE committee review in this step **********

Program Level Analysis (Bio-BA)

Bachelor of Arts in Biology

BioBA-F1) Trend and Financial Analysis

First-Time Freshman Admissions Funnel							
Biology (BA)	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Inquiries	**330**	**421**	**378**	**562**	**515**	**264**	**249**
Share of PLNU inquiries	*2.9%*	*2.8%*	*2.3%*	*3.1%*	*2.8%*	*1.2%*	*1.5%*
Completed Applications	**75**	**37**	**18**	**52**	**43**	**42**	**41**
Share of PLNU Applications	*3.6%*	*1.4%*	*0.6%*	*1.8%*	*1.5%*	*1.6%*	*1.6%*
Applicant Conversion Rate	**22.7%**	**8.8%**	**4.8%**	**9.3%**	**8.3%**	**15.9%**	**16.5%**
PLNU Applicant Conversion Rate	*18.6%*	*17.3%*	*17.0%*	*15.7%*	*16.1%*	*12.1%*	*15.0%*
Admits	**65**	**23**	**11**	**32**	**26**	**37**	**35**
Share of PLNU Admits	*3.6%*	*1.2%*	*0.6%*	*1.6%*	*1.2%*	*1.8%*	*1.7%*
Selection Rate	**86.7%**	**62.2%**	**61.1%**	**61.5%**	**60.5%**	**88.1%**	**85.4%**
PLNU Selection Rate	*87.4%*	*72.9%*	*68.9%*	*69.0%*	*70.5%*	*79.5%*	*79.8%*
New Transfer Admissions Funnel							
Biology (BA)	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Inquiries	**13**	**4**	**10**	**30**	**26**	**16**	**20**
Share of PLNU inquiries	*1.6%*	*0.6%*	*1.1%*	*1.8%*	*1.7%*	*0.9%*	*1.0%*
Completed Applications	**6**	**2**	**5**	**6**	**8**	**1**	**5**
Share of PLNU Applications	*1.5%*	*0.5%*	*1.0%*	*1.3%*	*1.6%*	*0.1%*	*1.1%*
Applicant Conversion Rate	**46.2%**	**sm**	**50.0%**	**20.0%**	**30.8%**	**6.3%**	**25.0%**
PLNU Applicant Conversion Rate	*50.2%*	*55.5%*	*56.2%*	*28.4%*	*33.2%*	*36.9%*	*21.7%*
Admits	**6**	**2**	**3**	**2**	**5**	**1**	**4**
Share of PLNU Admits	*1.8%*	*0.9%*	*1.1%*	*0.7%*	*1.5%*	*0.2%*	*1.1%*
Selection Rate	**100.0%**	**sm**	**60.0%**	**33.3%**	**62.5%**	**sm**	**80.0%**
PLNU Selection Rate	*79.3%*	*57.9%*	*54.8%*	*60.5%*	*65.4%*	*64.1%*	*79.2%*
sm = cell size too small							

1. What does this data tell you about the external demand for your program? What does this say about the future viability of your program?

We have very high external demand for all of the undergraduate Biology programs. We have asked Admissions to limit enrollment of all Biology majors (Biology-BA, Biology-BS, Biology-Chemistry-BS, Environmental Science-BS) to 100 students per year, as we do not have the faculty to deal with larger numbers of students.

First-Time Freshman Admissions Yield							
Biology (BA)	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Admits	65	23	11	32	26	37	35
Matriculants	**5**	**2**	**4**	**4**	**8**	**7**	**6**
Share of PLNU Matriculants	*0.9%*	*0.3%*	*0.8%*	*0.7%*	*1.2%*	*1.2%*	*1.0%*
Yield Rate	**7.7%**	**8.7%**	**36.4%**	**12.5%**	**30.8%**	**18.9%**	**17.1%**
PLNU Yield Rate	*29.3%*	*30.5%*	*27.7%*	*30.3%*	*31.0%*	*27.9%*	*29.9%*
New Transfer Admissions Yield							
Biology (BA)	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Admits	6	2	3	2	5	1	4
Matriculants	**0**	**1**	**1**	**1**	**2**	**1**	**1**
Share of PLNU Matriculants	*0.0%*	*0.7%*	*0.7%*	*0.7%*	*1.4%*	*0.5%*	*0.6%*
Yield Rate	**0.0%**	**sm**	**sm**	**sm**	**40.0%**	**sm**	**sm**
PLNU Yield Rate	*51.1%*	*60.2%*	*54.7%*	*47.3%*	*44.6%*	*46.0%*	*48.0%*
sm = cell size too small							

2. How does your yield rate (percentage of students who enroll at PLNU after being admitted) compare to the PLNU average? If your rate is more than 8 percentage points above the PLNU average, what factors do you believe are contributing to this positive outcome? If your rate is more than 8 percentage points below the PLNU average for more than one year, what factors do you believe are contributing to this difference?

Our yield rate for this particular major is often below the PLNU average, primarily because Biology-BS is a much more popular major. The Biology-BA major is often chosen by students who are doing a second major or a minor in another department.

Enrollment							
Majors	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Biology (BA)	**26**	**16**	**16**	**20**	**21**	**17**	**19**
Share of PLNU Undergraduates	*1.1%*	*0.7%*	*0.7%*	*0.8%*	*0.8%*	*0.7%*	*0.7%*
Minors	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Biology: Cell and Molecular Biology	4	3	3	6	2	2	4
Biology: Environmental Biology	1	4	3	4	2	2	4
Biology: Organismal Biology	4		3	2	4	6	2
Minors (Total)	**9**	**7**	**9**	**12**	**8**	**10**	**10**
Share of PLNU Minors	*2.6%*	*2.0%*	*2.6%*	*3.3%*	*2.2%*	*2.4%*	*2.8%*
Major Migration of Completers*							
Top Importing Programs:	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**6-yr Total**
Biology (BS)		1	1	4		2	8
Biology-Chemistry	1			1			2
Pre-Nursing			2				2
Top Export Destinations:	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**6-yr Total**
Biology (BS)	10	6	8	1		1	26
Business Administration	2	3					5
Exercise Science	2	1		1	1		5
Psychology	2	1		1			4
* Based on degree completions of students who either started or finished within the program and who originally matriculated as first-time freshmen							

3. What does this data tell you about the internal demand for your program? Does this raise any questions about the viability and/or sustainability of your program as it is currently configured? Explain why or why not. Are there any actionable strategies that you can do that might make a difference if your trends are in the wrong direction?

As noted above, we have a very high demand for our program in general. Since we don't teach any classes that are for Biology-BA majors alone, having a low number of students in this major is not a problem. Also note that the major export is to the Biology-BS major.

General Education and Service Credit Hour Production Department UG Total				
	2011/12	**2012/13**	**2013/14**	**2014/15**
Total Dept UG student credit hours	5,421.0	5,880.0	5,742.0	5,648.0
Number of GE sections taught	?	?	?	?
% of SCH that are GE	47.0%	51.6%	52.1%	51.5%
Share of PLNU GE SCH	*7.3%*	*8.4%*	*8.3%*	*8.1%*
Number of service course sections taught	?	?	?	?
% of SCH that are service	18.2%	20.5%	21.2%	21.2%
Share of PLNU service SCH	*TBD*	*TBD*	*TBD*	*TBD*

4. What does this data tell you about how your program is impacted by the needs of GE and other academic disciplines? Does this raise any questions about the viability and/or sustainability of your program if these non-programmatic trends continue? Explain why or why not.

We teach a lot of GE units and service units. As discussed below, the GE units help to offset the cost of the unfunded load that is due to the laboratory experiences for the service courses and the majors. We do not anticipate a decrease in service units as the Nursing and Allied Health programs are also in high demand. If PLNU restructures GE such that a Biology course is no longer required by all students, this would obviously have a dramatic impact on our teaching loads.

Delaware Study Data Department Total												
	2010/11			**2011/12**			**2012/13**			**2013/14**		
Program Cost per SCH	**$244**			**$239**			**$237**			**$260**		
Benchmark Percentiles	$148	$194	$244	$153	$201	$235	$161	$198	$243	$174	$217	$266
Ranking	Medium-High			High			Medium			Medium		

5. We know that the following factors influence the Delaware cost per credit hour:
   - Large amount of GE and service classes taught by the program
   - The career stage of the program faculty (early career faculty are less expensive)
   - The number of elective courses in the program
   - The amount of unfunded load (faculty receiving more credit for a course than the number of units received by a student – e.g. 4 units of faculty load for teaching a 3 unit class)
   - The amount of release time associated with the program
   - Faculty members on sabbatical
   - The size of the department budget and the cost of specialized equipment

Please reflect on your program's Delaware data in light of this information. In particular, what factors contribute to your program having a high (above 75th percentile), medium (50th-75th percentile), or low (below 50th percentile) ranking?

As discussed in prioritization, the Biology department has a high unfunded load due to the many laboratory courses we offer. We feel that these courses are essential to students' education because they must learn how to DO Biology, not just read, write, and think about Biology. The unfunded load is offset by the high amount of GE and service courses that we teach. This brings us into the medium cost range for the Delaware study comparison.

6. Recognizing that not all factors above are under departmental control, what kinds of adjustments might be made to reduce the cost per student credit hour?

We reduced the unfunded load of the GE courses by making the laboratory experience worth 1 unit. This is not possible for the service and major courses, however, because it would increase the sizes of the affected majors beyond their acceptable limits.

***** Future *****
Financial Data: (possibly delayed to the future)
Extra Revenue Generated by Program (lab fees, studio fees, etc.)
Extra Revenue per student credit hour
Extra Costs for the program (equipment not purchased outside of department budget, etc.)
Extra costs per student credit hour
Modified Delaware values: Delaware – extra revenue per SCH + extra costs per SCH

7. Do these modified Delaware values tell you anything new about the future viability and/or sustainability of your program as it is currently configured? Please explain.

Data not provided.

BioBA-F2) Findings from Assessment

Links to the department's assessment wheel
• Student Learning Outcomes • Curriculum Maps • Assessment Plan • Evidence of Student Learning • Use of the Evidence of Student Learning

Reflection on longitudinal assessment of student learning data:

1. What have you learned from this program's student learning assessment data?

Our first priority as an academic department is to ensure that our students are learning the essential content in the field of biology. We use the ETS Major Field Test in Biology to measure the performance of our undergraduates in four major areas of Biology: Cell Biology, Molecular Biology & Genetics, Organismal Biology, and Population Biology, Evolution, & Ecology. At least 50% of the students are expected to score above the 60th percentile on the overall exam, and in each sub-discipline. Additionally, the overall group mean and the group mean in each sub-discipline are expected to be above the 75th percentile. The Biology-BA majors (n=14) did not meet any of these criteria from 2013-2015. However, the Biology-BS majors took the same exam and met all of the criteria. The only difference between the BA and BS majors is that the BS students take 8 units of Physics and 2-3 more units of Biology. It is difficult to imagine that this course difference would account for the startlingly better performance of the BS students on the ETS exam in Biology. Instead, the difference may be accounted for by the possibility that lower performing students self-select into the BA option instead of the BS option. We have also noticed that many of the Biology-BA majors are employed at least 15 hours a week.

Since many students struggle with the integration of their Christian faith with science, another priority of our department is that students will develop a rationally defensible integration of science with their faith. In our most recent measurement, 80% of the graduating Biology-BA students were able to write an essay with a strong defensible integration of their faith with science.

Finally, a top priority is that our students should be prepared to gain admittance to graduate programs and science-related careers. We assess these data every five years. In our most recent survey, 88% of our alumni were employed or attending graduate school in a STEM-related field. In addition, our acceptance rate of students into graduate and health profession's schools continues to be at least 90%. Of the fifteen Biology-BA majors who responded to the survey, 80% are employed or in graduate school in a STEM-related field.

2. What changes (curricular and others) have you made based on the student learning assessment data?

At our last program review, we determined that we needed to split a freshman course that was attempting to introduce Ecology, Evolution, and Organismal Biology in one semester into two semester-long courses: Ecological and Evolutionary Systems and Organismal Biology. This change was recommended based on the poor performance of our majors in the sub-categories of Animal Biology and Plant Biology on the ETS Major Field Test in Biology. After implementing these changes to our curricula, we then discovered that we needed to modify two upper-division courses: BIO360 (Ecology) and BIO310 (Botany). Our students were getting a much better background in ecology and plant biology, such that these two upper-division courses no longer needed to teach the background content. We discovered this disconnect via our senior exit interview process. Thus, we significantly changed the content of the upper-division courses. Instead of Botany, we now offer BIO312 (Applied Plant Biology), and instead of Ecology, we now offer BIO363 (Conservation Ecology), which focuses on conservation and sustainability.

In addition, after hiring a Marine Biologist, we significantly changed the content of all three of our Marine Biology courses, as we discovered that they did not reflect how modern Marine Biology is taught. We now offer Introduction to Oceanography, Marine Biology, and Experimental Marine Ecology.

Finally, we also changed the structure of both the Biology-BA and -BS majors. We decreased the number of required courses, increased the number of electives, and decreased the size of these majors by 2-4 units. These changes were also driven by assessment, as three years of senior exit interviews revealed that many students wanted more choice in their electives in order to be able to do a minor and/or study abroad. Importantly, the size of these majors is still similar to their size at comparator institutions. Recent senior exit interviews indicate that student satisfaction with these majors is now much higher.

3. What additional changes are you recommending based on your review of the student learning assessment data?

The only other recent change we made was based on senior exit interviews. We changed Calculus-Based Statistics (MTH362) from a 2 unit class to a 3 unit class (MTH363). We found that students going on to graduate school generally need 3 units of statistics. Moreover, we also found that our majors needed a more robust statistics course in order to meet the demands of the data analyses required by modern biology. In particular, students need to learn the use of the statistics package R, and this content could not be added into the existing 2-unit course without deleting other important content.

DQP Outcomes with Scores
***** TBD *****
DQP Definitions
Intellectual Skills Intellectual Skills define proficiencies that transcend the boundaries of particular fields of study: analytic inquiry, use of information resources, engaging diverse perspectives, ethical reasoning, quantitative fluency, and communicative fluency.
Specialized Knowledge What students in any specialization should demonstrate with respect to the specialization, often called the major field. All fields call more or less explicitly for proficiencies involving terminology, theory, methods, tools, literature, complex problems or applications and cognizance of limits.
Applied and Collaborative Learning Applied learning suggests what graduates can do with what they know. This area focuses on the interaction of academic and non-academic settings and the corresponding integration of theory and practice, along with the ideal of learning with others in the course of application projects.
Broad and Integrative Knowledge Students integrate their broad learning by exploring, connecting and applying concepts and methods across multiple fields of study to complex questions—in the student's areas of specialization, in work or other field-based settings and in the wider society.
Civic and Global Learning Civic and Global Learning proficiencies rely principally on the types of cognitive activities (describing, examining, elucidating, justifying) that are within the direct purview of the university, but they also include evidence of civic activities and learning beyond collegiate settings. These proficiencies reflect the need for analytic inquiry and engagement with diverse perspectives.

Reflection on DQP related data:

Understanding that the DQP framework provides one particular lens on the meaning, quality and integrity of your curriculum, reflect on the DQP data and framework provided for your program.

4. What have you learned from this program's DQP comparison?

The DQP roll-up is based on current department assessment, so we have nothing to add here.

5. What changes (curricular and others) have you made based on the DQP comparison?

None.

6. What additional changes are you recommending based on your review of the DQP comparison?

None.

Links to stakeholder assessment data (if present this will be department housed data)
• Surveys • Focus Groups • Market Analysis • Etc…

Reflection on stakeholder feedback data:

7. What have you learned from this program's stakeholder assessment data? If you do not have stakeholder data, please provide a plan for how you will regularly collect this in the future.

We conducted an alumni survey in 2015. 408 alumni from 2004-2014 were mailed and 115 replied (28% response). 60% of the respondents were currently in a graduate program or had already obtained an advanced degree. The most common occupations were: currently in a graduate program (35%), health professional (23%), research (12%: biotechnology, academic, government, etc.) and K-12 teacher (5%). 73% of the respondents overall said that they felt well-prepared scientifically. Of the 10 Biology-BA majors who answered this question, 8 said that they felt well-prepared scientifically. As mentioned above, of the fifteen Biology-BA majors who responded to the survey (23% response rate for this major), 80% are employed or in graduate school in a STEM-related field.

8. What changes (curricular and others) have you made based on the stakeholder assessment data?

None.

9. What additional changes are you recommending based on your review of the stakeholder assessment data?

None.

BioBA-F3) Curriculum Analysis

In looking at your curriculum, the program review process is asking you to analyze it through three different lenses. The first lens is looking at your content and structure from the perspective of guild standards or standards gleaned from looking at programs at comparator institutions. The second lens that of employability and is asking you to look at your curriculum and educational experiences from the perspective of skills and professional qualities that you are developing in your students that will serve them will in their future work and vocational callings. The third lens is that of pedagogy and is asking you to look at the delivery of your curriculum to ensure a high quality student learning experience.

Menu and Elective Unit Analysis Biology (BA)	
Number of menu and elective units required by the program	12
Number of menu and elective units offered by the program	38
Menu/Elective Ratio	3.17
Longitudinal Class Section Enrollment Data	
• Link to Class Section Enrollment Report	

Comparison of current curriculum to guild standards and/or comparator institutions.

If your guild standards are associated with a specialized accreditation that your program has, these should be the basis of your analysis. If your guild standards are associated with specialized accreditation that we do not have, then you should primarily use comparator institutions as the basis for your analysis.

If your guild has standards that are not associated with specialized accreditation, then you may choose to use those standards and/or comparator institutions.

After consultation with your Dean, provide the set of guild standards or a list of the comparator institutions that you are using in your analysis.

If using guild standards:

1. Please provide a list of the guild standards that you are using to evaluate your curriculum.

We do not have an accrediting body for Biology. We have used comparator institutions to analyze our curriculum in the past, however a new resource was recently published for Biology programs. The American Association for the Advancement of Science (AAAS) published "Vision and Change in Undergraduate Biology Education" where they outlined five core concepts intended to guide undergraduate biology education: 1) evolution; 2) structure and function; 3) information flow, exchange, and storage; 4) pathways and transformations of energy and matter; and 5) systems. Brownell et al. (2014) used these general recommendations to create a framework that biology departments can use to align with the goals of Vision and Change. Accordingly, we used this document to analyze both the Biology and the Biology-Chemistry majors (Appendix A).

2. Indicate if and how your curriculum satisfies the standards (this can be done in a table or narrative form). If applicable, indicate areas where your curriculum falls short of the standards.

For the most part, our curriculum satisfies these national goals. The only possible shortcoming is in some of the Physiology standards (coded pink in Appendix A). Some of these standards are not mastered via the required courses. Thus, depending on which upper-division electives students choose, they may or may not master this material. We decided several years ago to decrease the amount of upper-division requirements in the major, so that students would have the freedom to take courses aligning with their interests and career-goals. As a department, we are thus willing to live with the possibility that students will not master every area of Biology.

Based on the analysis of standard and reflection on the menu and elective ratio above, consider and discuss the following questions:

3. Are there courses in your program that should be modified? Why or why not.

We are not currently considering modifying any of the courses for the Biology major due to the fact that our curriculum does quite well at meeting the AAAS national goals.

4. Are there courses that should be eliminated? Why or why not.

Similarly, we are not considering eliminating any courses. We do not have very many low enrollment courses. In looking at the course enrollment report, BIO490 and BIO499 are internship and research courses that are paid via faculty overload. BIO325 has not been offered for several years; this is the only possible course we would eliminate. BIO330 was already eliminated. BIO333 (the replacement for BIO330) and BIO473 are brand new courses and are offered every other year. The enrollment in them is expected to increase.

5. Are there courses that could be merged? Why or why not.

There are not any obvious courses in our curriculum that would benefit from being merged.

6. Are there courses that should be added? Why or why not. Note that in general, in order to create the space to add a new course, another course will need to be eliminated or taught less frequently.

We are also not currently considering adding courses to the Biology major. However, we are proposing to add a course to the Environmental Science major, and it would be an additional elective for Biology majors (see discussion in that portion of the document).

7. What did you learn about your overall curricular structure in terms of its complexity, breadth and depth in light of the guild standards and our institutional size and scope? Are there any structural changes that need to be made in light of your analysis (e.g. sequencing of courses, % and or grouping of electives, overall units required, use of concentrations, etc…)?

As stated previously, we were pleased that our curriculum met the AAAS national goals so well.

If using comparator institutions:

1. Begin by working with your Dean to identify a list of 5-8 comparator schools to use. In selecting schools, consideration should be given to type of institution, mission of the institution and the number of students majoring in the program.

Institution 1 Institution 2 Institution 3 Institution 4 Institution 5 Institution 6

Gather the curricular requirements for the program in question at each of the comparator institutions.

2. Use this collection of curricular requirements to develop a list of curricular features that are essential for programs of this type. In addition, make note of any innovative or creative curricular feature that may be useful in enhancing the quality of you program.

NA

Review this list with your Dean before using it to analyze your own curriculum.

3. Indicate how your curriculum compares to the list of curricular features from your analysis (this can be done in a table or narrative form).

NA

Based on the analysis of comparator programs and reflection on the menu and elective ratio above:

4. Are there courses in your program that should be modified? Why or why not.

NA

5. Are there courses that should be eliminated? Why or why not.

NA

6. Are there courses that could be merged? Why or why not.

NA

7. Are there courses that should be added? Why or why not. Note that in general, in order to create the space to add a new course, another course will need to be eliminated or taught less frequently.

NA

8. What did you learn about your overall curricular structure in terms of its complexity, breadth and depth in light of the comparator schools and our institutional size and scope? Are there any structural changes that need to be made in light of your analysis (e.g. sequencing of courses, % and or grouping of electives, overall units required, use of concentrations, etc…)?

NA

Burning Glass Skills Data Biology (BA)		
1. Communication Skills ***Virtually every course between presentations of primary literature articles, data communication, and scientific writing.***	5. Quality Assurance and Control ***Che294.***	9. Management ***Basic skills developed in our teaching assistant* and summer research programs**, as well as in Biology internships.***
2. Research ***Virtually every course as each science course has a required, associated lab portion. This is also mastered with summer research opportunities, Bio499, Biology internships, and honor's projects.***	6. Leadership ***Basic skills developed in our teaching assistant* and summer research programs**, as well as in Biology internships.***	10. Project Management ***None.***
3. Writing ***Virtually every course with assigned lab reports and scientific writing.***	7. Planning ***Bio210, 211, 301, 345, 380, 390, 400. Che152, 153, 294.***	11. Detail-Oriented ***Bio210, 211, 301, 345, 350, 380, 390. Che152, 153, 294.***
4. Organizational Skills ***Bio210, 211, 301, 345, 350, 380, 400. Che152, 153, 294.***	8. Problem Solving ***Bio210, 211, 301, 345, 380, 390, 400. Che152, 153, 294.***	12. Supervisory Skills ***Basic skills developed in our teaching assistant* and summer research programs**, as well as in Biology internships.***

* While the Teaching Assistant Program is not a required course, we highly encourage every student within the major to participate and many of them do. As a TA, they directly interface with the students in laboratory courses, providing assistance with data collection, analysis and report generation. Some are also in charge of lab set-up, breakdown, and grading lab quizzes. It is a position designed to develop basic skills in leadership, management, and supervisory capacities.
**The Summer Research Program is not a required course, but it is very highly recommended and some of our majors participate. These students are required to commit to two summers so that many labs have some new students and some returning students. As such, the returning students act as mentors working with the new students. This situation highly encourages the development of basic skills in leadership, management, and supervisory capacities.

Analysis of the curriculum against preparation for employment

9. The Burning Glass data provides a list of skills for students entering common professions that are often linked to your major. Indicate in the table if and where each skill is being taught in your program. Based on reflecting on this data, are there changes you would recommend making to your curriculum?

Interestingly, we had already decided as a department what skills are important for our majors to have, and we added them to the AAAS document discussed above (Appendix A). The top four Burning Glass skills are a close match with the skills we had already identified, and they are all highly developed in our curriculum, as shown in Appendix A. In addition, problem solving and an orientation to details are a natural part of the Biology curriculum. Some of the other skills listed above would be gained through on-the-job experience or through Business classes. The new Science-Business minor is also an option for students planning to go into careers in Biotechnology or the Pharmaceutical Industry, where those skills would be crucial in addition to their Biology background.

10. Some programs may serve to prepare students with professional qualities and skills that can serve them well in a great variety of professions that may not show up in data sets like Burning Glass. If this is indicative of your program, please identify the unique skills and/or professional qualities that your program develops in your students and indicate where in the curriculum this is being taught or developed.

As mentioned previously, the fact that nearly every Biology class has an associated lab is crucial to the skill set of Biology majors. In these labs, students learn not only laboratory skills, but also how to formulate hypotheses, how to evaluate date, how to do independent research, and how to write a research proposal. Through our intensive summer research program, students hone these skills even further. Yet, since only 14% of the Biology-BA students participate in the intensive summer research program (see below), it is crucially important that the laboratory classes remain a foundational part of our curriculum.

Analysis of the teaching of your curriculum

11. How do the pedagogical features of your program compare with the best practices for teaching in your discipline?

Note: This is the same answer for all of our undergraduate programs.
In 2011, the National Science Foundation (NSF) and the American Association for the Advancement of Science (AAAS) issued a report articulating much needed changes in biology education across the country. The document, titled "Vision and Change in Undergraduate Biology Education: A Call to Action," argued for a transition from faculty-centered education to student-centered education. As a Department, we have chosen the guidance in this document as our benchmarks for best practices in the discipline. Below, we describe each Vision and Change benchmark and then discuss how our program falls short, meets, or exceeds the standard.

The student-centered classroom, sometimes called active learning, is one that is "interactive, inquiry-driven, cooperative, collaborative, and relevant." In short, it is designed with student learning in mind rather than faculty teaching in mind. One approach to accomplishing a student-centered classroom is by way of what is commonly referred to as "scientific teaching", or sometimes "backward design." This strategy for designing a course starts not with the teacher's favorite topics or what they will say in class. Instead, careful time and attention are given to developing and precisely articulating learning outcomes. Once the learning outcomes are clear, the teacher designs the best assessments to determine if the students have achieved the desired outcomes. Finally, teaching methods are considered that can provide the best opportunity for the students to achieve the stated learning outcomes.

PLNU Biology Department faculty members have been proactive in learning new techniques for student-centered teaching. We have three Ph.D.-trained science educators in our department who consult with each of us frequently and regularly offer training sessions. Many of us have attended workshops on active learning, such as the National Academies Summer Institute on Undergraduate Education in Biology offered by HHMI and NSF. We participate in a twice-monthly Faculty Learning Community focused on teaching in the STEM disciplines. Many of us take advantage of (and sometimes help lead) training opportunities offered by the Center for Teaching and Learning, such as the hugely successful Teachers Noticing Teachers program. We meet every Thursday for lunch to discuss teaching issues, and have read books (e.g., *Scientific Teaching* by Handelsman et al.) and journal articles (e.g., *Active Learning Increases Student Performance in Science, Engineering, and Mathematics* by Freeman et al. PNAS 2013) together on active learning.

Some of the student-centered teaching techniques recommended in the Vision and Change document include authentic research experiences, case studies, immediate feedback assessment technique, personal response systems, inquiry-driven learning, concept mapping, peer-led team learning, problem-based learning, process-oriented guided inquiry learning, and team-based learning. We have already implemented many of these techniques and are in the process of experimenting with others.

For example, the lab component of our upper division Microbiology course was converted several years ago to a research experience. Students learn fundamental microbiological lab techniques in the context of a bona fide research project within the expertise of the instructor. At the end of the semester, student teams present their research to the campus community in a mini-conference poster session, complete with judges and prizes.

Another example takes place in Developmental Biology. Students study assigned pieces of a complex story at home, then in class they meet in groups to bring their pieces together (process-oriented guided inquiry learning).

Several Biology professors further make use of flipped classrooms, case studies, online adaptive learning tools, personal response systems (clickers), concept mapping, peer-led team learning, and team-based learning, to name a few.

12. What new pedagogical practices have been tried by members of your department in the last few years? What has your department learned from these experiments?

See above.

13. Are there new developments in pedagogy in your discipline? What would be required to implement these changes in pedagogy in your department?

The 2011 Vision and Change document discussed above represents the most recent pedagogical developments that have been widely adopted by the biology teaching community. Possibly the two greatest hindrances to implementing active learning practices are (1) class sizes (in some cases), and (2) faculty time to develop the methods and assessment tools.

BioBA-F4) Potential Impact of National Trends

Top Burning Glass Occupations for the Program Biology (BA)		
Occupation	**Hiring Demand**	**Salary Range**
Medical Scientist	High	$53K - $107K
Biological Technician	Medium	$36K - $38K
Biologist	Medium	$57K - $61K
Clinical Research Coordinator	Medium	$46K - $50K
Medical Laboratory Technologist	Medium	$58K - $60K
Quality Control Analyst	Medium	$50K - $54K
Quality Manager	Medium	$78K - $81K
Biochemist	Low	$55K - $112K
Biomedical Engineer	Low	$74K - $85K
Biostatistician	Low	$86K - $99K
Environmental Compliance Specialist	Low	$42K - $65K
Epidemiologist	Low	$62K - $68K
Food / Agricultural Inspector	Low	$31K - $39K
Microbiologist	Low	$48K - $92K
Physical Science Technician	Low	$39K - $46K
Research Manager	Low	$59K - $69K
Wildlife Biologist	Low	$48K - $54K

Note that some programs do not have as many professions listed in the Burning Glass data as others do. In these cases we will want to get a list of professions from the chair/school dean to supplement the Burning Glass data.

1. Which professions in the Burning Glass data were you already aware of and for which are you already intentionally preparing students and does the hiring demand in these professions signal anything about the future that you need to be aware of regarding the design and structure of your program ?

We are aware of all of these professions. Our Biology curriculum is not specialized toward any one profession. Rather we offer a broad foundation in modern Biology knowledge and skills, so that students are prepared for many professions. Additionally, our upper-division elective menu allows students to specialize toward their interests. For example, a student who wants to be a Wildlife Biologist would take courses such as Animal Behavior or Marine Biology, whereas a student who wants to be an Epidemiologist would take courses such as Microbiology or Immunology.

2. Are there additional professions in the Burning Glass list or from your knowledge of occupations your alumni have entered, for which you should be preparing students?

We also prepare students for careers in medicine, which are not listed on Burning Glass, perhaps because an advanced degree is required. Similarly, we prepare students for careers in teaching, which is also oddly not on the Burning Glass list. There is a large need for K-12 teachers in California, especially science teachers.

3. What changes in your program would be necessary in order to prepare students for the skills and professional qualities needed to succeed in these additional professions?

No program changes are required. Our alumni are highly successful in getting into both graduate school and careers, as already discussed.

4. Are there national trends in higher education or industry that are particularly important to your discipline? If yes, how is your program reacting to those trends?

As discussed previously, we have analyzed our curriculum for the knowledge recommended by AAAS, and we have also implemented national recommendations for student-centered pedagogy into our curriculum.

BioBA-F5) Quality Markers

Retention/Graduation Rates (First-Time Freshmen)							
	Matriculation Term						
Biology (BA)	**Fall 2008**	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**
First-Year Retention	**75.0%**	**sm**	**sm**	**83.3%**	**sm**	**sm**	**sm**
PLNU First-Year Retention	*84.2%*	*84.1%*	*81.1%*	*82.9%*	*89.3%*	*84.5%*	*84.5%*
	Matriculation Term						
Biology (BA)	**Fall 2005**	**Fall 2006**	**Fall 2007**	**Fall 2008**	**Fall 2009**	**Fall 2010**	**Fall 2011**
Four-Year Graduation Rate	**33.3%**	**25.0%**	**sm**	**42.9%**	**44.4%**	**sm**	**42.9%**
PLNU Four-Year Graduation Rate	*62.0%*	*65.2%*	*61.7%*	*59.1%*	*63.4%*	*62.2%*	*63.2%*
	Matriculation Term						
Biology (BA)	**Fall 2003**	**Fall 2004**	**Fall 2005**	**Fall 2006**	**Fall 2007**	**Fall 2008**	**Fall 2009**
Six-Year Graduation Rate	**83.3%**	**66.7%**	**50.0%**	**37.5%**	**60.0%**	**71.4%**	**66.7%**
PLNU Six-Year Graduation Rate	*72.4%*	*73.2%*	*73.0%*	*74.9%*	*72.2%*	*73.6%*	*75.0%*
Degree Completions							
Majors	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
Biology (BA)	**8**	**6**	**2**	**4**	**8**	**3**	**2**
Share of PLNU Bachelor's Degrees	*1.3%*	*1.1%*	*0.4%*	*0.7%*	*1.4%*	*0.5%*	*0.4%*
Minors	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
Biology: Cell and Molecular Biology		2	3		1	1	1
Biology: Environmental Biology		1		2		1	
Biology: Organismal Biology	1	3			2		
Total Minors	**1**	**6**	**3**	**2**	**3**	**2**	**1**
Share of PLNU (completion) Minors	*1.2%*	*7.2%*	*3.7%*	*2.6%*	*3.5%*	*2.3%*	*1.1%*
FTF Time to Degree *(in semesters)*	**sm**	**sm**	**sm**	**sm**	**8.9**	**sm**	**sm**
PLNU FTF Time to Degree	*8.2*	*8.2*	*8.3*	*8.2*	*8.3*	*8.3*	*8.3*
Study Abroad Participants	2	1			1		
sm = cell size too small							

1. Based on comparing the quality marker data for your program with the PLNU averages:
   a. What does this tell you about your program?

We have a very small number of Biology-BA students. As such, it is difficult to see any trends in these data.

   b. If your values are below the PLNU averages, what changes could you make to address any areas of concern?

Same answer as above.

   c. If your values are above the PLNU averages, what do you believe contributes to this success?

Same answer as above.

2. Describe regular opportunities for students to apply their knowledge (internships, practicums, research projects, senior projects, etc.). Estimate what percentage of your students in this program participates in these kinds of opportunities.

Both Biology and Chemistry have an intensive undergraduate research program, where students gain an 800 hour research experience over the course of two summers. Of the Biology Department students who graduated from 2007-2015, 50% participated in an intensive research experience. It should be noted that this number does differ quite a bit between majors. For the Biology-BA students, only 14% participated in this program, contrasted with 50% of the Biology-BS majors, 66% of the Biology-Chemistry majors, and 48% of the Environmental Science majors. As noted previously, Biology-BA students tend to be lower performing, and they do not apply and/or do not get accepted into the summer research program, which is highly competitive. Additionally, Biology-Chemistry and Environmental Science students can do research in either Biology or Chemistry (due to the joint major), and so their chances of getting a research position are higher. Since 2013 we have been trying to develop more internship opportunities for our students as an alternative way of developing crucial career skills in the students who do not participate in the intensive research experience. In Spring 2015, six students interned throughout San Diego county and in Fall 2015 eight students interned. The intern sites include everything from entering and analyzing research data (e.g. at Cabrillo National Monument), to learning to care for animals (e.g. Project Wildlife), or working in a science classroom (e.g. St. Charles Borromeo Middle School). Over the past two years, we have expanded the number of internship opportunities to about 10. It should be noted that this requires a lot of effort! To truly expand these opportunities for our students, we would need release time for an internship coordinator (see program recommendations). A coordinator would (a) cultivate new internship opportunities, (b) act as a liaison between the organization and the PLNU biology department, (c) meet with interns one-on-one to identify appropriate internship possibilities, (d) assist students with internship applications (when needed), (e) communicate regularly with the students during the internship, (f) communicate with the site internship supervisor to follow up on the progress and success of the student intern. In addition, students are highly encouraged to participate in the life of the department, including work as Teaching Assistants and/or graders for the courses, particularly the laboratory portions. This helps students apply their knowledge by making solutions, setting up reagents, working with advanced equipment, and teaching fellow students as part of their TA position. While the professor is the main instructor for every course, these opportunities of engagement for the students also help facilitate learning within the student community. In the last few years, over 50% of our students have participated as TAs in the department, many TAing for several semesters and multiple courses. However, we do not have this data broken down into individual programs within the biology department.

3. Describe any public scholarship of your undergraduate and graduate students in this program (conference presentations, publications, performances, etc.). What percentage of your undergraduate students are involved in these kinds of activities?

About half of the students that are involved in the intensive research experience with the faculty then have publications and/or presentations based on this research. Since few Biology-BA students participate in this experience, few of them are involved in public scholarship.

4. How many of your students participate in study abroad opportunities in general? Describe any study abroad opportunities specifically organized by your program. What percentage of your majors are involved annually (annualize the number)? How many students outside of your department participate in this departmentally organized program (Annualize the number)?

The numbers of Biology-BA students are too low to comment specifically on their participation in Study Abroad.

We have one opportunity that is organized by our department. In the mid-2000s we began to explore the possibility of a faculty-led study abroad course in ecosystems of the new world tropics. In the spring of 2008, Biology faculty member David Cummings joined a faculty-led course to Costa Rica offered by Northwest Nazarene University. The following September a PLNU course proposal was drafted and in spring 2009 Cummings along with colleague Mike Mooring led the first course in Neotropical Ecology (now designated BIO340). The 2-unit upper division course comprises 7-8 weeks of instruction on campus during the second quad of the spring semester followed by a two-week trip to Costa Rica, exploring the montane cloud forests and the lowland rain forests. Students study one of the few books on new world tropical ecosystems, give presentations on various plants and animals of the Costa Rican forests, and experience many of the things they have learned first-hand on the trail in Costa Rica.

The course is offered every other year in the spring and is capped at 12 students. Our enrollment has varied from 7-12. To date only one student outside of the Department has participated.

5. What are any other distinctives of your program? Describe how they contribute to the program's success.

A top priority of our department is for students to do biology, not just learn about biology. To accomplish this, we have a laboratory rich curriculum. Almost all of our classes have a required laboratory experience. We are proud of the deliberate mentoring of students that occurs while they are at PLNU and the relationships we have been able to maintain with a large number of our alums. Our students work as prep-room workers, graders, review session leaders, tutors, and lab assistants under the supervision of faculty. Our alumni are constantly giving back through guest lectures, mentoring, shadowing opportunities, etc., and are extremely willing to help current students. Alumni tell us that they are very well prepared for post-baccalaureate education and jobs in the discipline.

All of the full-time faculty in biology earned a Ph.D. prior to coming to PLNU. Moreover, all of our faculty have completed postdoctoral research beyond the Ph.D. This indicates that our program has a track record of attracting faculty highly-qualified in both teaching and scientific research.

Another distinctive shared by both the Biology and Chemistry Departments is our pre-health professions advising. We have a dedicated advisor (currently Sara Choung) for students preparing for medical, dental, optometry, pharmaceutical, or veterinary school. This program includes two preparatory interviews for the students, sessions with alumni and local health professionals, and a committee-written letter of recommendation. This program has almost certainly contributed to the high rate of acceptance of our students into the health professional schools (over 90% for over 15 years).

6. Does your program have an advisory board? If so, describe how it has influenced the quality of your program? If not, could it benefit from creating one?

NA

7. Describe any current joint interdisciplinary degrees (majors or minors) offered by your department. Are there additional areas where interdisciplinary programs should be considered?

See Biology-Chemistry and Environmental Science majors.

8. Describe your success with students acquiring jobs related to their discipline.

As discussed previously, we assess these data every five years. In our most recent survey, 88% of our alumni were employed or attending graduate school in a STEM-related field. In addition, our acceptance rate of students into graduate and health profession's schools continues to be at least 90%. Of the fifteen Biology-BA majors who responded to the survey, 80% are employed or in graduate school in a STEM-related

9. Describe your undergraduate and graduate student success rate for passing licensure or credentialing exams (if they exist in your discipline).

NA

10. Describe your success with undergraduate student acceptance into post-baccalaureate education.

See answer above.

11. What kind of support does your program provide for students encountering academic difficulties? How do you intentionally facilitate these students' connection with institutional support services?

Our department has multiple means of supporting students with academic difficulties. First, these students are usually identified in the freshman classes (BIO210 and BIO211), where the instructors contact students who are doing poorly on exams and offer specific advice on study habits, extra office hours, and direction to tutoring. Second, the Chemistry department offers a weekly tutorial for students in the first semester of General Chemistry (CHE151), as well as student-led weekly review sessions for both semesters of General Chemistry and Organic Chemistry. Third, during the twice yearly advising sessions, we meet with our advisees for 15-30 minutes and discuss both academic and non-academic factors, as well as vocation. Fourth, on some occasions, we have directly referred students to the Wellness Center, the DRC, or even contacted Caye Smith, Jeff Bolster, or Mark Pitts, depending on the situation. Finally, we are hoping to use the new capabilities of the SSC to bolster these efforts by identifying students who may be in the middle ground but could use some resources to make their college experience even better.

BioBA-F6) Infrastructure and Staffing

Full-Time Faculty Program Contribution Department UG Total			
	2012-13	**2013-14**	**2014-15**
Percentage of UG classes taught by FT faculty	71.9%	72.2%	83.9%
PLNU percentage of UG classes taught by FT Faculty	*TBD*	*TBD*	*TBD*
Includes: regular lectures, labs, seminars Excludes: independent studies, private lessons, internships			

1. Are your program's current technological resources and support adequate? If not, what is needed? Do you foresee any additional needs in this area?

At present our technological resources and support are superior with the recent addition of the Latter Hall classrooms and Sator Hall laboratories. Our current needs are well met; however, instrumental technology is continually evolving. The faculty actively pursues grants to support these needs. In addition, administration has been supportive of many of these changing needs as well. We need this continued support to provide our graduates with the most up-to-date education and experiences to be truly competitive.

2. Are your program's current facilities adequate? If not, what is needed? Do you foresee any additional needs in this area?

The classrooms and facilities in the new building are wonderful and adequate, as long there is stable enrollment in the Nursing, Allied Health, and Biology programs. Our office space is not adequate. Cho is in MICS space, which he will soon need to vacate. Koudelka is in a trailer outside the building. We thus need a minimum of two more offices.

3. Is your program's current staffing (administrative, clerical, technical and instructional) adequate? If not, what is needed? Do you foresee any additional needs in this area?

Staffing is close to adequate, again as long there is stable enrollment in the Nursing, Allied Health, and Biology programs. Ideally, we need a long-term adjunct or part-time professor so that we can split up the overly large sections of BIO130 and BIO140 that have 72 students. As discussed previously, this would require at least 6 units of extra load per year.

BioBA-F7) Challenges and Opportunities

1. Are there any particular challenges regarding this program that have not been addressed through the analysis and reflection on data or questions in sections F1-F6 that you would like to include here?

One of the biggest challenges with the Biology-BA students is the issue of identity. These students are generally lower-performing and are not on the graduate school/health professional school track that many of the other students in the department are on. We need to provide these students with opportunities to explore their vocation and also personally invite them to connect with the department since they may not do so on their own. The department faculty are currently exploring ways to better help our students understand their vocation, and we anticipate that these efforts will be implemented on a department-wide basis. Additionally, we are specifically encouraging some of the students that have been less involved with the department to become more involved by being a laboratory TA.

2. Are there any particular opportunities regarding this program that have not been addressed through the analysis and reflection on data or questions in sections F1-F6 that you would like to include here?

See answer above.

BioBA-F8) Recommendations for Program Improvement

List the recommendations you are making regarding this program analysis with a brief rationale for each recommendation.

- We have recognized that internship opportunities are a crucially important path for students to be able to explore their vocation. Thus we propose to make the BIO490 Internship count for up to 3 units of the Biology-BA students' total of 12 units of upper-division electives. This is already the case for the Biology-BS and Environmental Science-BS students.
- We have also ramped up our internship opportunities over the past two years and have also begun intentionally advising students to take advantage of these opportunities. From 2012-14, we only had 1-4 units of student internships. In both 2014-15 and 2015-16, we had 12-14 units of student internships per year. Currently, four different faculty are overseeing various internships and being paid overload pay to coordinate them. In order to make this program more effective, we request 1 unit of load release per year for an internship coordinator, which is the standard rate for 12 internship units. This coordinator would (a) cultivate new internship opportunities, (b) act as a liaison between the organization and the PLNU biology department, (c) meet with interns one-on-one to identify appropriate internship possibilities, (d) assist students with internship applications, (e) communicate regularly with the students during the internship, and (f) communicate with the site internship supervisor to follow up on the progress and success of the student intern. This coordinator would interact with the students in all of the undergraduate Biology programs, hence this recommendation will be made in each program section.

Program Level Analysis (Bio-BS)

Bachelor of Science in Biology

BioBS-F1) Trend and Financial Analysis

First-Time Freshman Admissions Funnel							
Biology (BS)	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Inquiries	**126**	**339**	**392**	**408**	**625**	**697**	**741**
Share of PLNU inquiries	*1.1%*	*2.2%*	*2.4%*	*2.2%*	*3.4%*	*3.2%*	*4.4%*
Completed Applications	**70**	**132**	**180**	**189**	**195**	**154**	**186**
Share of PLNU Applications	*3.4%*	*5.0%*	*6.4%*	*6.6%*	*6.6%*	*5.8%*	*7.4%*
Applicant Conversion Rate	**55.6%**	**38.9%**	**45.9%**	**46.3%**	**31.2%**	**22.1%**	**25.1%**
PLNU Applicant Conversion Rate	*18.6%*	*17.3%*	*17.0%*	*15.7%*	*16.1%*	*12.1%*	*15.0%*
Admits	**69**	**108**	**138**	**146**	**131**	**138**	**161**
Share of PLNU Admits	*3.8%*	*5.6%*	*7.2%*	*7.4%*	*6.3%*	*6.5%*	*8.0%*
Selection Rate	**98.6%**	**81.8%**	**76.7%**	**77.2%**	**67.2%**	**89.6%**	**86.6%**
PLNU Selection Rate	*87.4%*	*72.9%*	*68.9%*	*69.0%*	*70.5%*	*79.5%*	*79.8%*
New Transfer Admissions Funnel							
Biology (BS)	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Inquiries	**18**	**15**	**30**	**24**	**40**	**70**	**50**
Share of PLNU inquiries	*2.2%*	*2.1%*	*3.4%*	*1.5%*	*2.7%*	*3.8%*	*2.4%*
Completed Applications	**12**	**8**	**20**	**12**	**19**	**26**	**15**
Share of PLNU Applications	*2.9%*	*2.0%*	*4.0%*	*2.6%*	*3.8%*	*3.9%*	*3.3%*
Applicant Conversion Rate	**66.7%**	**53.3%**	**66.7%**	**50.0%**	**47.5%**	**37.1%**	**30.0%**
PLNU Applicant Conversion Rate	*50.2%*	*55.5%*	*56.2%*	*28.4%*	*33.2%*	*36.9%*	*21.7%*
Admits	**11**	**4**	**13**	**6**	**11**	**20**	**15**
Share of PLNU Admits	*3.4%*	*1.7%*	*4.7%*	*2.1%*	*3.4%*	*4.7%*	*4.2%*
Selection Rate	**91.7%**	**50.0%**	**65.0%**	**50.0%**	**57.9%**	**76.9%**	**100.0%**
PLNU Selection Rate	*79.3%*	*57.9%*	*54.8%*	*60.5%*	*65.4%*	*64.1%*	*79.2%*

1. What does this data tell you about the external demand for your program? What does this say about the future viability of your program?

   We have very high external demand for all of the undergraduate Biology programs. We have asked Admissions to limit enrollment of all Biology majors (Biology-BA, Biology-BS, Biology-Chemistry-BS, Environmental Science-BS) to 100 students per year, as we do not have the faculty to deal with larger numbers of students.

First-Time Freshman Admissions Yield							
Biology (BS)	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Admits	69	108	138	146	131	138	161
Matriculants	**29**	**26**	**35**	**46**	**43**	**27**	**54**
Share of PLNU Matriculants	*5.4%*	*4.4%*	*6.6%*	*7.7%*	*6.6%*	*4.6%*	*9.0%*
Yield Rate	**42.0%**	**24.1%**	**25.4%**	**31.5%**	**32.8%**	**19.6%**	**33.5%**
PLNU Yield Rate	*29.3%*	*30.5%*	*27.7%*	*30.3%*	*31.0%*	*27.9%*	*29.9%*
New Transfer Admissions Yield							
Biology (BS)	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Admits	11	4	13	6	11	20	15
Matriculants	**5**	**2**	**5**	**1**	**6**	**7**	**9**
Share of PLNU Matriculants	*3.0%*	*1.4%*	*3.3%*	*0.7%*	*4.2%*	*3.5%*	*5.2%*
Yield Rate	**45.5%**	**sm**	**38.5%**	**16.7%**	**54.5%**	**35.0%**	**60.0%**
PLNU Yield Rate	*51.1%*	*60.2%*	*54.7%*	*47.3%*	*44.6%*	*46.0%*	*48.0%*
sm = cell size too small							

2. How does your yield rate (percentage of students who enroll at PLNU after being admitted) compare to the PLNU average? If your rate is more than 8 percentage points above the PLNU average, what factors do you believe are contributing to this positive outcome? If your rate is more than 8 percentage points below the PLNU average for more than one year, what factors do you believe are contributing to this difference?

Our yield for this major is generally at or above the PLNU average, but as stated above, we cannot easily handle more students.

Enrollment							
Majors	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Biology (BS)	**89**	**102**	**123**	**131**	**145**	**120**	**154**
Share of PLNU Undergraduates	*3.7%*	*4.2%*	*5.2%*	*5.4%*	*5.7%*	*4.7%*	*5.8%*
Minors (duplicated from Bio-BA)	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Biology: Cell and Molecular Biology	4	3	3	6	2	2	4
Biology: Environmental Biology	1	4	3	4	2	2	4
Biology: Organismal Biology	4		3	2	4	6	2
Minors (Total)	**9**	**7**	**9**	**12**	**8**	**10**	**10**
Share of PLNU Minors	*2.6%*	*2.0%*	*2.6%*	*3.3%*	*2.2%*	*2.4%*	*2.8%*
Major Migration of Completers*							
Top Importing Programs:	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**6-yr Total**
Biology-Chemistry	5	7	3	6	10	8	39
Biology (BA)	10	6	8	1		1	26
Undeclared	1				1		2
Top Export Destinations:	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**6-yr Total**
Biology (BA)		1	1	4		2	8
Exercise Science				3	2	1	6
Biology-Chemistry			1		1	2	4
Psychology				3		1	4
Applied Health Science					1	1	2

* Based on degree completions of students who either started or finished within the program and who originally matriculated as first-time freshmen

3. What does this data tell you about the internal demand for your program? Does this raise any questions about the viability and/or sustainability of your program as it is currently configured? Explain why or why not. Are there any actionable strategies that you can do that might make a difference if your trends are in the wrong direction?

Again, we have a very high demand for our program. Note that the major export is to the Biology-BA.

General Education and Service Credit Hour Production Department UG Total				
	2011/12	**2012/13**	**2013/14**	**2014/15**
Total Dept UG student credit hours	5,421.0	5,880.0	5,742.0	5,648.0
Number of GE sections taught	?	?	?	?
% of SCH that are GE	47.0%	51.6%	52.1%	51.5%
Share of PLNU GE SCH	*7.3%*	*8.4%*	*8.3%*	*8.1%*
Number of service course sections taught	?	?	?	?
% of SCH that are service	18.2%	20.5%	21.2%	21.2%
Share of PLNU service SCH	*TBD*	*TBD*	*TBD*	*TBD*

4. What does this data tell you about how your program is impacted by the needs of GE and other academic disciplines? Does this raise any questions about the viability and/or sustainability of your program if these non-programmatic trends continue? Explain why or why not.

Note: This is the same answer as for the Biology-BA.
We teach a lot of GE units and service units. As discussed already, the GE units help to offset the cost of the unfunded load in the department that is due to the laboratory experiences for the service courses and the majors. We do not anticipate a decrease in service units as the Nursing and Allied Health programs are also in high demand. If PLNU restructures GE such that a Biology course is no longer required by all students, this would obviously have a dramatic impact on our teaching loads.

Delaware Study Data Department Total												
	2010/11			**2011/12**			**2012/13**			**2013/14**		
Program Cost per SCH	**$244**			**$239**			**$237**			**$260**		
Benchmark Percentiles	$148	$194	$244	$153	$201	$235	$161	$198	$243	$174	$217	$266
Ranking	Medium-High			High			Medium			Medium		

5. We know that the following factors influence the Delaware cost per credit hour:
   - Large amount of GE and service classes taught by the program
   - The career stage of the program faculty (early career faculty are less expensive)
   - The number of elective courses in the program
   - The amount of unfunded load (faculty receiving more credit for a course than the number of units received by a student – e.g. 4 units of faculty load for teaching a 3 unit class)
   - The amount of release time associated with the program
   - Faculty members on sabbatical
   - The size of the department budget and the cost of specialized equipment

Please reflect on your program's Delaware data in light of this information. In particular, what factors contribute to your program having a high (above 75th percentile), medium (50th-75th percentile), or low (below 50th percentile) ranking?

Note: This is the same answer as for the Biology-BA.
As discussed in prioritization, the Biology department has a high unfunded load due to the many laboratory courses we offer. We feel that these courses are essential to students' education because they must learn how to DO Biology, not just read, write, and think about Biology. The unfunded load is offset by the high amount of GE and service courses that we teach. This brings us into the medium cost range for the Delaware study comparison.

6. Recognizing that not all factors above are under departmental control, what kinds of adjustments might be made to reduce the cost per student credit hour?

Note: This is the same answer as for the Biology-BA.
We reduced the unfunded load of the GE courses by making the laboratory experience worth 1 unit. This is not possible for the service and major courses, however, because it would increase the sizes of the affected majors beyond their acceptable limits.

***** Future *****
Financial Data: (possibly delayed to the future)
Extra Revenue Generated by Program (lab fees, studio fees, etc.)
Extra Revenue per student credit hour
Extra Costs for the program (equipment not purchased outside of department budget, etc.)
Extra costs per student credit hour
Modified Delaware values: Delaware – extra revenue per SCH + extra costs per SCH

7. Do these modified Delaware values tell you anything new about the future viability and/or sustainability of your program as it is currently configured? Please explain.

Data not provided.

BioBS-F2) Findings from Assessment

Links to the department's assessment wheel
• Student Learning Outcomes • Curriculum Maps • Assessment Plan • Evidence of Student Learning • Use of the Evidence of Student Learning

Reflection on longitudinal assessment of student learning data:

1. What have you learned from this program's student learning assessment data?

Our first priority as an academic department is to ensure that our students are learning the essential content in the field of biology. We use the ETS Major Field Test in Biology to measure the performance of our undergraduates in four major areas of Biology: Cell Biology, Molecular Biology & Genetics, Organismal Biology, and Population Biology, Evolution, & Ecology. At least 50% of the students are expected to score above the 60th percentile on the overall exam, and in each sub-discipline. Additionally, the overall group mean and the group mean in each sub-discipline are expected to be above the 75th percentile. The Biology-BS students (n=79) met all of these criteria in 2013 and 2015 and met most of these criteria in 2014.

Since many students struggle with the integration of their Christian faith with science, another priority of our department is that students will develop a rationally defensible integration of science with their faith. In our most recent measurement, all of the graduating Biology-BS students were able to write an essay with a strong defensible integration of their faith with science.

Finally, a top priority is that our students should be prepared to gain admittance to graduate programs and science-related careers. We assess these data every five years. In our most recent survey, 88% of our alumni were employed or attending graduate school in a STEM-related field. In addition, our acceptance rate of students into graduate and health profession's schools continues to be at least 90%. Of the 44 Biology-BS majors who responded to the survey, 84% are employed or in graduate school in a STEM-related field.

2. What changes (curricular and others) have you made based on the student learning assessment data?

Note: This is the same answer as for the Biology-BA.
At our last program review, we determined that we needed to split a freshman course that was attempting to introduce Ecology, Evolution, and Organismal Biology in one semester into two semester-long courses: Ecological and Evolutionary Systems and Organismal Biology. This change was recommended based on the poor performance of our majors in the sub-categories of Animal Biology and Plant Biology on the ETS Major Field Test in Biology. After implementing these changes to our curricula, we then discovered that we needed to modify two upper-division courses: BIO360 (Ecology) and BIO310 (Botany). Our students were getting a much better background in ecology and plant biology, such that these two upper-division courses no longer needed to teach the background content. We discovered this disconnect via our senior exit interview process. Thus, we significantly changed the content of the upper-division courses. Instead of Botany, we now offer BIO312 (Applied Plant Science), and instead of Ecology, we now offer BIO363 (Conservation Ecology), which focuses on conservation and sustainability.

In addition, after hiring a Marine Biologist, we significantly changed the content of all of our Marine Biology courses, as we discovered that they did not reflect how modern Marine Biology is taught. We now offer Introduction to Oceanography, Marine Biology, and Experimental Marine Ecology.

Finally, we also changed the structure of both the Biology-BA and -BS majors. We decreased the number of required courses, increased the number of electives, and decreased the size of these majors by 2-4 units. These changes were also driven by assessment, as three years of senior exit interviews revealed that many students wanted more choice in their electives in order to be able to do a minor and/or study abroad. Importantly, the size of these majors is still similar to their size at comparator institutions. Recent senior exit interviews indicate that student satisfaction with these majors is now much higher.

3. What additional changes are you recommending based on your review of the student learning assessment data?

Note: This is the same answer as for the Biology-BA.
The only other recent change we made was based on senior exit interviews. We changed Calculus-Based Statistics (MTH362) from a 2 unit class to a 3 unit class (MTH363). We found that students going on to graduate school generally need 3 units of statistics. Moreover, we also found that our majors needed a more robust statistics course in order to meet the demands of the data analyses required by modern biology. In particular, students need to learn the use of the statistics package R, and this content could not be added into the existing 2-unit course without deleting other important content.

DQP Outcomes with Scores
***** TBD *****
DQP Definitions
Intellectual Skills Intellectual Skills define proficiencies that transcend the boundaries of particular fields of study: analytic inquiry, use of information resources, engaging diverse perspectives, ethical reasoning, quantitative fluency, and communicative fluency.
Specialized Knowledge What students in any specialization should demonstrate with respect to the specialization, often called the major field. All fields call more or less explicitly for proficiencies involving terminology, theory, methods, tools, literature, complex problems or applications and cognizance of limits.
Applied and Collaborative Learning Applied learning suggests what graduates can do with what they know. This area focuses on the interaction of academic and non-academic settings and the corresponding integration of theory and practice, along with the ideal of learning with others in the course of application projects.
Broad and Integrative Knowledge Students integrate their broad learning by exploring, connecting and applying concepts and methods across multiple fields of study to complex questions—in the student's areas of specialization, in work or other field-based settings and in the wider society.
Civic and Global Learning Civic and Global Learning proficiencies rely principally on the types of cognitive activities (describing, examining, elucidating, justifying) that are within the direct purview of the university, but they also include evidence of civic activities and learning beyond collegiate settings. These proficiencies reflect the need for analytic inquiry and engagement with diverse perspectives.

Reflection on DQP related data:

Understanding that the DQP framework provides one particular lens on the meaning, quality and integrity of your curriculum, reflect on the DQP data and framework provided for your program.

4. What have you learned from this program's DQP comparison?

The DQP roll-up is based on current department assessment, so we have nothing to add here.

5. What changes (curricular and others) have you made based on the DQP comparison?

None.

6. What additional changes are you recommending based on your review of the DQP comparison?

None.

Links to stakeholder assessment data (if present this will be department housed data)
• Surveys • Focus Groups • Market Analysis • Etc…

Reflection on stakeholder feedback data:

7. What have you learned from this program's stakeholder assessment data? If you do not have stakeholder data, please provide a plan for how you will regularly collect this in the future.

We conducted an alumni survey in 2015. 408 alumni from 2004-2014 were mailed and 115 replied (28% response). 60% of the respondents were currently in a graduate program or had already obtained an advanced degree. The most common occupations were currently in a graduate program (35%), health professional (23%), research (12%: biotechnology, academic, government, etc.) and K-12 teacher (5%). 73% of the respondents overall said that they felt well-prepared scientifically. Of the 34 Biology-BS majors who answered this question, 33 said that they felt well-prepared scientifically. As mentioned above, of the 44 Biology-BS majors who responded to the survey (27% response rate for this major), 84% are employed or in graduate school in a STEM-related field.

8. What changes (curricular and others) have you made based on the stakeholder assessment data?

None.

9. What additional changes are you recommending based on your review of the stakeholder assessment data?

None.

BioBS-F3) Curriculum Analysis

In looking at your curriculum, the program review process is asking you to analyze it through three different lenses. The first lens is looking at your content and structure from the perspective of guild standards or standards gleaned from looking at programs at comparator institutions. The second lens that of employability and is asking you to look at your curriculum and educational experiences from the perspective of skills and professional qualities that you are developing in your students that will serve them will in their future work and vocational callings. The third lens is that of pedagogy and is asking you to look at the delivery of your curriculum to ensure a high quality student learning experience.

Menu and Elective Unit Analysis Biology (BS)	
Number of menu and elective units required by the program	14
Number of menu and elective units offered by the program	38
Menu/Elective Ratio	2.71
Longitudinal Class Section Enrollment Data	
• Link to Class Section Enrollment Report	

Comparison of current curriculum to guild standards and/or comparator institutions.

If your guild standards are associated with a specialized accreditation that your program has, these should be the basis of your analysis. If your guild standards are associated with specialized accreditation that we do not have, then you should primarily use comparator institutions as the basis for your analysis.

If your guild has standards that are not associated with specialized accreditation, then you may choose to use those standards and/or comparator institutions.

After consultation with your Dean, provide the set of guild standards or a list of the comparator institutions that you are using in your analysis.

If using guild standards:

1. Please provide a list of the guild standards that you are using to evaluate your curriculum.

Note: This is the same answer as for the Biology-BA. We do not have an accrediting body for Biology. We have used comparator institutions to analyze our curriculum in the past, however a new resource was recently published for Biology programs. The American Association for the Advancement of Science (AAAS) published "Vision and Change in Undergraduate Biology Education" where they outlined five core concepts intended to guide undergraduate biology education: 1) evolution; 2) structure and function; 3) information flow, exchange, and storage; 4) pathways and transformations of energy and matter; and 5) systems. Brownell et al. (2014) used these general recommendations to create a framework that biology departments can use to align with the goals of Vision and Change. Accordingly, we used this document to analyze both the Biology and the Biology-Chemistry majors (Appendix A).

2. Indicate if and how your curriculum satisfies the standards (this can be done in a table or narrative form). If applicable, indicate areas where your curriculum falls short of the standards.

Note: This is the same answer as for the Biology-BA. For the most part, our curriculum satisfies these national goals. The only possible shortcoming is in some of the Physiology standards (coded pink in Appendix A). Some of these standards are not mastered via the required courses. Thus, depending on which upper-division electives students choose, they may or may not master this material. We decided several years ago to decrease the amount of upper-division requirements in the major, so that students would have the freedom to take courses aligning with their interests. As a department, we are thus willing to live with the possibility that students will not master every area of Biology.

Based on the analysis of standard and reflection on the menu and elective ratio above, consider and discuss the following questions:

3. Are there courses in your program that should be modified? Why or why not.

Note: This is the same answer as for the Biology-BA. We are not currently considering modifying any of the courses for the Biology major due to the fact that our curriculum does quite well at meeting the AAAS national goals.

4. Are there courses that should be eliminated? Why or why not.

Note: This is the same answer as for the Biology-BA.
Similarly, we are not considering eliminating any courses. We do not have very many low enrollment courses. In looking at the enrollment report, BIO490 and BIO499 are internship and research courses that are paid via faculty overload. BIO325 has not been offered for several years; this is the only possible course we would eliminate. BIO330 was already eliminated. BIO333 (the replacement for BIO330) and BIO473 are brand new courses and are offered every other year. The enrollment in them is expected to increase.

5. Are there courses that could be merged? Why or why not.

Note: This is the same answer as for the Biology-BA.
There are not any obvious courses in our curriculum that would benefit from being merged.

6. Are there courses that should be added? Why or why not. Note that in general, in order to create the space to add a new course, another course will need to be eliminated or taught less frequently.

Note: This is the same answer as for the Biology-BA.
We are also not currently considering adding courses to the Biology major. However, we are proposing to add a course to the Environmental Science major, and it would be an additional elective for Biology majors (see discussion in that portion of the document).

7. What did you learn about your overall curricular structure in terms of its complexity, breadth and depth in light of the guild standards and our institutional size and scope? Are there any structural changes that need to be made in light of your analysis (e.g. sequencing of courses, % and or grouping of electives, overall units required, use of concentrations, etc…)?

Note: This is the same answer as for the Biology-BA.
As stated previously, we were pleased that our curriculum met the AAAS national goals so well.

If using comparator institutions:

1. Begin by working with your Dean to identify a list of 5-8 comparator schools to use. In selecting schools, consideration should be given to type of institution, mission of the institution and the number of students majoring in the program.

Institution 1
Institution 2
Institution 3
Institution 4
Institution 5
Institution 6

Gather the curricular requirements for the program in question at each of the comparator institutions.

2. Use this collection of curricular requirements to develop a list of curricular features that are essential for programs of this type. In addition, make note of any innovative or creative curricular feature that may be useful in enhancing the quality of you program.

NA

Review this list with your Dean before using it to analyze your own curriculum.

3. Indicate how your curriculum compares to the list of curricular features from your analysis (this can be done in a table or narrative form).

NA

Based on the analysis of comparator programs and reflection on the menu and elective ratio above:

4. Are there courses in your program that should be modified? Why or why not.

NA

5. Are there courses that should be eliminated? Why or why not.

NA

6. Are there courses that could be merged? Why or why not.

NA

7. Are there courses that should be added? Why or why not. Note that in general, in order to create the space to add a new course, another course will need to be eliminated or taught less frequently.

NA

8. What did you learn about your overall curricular structure in terms of its complexity, breadth and depth in light of the comparator schools and our institutional size and scope? Are there any structural changes that need to be made in light of your analysis (e.g. sequencing of courses, % and or grouping of electives, overall units required, use of concentrations, etc…)?

NA

Burning Glass Skills Data Biology (BS)		
1. Communication Skills ***Virtually every course between presentations of primary literature articles, data communication, and scientific writing.***	5. Quality Assurance and Control ***Che294.***	9. Management ***Basic skills developed in our teaching assistant* and summer research programs**, as well as in Biology internships.***
2. Research ***Virtually every course as each science course has a required, associated lab portion. This is also mastered with summer research opportunities, Bio499, Biology internships, and honor's projects.***	6. Leadership ***Basic skills developed in our teaching assistant* and summer research programs**, as well as in Biology internships.***	10. Project Management ***None.***

3. Writing ***Virtually every course with assigned lab reports and scientific writing.***	7. Planning ***Bio210, 211, 301, 345, 380, 390, 400. Che152, 153, 294.***	11. Detail-Oriented ***Bio210, 211, 301, 345, 350, 380, 390. Che152, 153, 294.***
4. Organizational Skills ***Bio210, 211, 301, 345, 350, 380, 400. Che152, 153, 294.***	8. Problem Solving ***Bio210, 211, 301, 345, 380, 390, 400. Che152, 153, 294.***	12. Supervisory Skills ***Basic skills developed in our teaching assistant* and summer research programs**, as well as in Biology internships.***

* While the Teaching Assistant Program is not a required course, we highly encourage every student within the major to participate and many of them do. As a TA, they directly interface with the students in laboratory courses, providing assistance with data collection, analysis and report generation. Some are also in charge of lab set-up, breakdown, and grading lab quizzes. It is a position designed to develop basic skills in leadership, management, and supervisory capacities.

**The Summer Research Program is not a required course, but it is very highly recommended and many of our majors participate. Participating students are required to commit to two summers so that many labs have some new students and some returning students. As such, the returning students act as mentors working with the new students. This situation highly encourages the development of basic skills in leadership, management, and supervisory capacities.

Analysis of the curriculum against preparation for employment

9. The Burning Glass data provides a list of skills for students entering common professions that are often linked to your major. Indicate in the table if and where each skill is being taught in your program. Based on reflecting on this data, are there changes you would recommend making to your curriculum?

Note: This is the same answer as for the Biology-BA.
Interestingly, we had already decided as a department what skills are important for our majors to have, and we added them to the AAAS document discussed above (Appendix A). The top four Burning Glass skills are a close match with the skills we had already identified, and they are all highly developed in our curriculum, as shown in Appendix A. In addition, problem solving and an orientation to details are a natural part of the Biology curriculum. The other skills listed above would be gained through on-the-job experience or through Business classes. The new Science-Business minor is an option for students planning to go into careers in Biotechnology or the Pharmaceutical Industry, where those skills would be crucial in addition to their Biology background.

10. Some programs may serve to prepare students with professional qualities and skills that can serve them well in a great variety of professions that may not show up in data sets like Burning Glass. If this is indicative of your program, please identify the unique skills and/or professional qualities that your program develops in your students and indicate where in the curriculum this is being taught or developed.

As mentioned previously, the fact that nearly every Biology class has an associated lab is crucial to the skill set of Biology majors. In these labs, students learn not only laboratory skills, but also how to formulate hypotheses, how to evaluate date, how to do independent research, and how to write a research proposal.

Through our intensive summer research program, students hone these skills even further. Yet, since only half of our students participate in the intensive summer research program, it is crucially important that the laboratory courses remain a foundational part of our curriculum.

Analysis of the teaching of your curriculum

11. How do the pedagogical features of your program compare with the best practices for teaching in your discipline?

Note: This is the same answer for all of our undergraduate programs.
In 2011, the National Science Foundation (NSF) and the American Association for the Advancement of Science (AAAS) issued a report articulating much needed changes in biology education across the country. The document, titled "Vision and Change in Undergraduate Biology Education: A Call to Action," argued for a transition from faculty-centered education to student-centered education. As a Department, we have chosen the guidance in this document as our benchmarks for best practices in the discipline. Below, we describe each Vision and Change benchmark and then discuss how our program falls short, meets, or exceeds the standard.

The student-centered classroom, sometimes called active learning, is one that is "interactive, inquiry-driven, cooperative, collaborative, and relevant." In short, it is designed with student learning in mind rather than faculty teaching in mind. One approach to accomplishing a student-centered classroom is by way of what is commonly referred to as "scientific teaching", or sometimes "backward design." This strategy for designing a course starts not with the teacher's favorite topics or what they will say in class. Instead, careful time and attention are given to developing and precisely articulating learning outcomes. Once the learning outcomes are clear, the teacher designs the best assessments to determine if the students have achieved the desired outcomes. Finally, teaching methods are considered that can provide the best opportunity for the students to achieve the stated learning outcomes.

PLNU Biology Department faculty members have been proactive in learning new techniques for student-centered teaching. We have three Ph.D.-trained science educators in our department who consult with each of us frequently and regularly offer training sessions. Many of us have attended workshops on active learning, such as the National Academies Summer Institute on Undergraduate Education in Biology offered by HHMI and NSF. We participate in a twice-monthly Faculty Learning Community focused on teaching in the STEM disciplines. Many of us take advantage of (and sometimes help lead) training opportunities offered by the Center for Teaching and Learning, such as the hugely successful Teachers Noticing Teachers program. We meet every Thursday for lunch to discuss teaching issues, and have read books (e.g., *Scientific Teaching* by Handelsman et al.) and journal articles (e.g., *Active Learning Increases Student Performance in Science, Engineering, and Mathematics* by Freeman et al. PNAS 2013) together on active learning.

Some of the student-centered teaching techniques recommended in the Vision and Change document include authentic research experiences, case studies, immediate feedback assessment technique, personal response systems, inquiry-driven learning, concept mapping, peer-led team learning, problem-based learning, process-oriented guided inquiry learning, and team-based learning. We have already implemented many of these techniques and are in the process of experimenting with others.

For example, the lab component of our upper division Microbiology course was converted several years ago to a research experience. Students learn fundamental microbiological lab techniques in the context of a bona fide research project within the expertise of the instructor. At the end of the semester, student teams present their research to the campus community in a mini-conference poster session, complete with judges and prizes.

Another example takes place in Developmental Biology. Students study assigned pieces of a complex story at home, then in class they meet in groups to bring their pieces together (process-oriented guided inquiry learning).

Several Biology professors further make use of flipped classrooms, case studies, online adaptive learning tools, personal response systems (clickers), concept mapping, peer-led team learning, and team-based learning, to name a few.

12. What new pedagogical practices have been tried by members of your department in the last few years? What has your department learned from these experiments?

See above.

13. Are there new developments in pedagogy in your discipline? What would be required to implement these changes in pedagogy in your department?

The 2011 Vision and Change document discussed above represents the most recent pedagogical developments that have been widely adopted by the biology teaching community. Possibly the two greatest hindrances to implementing active learning practices are (1) class sizes (in some cases), and (2) faculty time to develop the methods and assessment tools.

BioBS-F4) Potential Impact of National Trends

Top Burning Glass Occupations for the Program Biology (BS)		
Occupation	**Hiring Demand**	**Salary Range**
Medical Scientist	High	$53K - $107K
Biological Technician	Medium	$36K - $38K
Biologist	Medium	$57K - $61K
Clinical Research Coordinator	Medium	$46K - $50K
Medical Laboratory Technologist	Medium	$58K - $60K
Quality Control Analyst	Medium	$50K - $54K
Quality Manager	Medium	$78K - $81K
Biochemist	Low	$55K - $112K
Biomedical Engineer	Low	$74K - $85K
Biostatistician	Low	$86K - $99K
Environmental Compliance Specialist	Low	$42K - $65K
Epidemiologist	Low	$62K - $68K
Food / Agricultural Inspector	Low	$31K - $39K
Microbiologist	Low	$48K - $92K
Physical Science Technician	Low	$39K - $46K
Research Manager	Low	$59K - $69K
Wildlife Biologist	Low	$48K - $54K

Note that some programs do not have as many professions listed in the Burning Glass data as others do. In these cases we will want to get a list of professions from the chair/school dean to supplement the Burning Glass data.

1. Which professions in the Burning Glass data were you already aware of and for which are you already intentionally preparing students and does the hiring demand in these professions signal anything about the future that you need to be aware of regarding the design and structure of your program ?

Note: This is the same answer as for the Biology-BA.
We are aware of all of these professions. Our Biology curriculum is not specialized toward any one profession. Rather we offer a broad foundation in modern Biology knowledge and skills, so that students are prepared for many professions. Additionally, our upper-division elective menu allows students to specialize toward their interests. For example, a student who wants to be a Wildlife Biologist would take courses such as Animal Behavior or Marine Biology, whereas a student who wants to be an Epidemiologist would take courses such as Microbiology or Immunology.

2. Are there additional professions in the Burning Glass list or from your knowledge of occupations your alumni have entered, for which you should be preparing students?

Note: This is the same answer as for the Biology-BA.
We also prepare students for careers in medicine, which are not listed on Burning Glass, perhaps because an advanced degree is required. Similarly, we prepare students for careers in teaching, which is also oddly not on the Burning Glass list. There is a large need for K-12 teachers in California, especially science teachers.

3. What changes in your program would be necessary in order to prepare students for the skills and professional qualities needed to succeed in these additional professions?

Note: This is the same answer as for the Biology-BA.
No program changes are required. Our alumni are highly successful in getting into both graduate school and careers, as already discussed.

4. Are there national trends in higher education or industry that are particularly important to your discipline? If yes, how is your program reacting to those trends?

Note: This is the same answer as for the Biology-BA.
As discussed previously, we have analyzed our curriculum for the knowledge recommended by AAAS, and we have also implemented national recommendations for student-centered pedagogy into our curriculum.

BioBS-F5) Quality Markers

Retention/Graduation Rates (First-Time Freshmen)							
	Matriculation Term						
Biology (BS)	**Fall 2008**	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**
First-Year Retention	**89.5%**	**86.7%**	**84.4%**	**83.3%**	**92.1%**	**79.4%**	**85.0%**
PLNU First-Year Retention	*84.2%*	*84.1%*	*81.1%*	*82.9%*	*89.3%*	*84.5%*	*84.5%*
	Matriculation Term						
Biology (BS)	**Fall 2005**	**Fall 2006**	**Fall 2007**	**Fall 2008**	**Fall 2009**	**Fall 2010**	**Fall 2011**
Four-Year Graduation Rate	**57.1%**	**88.9%**	**75.0%**	**78.9%**	**65.5%**	**80.6%**	**56.3%**
PLNU Four-Year Graduation Rate	*62.0%*	*65.2%*	*61.7%*	*59.1%*	*63.4%*	*62.2%*	*63.2%*
	Matriculation Term						
Biology (BS)	**Fall 2003**	**Fall 2004**	**Fall 2005**	**Fall 2006**	**Fall 2007**	**Fall 2008**	**Fall 2009**
Six-Year Graduation Rate	**90.0%**	**100.0%**	**84.6%**	**100.0%**	**92.9%**	**84.2%**	**72.4%**
PLNU Six-Year Graduation Rate	*72.4%*	*73.2%*	*73.0%*	*74.9%*	*72.2%*	*73.6%*	*75.0%*
Degree Completions							
Majors	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
Biology (BS)	**16**	**21**	**20**	**24**	**20**	**33**	**25**
Share of PLNU Bachelor's Degrees	*2.7%*	*4.0%*	*3.7%*	*4.4%*	*3.5%*	*5.6%*	*4.6%*
Minors (duplicated from Bio-BA)	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
Biology: Cell and Molecular Biology		2	3		1	1	1
Biology: Environmental Biology		1		2		1	
Biology: Organismal Biology	1	3			2		
Total Minors	**1**	**6**	**3**	**2**	**3**	**2**	**1**
Share of PLNU (completion) Minors	*1.2%*	*7.2%*	*3.7%*	*2.6%*	*3.5%*	*2.3%*	*1.1%*
FTF Time to Degree *(in semesters)*	**8.3**	**8.2**	**8.5**	**8.1**	**8.0**	**8.1**	**7.9**
PLNU FTF Time to Degree	*8.2*	*8.2*	*8.3*	*8.2*	*8.3*	*8.3*	*8.3*
Study Abroad Participants	2	2	5	1	1	3	2

1. Based on comparing the quality marker data for your program with the PLNU averages:
   a. What does this tell you about your program?

Retention, graduation rates, and FTF time to degree is generally at or above the PLNU average.

b. If your values are below the PLNU averages, what changes could you make to address any areas of concern?

NA

c. If your values are above the PLNU averages, what do you believe contributes to this success?

NA

2. Describe regular opportunities for students to apply their knowledge (internships, practicums, research projects, senior projects, etc.). Estimate what percentage of your students in this program participates in these kinds of opportunities.

Both Biology and Chemistry have an intensive undergraduate research program, where students gain an 800 hour research experience over the course of two summers. Of the Biology Department students who graduated from 2007-2015, 50% participated in an intensive research experience. This percentage is the same for the Biology-BS majors.

Since 2013 we have been trying to develop more internship opportunities for our students as an alternative way of developing crucial career skills in the students who do not participate in the intensive research experience. In Spring 2015, six students interned throughout San Diego county and in Fall 2015 eight students interned. The intern sites include everything from entering and analyzing research data (e.g. at Cabrillo National Monument), to learning to care for animals (e.g. Project Wildlife), or working in a science classroom (e.g. St. Charles Borromeo Middle School). Over the past two years, we have expanded the number of internship opportunities to about 10. It should be noted that this requires a lot of effort! To truly expand these opportunities for our students, we would need release time for an internship coordinator (see program recommendations). A coordinator would (a) cultivate new internship opportunities, (b) act as a liaison between the organization and the PLNU biology department, (c) meet with interns one-on-one to identify appropriate internship possibilities, (d) assist students with internship applications (when needed), (e) communicate regularly with the students during the internship, (f) communicate with the site internship supervisor to follow up on the progress and success of the student intern.

In addition, students are highly encouraged to participate in the life of the department, including work as Teaching Assistants and/or graders for the courses, particularly the laboratory portions. This helps students apply their knowledge by making solutions, setting up reagents, working with advanced equipment, and teaching fellow students as part of their TA position. While the professor is the main instructor for every course, these opportunities of engagement for the students also help facilitate learning within the student community. In the last few years, over 50% of our students have participated as TAs in the department, many TAing for several semesters and multiple courses. However, we do not have this data broken down into individual programs within the biology department.

3. Describe any public scholarship of your undergraduate and graduate students in this program (conference presentations, publications, performances, etc.). What percentage of your undergraduate students are involved in these kinds of activities?

As described above, about 50% of our students are involved in the intensive research experience with the faculty. At least half of these students then have publications and/or presentations based on this research. Many of them present at the West Coast Undergraduate Research Conference in Biology, which our department hosts every 2-3 years.

4. How many of your students participate in study abroad opportunities in general? Describe any study abroad opportunities specifically organized by your program. What percentage of your majors are involved annually (annualize the number)? How many students outside of your department participate in this departmentally organized program (Annualize the number)?

Relatively few of the Biology-BS students participate in study abroad. With the new changes in Study Abroad opportunities, along with the new ability of PLNU tuition and financial aid to pay for study abroad, we expect these numbers to increase.

The rest of this answer is the same as for the Biology-BA.
We have one opportunity that is organized by our department. In the mid-2000s we began to explore the possibility of a faculty-led study abroad course in ecosystems of the new world tropics. In the spring of 2008, Biology faculty member David Cummings joined a faculty-led course to Costa Rica offered by Northwest Nazarene University. The following September a PLNU course proposal was drafted and in spring 2009 Cummings along with colleague Mike Mooring led the first course in Neotropical Ecology (now designated BIO340). The 2-unit upper division course comprises 7-8 weeks of instruction on campus during the second quad of the spring semester followed by a two-week trip to Costa Rica, exploring the montane cloud forests and the lowland rain forests. Students study one of the few books on new world tropical ecosystems, give presentations on various plants and animals of the Costa Rican forests, and experience many of the things they have learned first-hand on the trail in Costa Rica.

The course is offered every other year in the spring and is capped at 12 students. Our enrollment has varied from 7-12. To date only one student outside of the Department has participated.

5. What are any other distinctives of your program? Describe how they contribute to the program's success.

Note: This is the same answer as for the Biology-BA.
A top priority of our department is for students to do biology, not just learn about biology. To accomplish this, we have a laboratory rich curriculum. Almost all of our classes have a required laboratory experience. We are proud of the deliberate mentoring of students that occurs while they are at PLNU and the relationships we have been able to maintain with a large number of our alums. Our students work as prep-room workers, graders, review session leaders, tutors, and lab assistants under the supervision of faculty. Our alumni are constantly giving back through guest lectures, mentoring, shadowing opportunities, etc., and are extremely willing to help current students. Alumni tell us that they are very well prepared for post-baccalaureate education and jobs in the discipline.

All of the full-time faculty in biology earned a Ph.D. prior to coming to PLNU. Moreover, all of our faculty have completed postdoctoral research beyond the Ph.D. This indicates that our program has a track record of attracting faculty highly-qualified in both teaching and scientific research.

Another distinctive shared by both the Biology and Chemistry Departments is our pre-health professions advising. We have a dedicated advisor (currently Sara Choung) for students preparing for medical, dental, optometry, pharmaceutical, or veterinary school. This program includes two preparatory interviews for the students, sessions with alumni and local health professionals, and a committee-written letter of recommendation. This program has almost certainly contributed to the high rate of acceptance of our students into the health professional schools (over 90% for over 15 years).

6. Does your program have an advisory board? If so, describe how it has influenced the quality of your program? If not, could it benefit from creating one?

NA

7. Describe any current joint interdisciplinary degrees (majors or minors) offered by your department. Are there additional areas where interdisciplinary programs should be considered?

See Biology-Chemistry and Environmental Science majors.

8. Describe your success with students acquiring jobs related to their discipline.

As mentioned previously, we assess these data every five years. In our most recent survey, 88% of our alumni were employed or attending graduate school in a STEM-related field. In addition, our acceptance rate of students into graduate and health profession's schools continues to be at least 90%. Of the 44 Biology-BS majors who responded to the survey, 84% are employed or in graduate school in a STEM-related field.

9. Describe your undergraduate and graduate student success rate for passing licensure or credentialing exams (if they exist in your discipline).

NA

10. Describe your success with undergraduate student acceptance into post-baccalaureate education.

See answer above.

11. What kind of support does your program provide for students encountering academic difficulties? How do you intentionally facilitate these students' connection with institutional support services?

Note: This is the same answer as for the Biology-BA.
Our department has multiple means of supporting students with academic difficulties. First, these students are usually identified in the freshman classes (BIO210 and BIO211), where the instructors contact students who are doing poorly on exams and offer specific advice on study habits, extra office hours, and direction to tutoring. Second, the Chemistry department offers a weekly tutorial for students in the first semester of General Chemistry (CHE151), as well as student-led weekly review sessions for both semesters of General Chemistry and Organic Chemistry. Third, during the twice yearly advising sessions, we meet with our advisees for 15-30 minutes and discuss both academic and non-academic factors, as well as vocation. Fourth, on some occasions, we have directly referred students to the Wellness Center, the DRC, or even contacted Caye Smith, Jeff Bolster, or Mark Pitts, depending on the situation. Finally, we are hoping to use the new capabilities of the SSC to bolster these efforts by identifying students who may be in the middle ground but could use some resources to make their college experience even better.

BioBS-F6) Infrastructure and Staffing

Full-Time Faculty Program Contribution Department UG Total			
	2012-13	**2013-14**	**2014-15**
Percentage of UG classes taught by FT faculty	71.9%	72.2%	83.9%
PLNU percentage of UG classes taught by FT Faculty	*TBD*	*TBD*	*TBD*
Includes: regular lectures, labs, seminars Excludes: independent studies, private lessons, internships			

1. Are your program's current technological resources and support adequate? If not, what is needed? Do you foresee any additional needs in this area?

Note: This is the same answer as for the Biology-BA.
At present our technological resources and support are superior with the recent addition of the Latter Hall classrooms and Sator Hall laboratories. Our current needs are well met; however, instrumental technology is continually evolving. The faculty actively pursues grants to support these needs. In addition, administration has been supportive of many of these changing needs as well. We need this continued support to provide our graduates with the most up-to-date education and experiences to be truly competitive.

2. Are your program's current facilities adequate? If not, what is needed? Do you foresee any additional needs in this area?

Note: This is the same answer as for the Biology-BA.
The classrooms and facilities in the new building are wonderful and adequate, as long there is stable enrollment in the Nursing, Allied Health, and Biology programs. Our office space is not adequate. Cho is in MICS space, which he will soon need to vacate. Koudelka is in a trailer outside the building. We thus need a minimum of two more offices.

3. Is your program's current staffing (administrative, clerical, technical and instructional) adequate? If not, what is needed? Do you foresee any additional needs in this area?

Note: This is the same answer as for the Biology-BA.
Staffing is close to adequate, again as long there is stable enrollment in the Nursing, Allied Health, and Biology programs. Ideally, we need a long-term adjunct or part-time professor so that we can split up the overly large sections of BIO130 and BIO140 that have 72 students. As discussed previously, this would require at least 6 units of extra load per year.

BioBS-F7) Challenges and Opportunities

1. Are there any particular challenges regarding this program that have not been addressed through the analysis and reflection on data or questions in sections F1-F6 that you would like to include here?

NA

2. Are there any particular opportunities regarding this program that have not been addressed through the analysis and reflection on data or questions in sections F1-F6 that you would like to include here?

NA

BioBS-F8) Recommendations for Program Improvement

List the recommendations you are making regarding this program analysis with a brief rationale for each recommendation.

This recommendation is the same as for the Biology-BA.

- We have ramped up our internship opportunities over the past two years and have also begun intentionally advising students to take advantage of these opportunities. From 2012-14, we only had 1-4 units of student internships. In both 2014-15 and 2015-16, we had 12-14 units of student internships per year. Currently, four different faculty are overseeing various internships and being paid overload pay to coordinate them. In order to make this program more effective, we request 1 unit of load release per year for an internship coordinator, which is the standard rate for 12 internship units. This coordinator would (a) cultivate new internship opportunities, (b) act as a liaison between the organization and the PLNU biology department, (c) meet with interns one-on-one to identify appropriate internship possibilities, (d) assist students with internship applications, (e) communicate regularly with the students during the internship, and (f) communicate with the site internship supervisor to follow up on the progress and success of the student intern. This coordinator would interact with the students in all of the undergraduate Biology programs, hence this recommendation will be made in each program section.

Program Level Analysis (Bio-Chem)

Bachelor of Science in Biology-Chemistry

BCHM-F1) Trend and Financial Analysis

First-Time Freshman Admissions Funnel							
Biology-Chemistry	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Inquiries	**370**	**651**	**771**	**987**	**848**	**1,097**	**674**
Share of PLNU inquiries	*3.3%*	*4.3%*	*4.7%*	*5.4%*	*4.6%*	*5.0%*	*4.0%*
Completed Applications	**65**	**85**	**106**	**112**	**96**	**85**	**75**
Share of PLNU Applications	*3.1%*	*3.2%*	*3.8%*	*3.9%*	*3.2%*	*3.2%*	*3.0%*
Applicant Conversion Rate	**17.6%**	**13.1%**	**13.7%**	**11.3%**	**11.3%**	**7.7%**	**11.1%**
PLNU Applicant Conversion Rate	*18.6%*	*17.3%*	*17.0%*	*15.7%*	*16.1%*	*12.1%*	*15.0%*
Admits	**61**	**74**	**89**	**80**	**75**	**77**	**69**
Share of PLNU Admits	*3.3%*	*3.8%*	*4.6%*	*4.0%*	*3.6%*	*3.6%*	*3.4%*
Selection Rate	**93.8%**	**87.1%**	**84.0%**	**71.4%**	**78.1%**	**90.6%**	**92.0%**
PLNU Selection Rate	*87.4%*	*72.9%*	*68.9%*	*69.0%*	*70.5%*	*79.5%*	*79.8%*
New Transfer Admissions Funnel							
Biology-Chemistry	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Inquiries	**12**	**12**	**20**	**16**	**20**	**41**	**29**
Share of PLNU inquiries	*1.5%*	*1.7%*	*2.2%*	*1.0%*	*1.3%*	*2.3%*	*1.4%*
Completed Applications	**7**	**8**	**13**	**5**	**14**	**15**	**7**
Share of PLNU Applications	*1.7%*	*2.0%*	*2.6%*	*1.1%*	*2.8%*	*2.2%*	*1.5%*
Applicant Conversion Rate	**58.3%**	**66.7%**	**65.0%**	**31.3%**	**70.0%**	**36.6%**	**24.1%**
PLNU Applicant Conversion Rate	*50.2%*	*55.5%*	*56.2%*	*28.4%*	*33.2%*	*36.9%*	*21.7%*
Admits	**7**	**5**	**11**	**3**	**9**	**14**	**4**
Share of PLNU Admits	*2.2%*	*2.2%*	*4.0%*	*1.1%*	*2.8%*	*3.3%*	*1.1%*
Selection Rate	**100.0%**	**62.5%**	**84.6%**	**60.0%**	**64.3%**	**93.3%**	**57.1%**
PLNU Selection Rate	*79.3%*	*57.9%*	*54.8%*	*60.5%*	*65.4%*	*64.1%*	*79.2%*

1. What does this data tell you about the external demand for your program? What does this say about the future viability of your program?

   We have very high external demand for all of the undergraduate Biology programs. We have asked Admissions to limit enrollment of all Biology majors (Biology-BA, Biology-BS, Biology-Chemistry-BS, Environmental Science-BS) to 100 students per year, as we do not have the faculty to deal with larger numbers of students.

First-Time Freshman Admissions Yield							
Biology-Chemistry	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Admits	61	74	89	80	75	77	69
Matriculants	**20**	**29**	**38**	**23**	**20**	**25**	**22**
Share of PLNU Matriculants	*3.7%*	*4.9%*	*7.1%*	*3.8%*	*3.1%*	*4.3%*	*3.7%*
Yield Rate	**32.8%**	**39.2%**	**42.7%**	**28.8%**	**26.7%**	**32.5%**	**31.9%**
PLNU Yield Rate	*29.3%*	*30.5%*	*27.7%*	*30.3%*	*31.0%*	*27.9%*	*29.9%*
New Transfer Admissions Yield							
Biology-Chemistry	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Admits	7	5	11	3	9	14	4
Matriculants	**4**	**3**	**7**	**0**	**3**	**7**	**3**
Share of PLNU Matriculants	*2.4%*	*2.2%*	*4.7%*	*0.0%*	*2.1%*	*3.5%*	*1.7%*
Yield Rate	**57.1%**	**60.0%**	**63.6%**	**sm**	**33.3%**	**50.0%**	**sm**
PLNU Yield Rate	*51.1%*	*60.2%*	*54.7%*	*47.3%*	*44.6%*	*46.0%*	*48.0%*
sm = cell sizes too small							

2. How does your yield rate (percentage of students who enroll at PLNU after being admitted) compare to the PLNU average? If your rate is more than 8 percentage points above the PLNU average, what factors do you believe are contributing to this positive outcome? If your rate is more than 8 percentage points below the PLNU average for more than one year, what factors do you believe are contributing to this difference?

Our yield for this major is generally at or above the PLNU average, but as stated above, we cannot easily handle more students.

Enrollment							
Majors	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Biology-Chemistry	**59**	**69**	**87**	**85**	**89**	**89**	**87**
Share of PLNU Undergraduates	*2.5%*	*2.9%*	*3.7%*	*3.5%*	*3.5%*	*3.5%*	*3.3%*
Minors	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
No minors for this program							
Major Migration of Completers*							
Top Importing Programs:	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**6-yr Total**
Undeclared			1	1	1	2	5
Biology (BS)			1		1	2	4
Business Administration	1		1		1		3
Biology (BA)			1	1			2
Pre-Nursing	1					1	2
Top Export Destinations:	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**6-yr Total**
Biology (BS)	5	7	3	6	10	8	39
Exercise Science		2	2	2		2	8
Applied Health Science					2	3	5
Business Administration	2				3		5
Nursing				2	1	1	4
* Based on degree completions of students who either started or finished within the program and who originally matriculated as first-time freshmen							

3. What does this data tell you about the internal demand for your program? Does this raise any questions about the viability and/or sustainability of your program as it is currently configured? Explain why or why not. Are there any actionable strategies that you can do that might make a difference if your trends are in the wrong direction?

Again, we have a very high demand for our program. Note that the major export is to the Biology-BS.

General Education and Service Credit Hour Production Department UG Total				
	2011/12	**2012/13**	**2013/14**	**2014/15**
Total Dept UG student credit hours	5,421.0	5,880.0	5,742.0	5,648.0
Number of GE sections taught	?	?	?	?
% of SCH that are GE	47.0%	51.6%	52.1%	51.5%
Share of PLNU GE SCH	*7.3%*	*8.4%*	*8.3%*	*8.1%*
Number of service course sections taught	?	?	?	?
% of SCH that are service	18.2%	20.5%	21.2%	21.2%
Share of PLNU service SCH	*TBD*	*TBD*	*TBD*	*TBD*

4. What does this data tell you about how your program is impacted by the needs of GE and other academic disciplines? Does this raise any questions about the viability and/or sustainability of your program if these non-programmatic trends continue? Explain why or why not.

Note: This is the same answer as for the Biology-BA/BS.
We teach a lot of GE units and service units. As discussed already, the GE units help to offset the cost of the unfunded load in the department that is due to the laboratory experiences for the service courses and the majors. We do not anticipate a decrease in service units as the Nursing and Allied Health programs are also in high demand. If PLNU restructures GE such that a Biology course is no longer required by all students, this would obviously have a dramatic impact on our teaching loads.

Delaware Study Data Department Total												
	2010/11			**2011/12**			**2012/13**			**2013/14**		
Program Cost per SCH	**$244**			**$239**			**$237**			**$260**		
Benchmark Percentiles	$148	$194	$244	$153	$201	$235	$161	$198	$243	$174	$217	$266
Ranking	Medium-High			High			Medium			Medium		

5. We know that the following factors influence the Delaware cost per credit hour:
   - Large amount of GE and service classes taught by the program
   - The career stage of the program faculty (early career faculty are less expensive)
   - The number of elective courses in the program
   - The amount of unfunded load (faculty receiving more credit for a course than the number of units received by a student – e.g. 4 units of faculty load for teaching a 3 unit class)
   - The amount of release time associated with the program
   - Faculty members on sabbatical
   - The size of the department budget and the cost of specialized equipment

   Please reflect on your program's Delaware data in light of this information. In particular, what factors contribute to your program having a high (above 75th percentile), medium (50th-75th percentile), or low (below 50th percentile) ranking?

Note: This is the same answer as for the Biology-BA/BS.
As discussed in prioritization, the Biology department has a high unfunded load due to the many laboratory courses we offer. We feel that these courses are essential to students' education because they must learn how to DO Biology, not just read, write, and think about Biology. The unfunded load is offset by the high amount of GE and service courses that we teach. This brings us into the medium cost range for the Delaware study comparison.

6. Recognizing that not all factors above are under departmental control, what kinds of adjustments might be made to reduce the cost per student credit hour?

Note: This is the same answer as for the Biology-BA/BS.
We reduced the unfunded load of the GE courses by making the laboratory experience worth 1 unit. This is not possible for the service and major courses, however, because it would increase the sizes of the affected majors beyond their acceptable limits.

***** Future *****
Financial Data: (possibly delayed to the future)
Extra Revenue Generated by Program (lab fees, studio fees, etc.)
Extra Revenue per student credit hour
Extra Costs for the program (equipment not purchased outside of department budget, etc.)
Extra costs per student credit hour
Modified Delaware values: Delaware – extra revenue per SCH + extra costs per SCH

7. Do these modified Delaware values tell you anything new about the future viability and/or sustainability of your program as it is currently configured? Please explain.

Data not provided.

BCHM-F2) Findings from Assessment

Links to the department's assessment wheel

- Student Learning Outcomes
- Curriculum Maps
- Assessment Plan
- Evidence of Student Learning
- Use of the Evidence of Student Learning

Reflection on longitudinal assessment of student learning data:

1. What have you learned from this program's student learning assessment data?

*Since this is a joint major, only the Biology-specific assessment will be addressed here. The Chemistry-specific assessment will be addressed in their program review document.
Our first priority as an academic department is to ensure that our students are learning the essential content in the field of biology. We use the ETS Major Field Test in Biology to measure the performance of the Biology-Chemistry majors in three major areas of Biology: Cell Biology, Molecular Biology & Genetics, and Organismal Biology. At least 50% of the students are expected to score above the 60th percentile on the overall exam, and in each sub-discipline. Additionally, the overall group mean and the group mean in each sub-discipline are expected to be above the 75th percentile. The Biology-Chemistry students (n=52) mostly met all of these criteria from 2013-2015; the difference in not meeting the criteria was based on the performance of only 1 or 2 students and so is probably not statistically valid.

Since many students struggle with the integration of their Christian faith with science, another priority of our department is that students will develop a rationally defensible integration of science with their faith. In our most recent measurement, 78% of the graduating Biology-Chemistry students were able to write an essay with a strong defensible integration of their faith with science.

Finally, a top priority is that our students should be prepared to gain admittance to graduate programs and science-related careers. We assess these data every five years. In our most recent survey, 88% of our alumni were employed or attending graduate school in a STEM-related field. In addition, our acceptance rate of students into graduate and health profession's schools continues to be at least 90%. Of the 32 Biology-Chemistry majors who responded to the survey, 97% are employed or in graduate school in a STEM-related field.

2. What changes (curricular and others) have you made based on the student learning assessment data?

At our last program review, we determined that we needed to split a freshman course that was attempting to introduce Ecology, Evolution, and Organismal Biology in one semester into two semester-long courses: Ecological and Evolutionary Systems and Organismal Biology. This change was recommended based on the poor performance of our majors in the sub-categories of Animal Biology and Plant Biology on the ETS Major Field Test in Biology.

3. What additional changes are you recommending based on your review of the student learning assessment data?

No changes recommended at this time.

DQP Outcomes with Scores
***** TBD *****
DQP Definitions
Intellectual Skills Intellectual Skills define proficiencies that transcend the boundaries of particular fields of study: analytic inquiry, use of information resources, engaging diverse perspectives, ethical reasoning, quantitative fluency, and communicative fluency.
Specialized Knowledge What students in any specialization should demonstrate with respect to the specialization, often called the major field. All fields call more or less explicitly for proficiencies involving terminology, theory, methods, tools, literature, complex problems or applications and cognizance of limits.
Applied and Collaborative Learning Applied learning suggests what graduates can do with what they know. This area focuses on the interaction of academic and non-academic settings and the corresponding integration of theory and practice, along with the ideal of learning with others in the course of application projects.
Broad and Integrative Knowledge Students integrate their broad learning by exploring, connecting and applying concepts and methods across multiple fields of study to complex questions—in the student's areas of specialization, in work or other field-based settings and in the wider society.
Civic and Global Learning Civic and Global Learning proficiencies rely principally on the types of cognitive activities (describing, examining, elucidating, justifying) that are within the direct purview of the university, but they also include evidence of civic activities and learning beyond collegiate settings. These proficiencies reflect the need for analytic inquiry and engagement with diverse perspectives.

Reflection on DQP related data:

Understanding that the DQP framework provides one particular lens on the meaning, quality and integrity of your curriculum, reflect on the DQP data and framework provided for your program.

4. What have you learned from this program's DQP comparison?

The DQP roll-up is based on current department assessment, so we have nothing to add here.

5. What changes (curricular and others) have you made based on the DQP comparison?

None.

6. What additional changes are you recommending based on your review of the DQP comparison?

None.

Links to stakeholder assessment data (if present this will be department housed data)
• Surveys • Focus Groups • Market Analysis • Etc…

Reflection on stakeholder feedback data:

7. What have you learned from this program's stakeholder assessment data? If you do not have stakeholder data, please provide a plan for how you will regularly collect this in the future.

We conducted an alumni survey in 2015. 408 alumni from 2004-2014 were mailed and 115 replied (28% response). 60% of the respondents were currently in a graduate program or had already obtained an advanced degree. The most common occupations were currently in a graduate program (35%), health professional (23%), research (12%: biotechnology, academic, government, etc.) and K-12 teacher (5%). 73% of the respondents overall said that they felt well-prepared scientifically. Of the 27 Biology-Chemistry majors who answered this question, 25 said that they felt well-prepared scientifically. As mentioned above, of the 32 Biology-Chemistry majors who responded to the survey (27% response rate for this major), 97% are employed or in graduate school in a STEM-related field.

8. What changes (curricular and others) have you made based on the stakeholder assessment data?

None.

9. What additional changes are you recommending based on your review of the stakeholder assessment data?

None.

BCHM-F3) Curriculum Analysis

In looking at your curriculum, the program review process is asking you to analyze it through three different lenses. The first lens is looking at your content and structure from the perspective of guild standards or standards gleaned from looking at programs at comparator institutions. The second lens that of employability and is asking you to look at your curriculum and educational experiences from the perspective of skills and professional qualities that you are developing in your students that will serve them will in their future work and vocational callings. The third lens is that of pedagogy and is asking you to look at the delivery of your curriculum to ensure a high quality student learning experience.

Menu and Elective Unit Analysis Biology-Chemistry	
Number of menu and elective units required by the program	6
Number of menu and elective units offered by the program	15
Menu/Elective Ratio	2.50
Longitudinal Class Section Enrollment Data	
• Link to Class Section Enrollment Report	

Comparison of current curriculum to guild standards and/or comparator institutions.

If your guild standards are associated with a specialized accreditation that your program has, these should be the basis of your analysis. If your guild standards are associated with specialized accreditation that we do not have, then you should primarily use comparator institutions as the basis for your analysis.

If your guild has standards that are not associated with specialized accreditation, then you may choose to use those standards and/or comparator institutions.

After consultation with your Dean, provide the set of guild standards or a list of the comparator institutions that you are using in your analysis.

If using guild standards:

1. Please provide a list of the guild standards that you are using to evaluate your curriculum.

Our Biology-Chemistry program is fairly unique with regards to its pseudo-double major nature. Most "Biochemistry" programs are in fact programs within the specialized field of biochemistry. Thus, it would not be appropriate to compare our major with those programs. Thus, in order to compare ourselves nationally, we have aligned the courses within the Biology-Chemistry major to the nationally-accepted core competencies within the biology and chemistry programs.

Biology: We have chosen to use the biology core competencies defined by the BioCore guide [Brownell SE, et. al., BioCore Guide: A Tool for Interpreting the Core Concepts of Vision and Change for Biology Majors, CBE—Life Sciences Education. Vol. 13, 200–211, Summer 2014]. This is a publication based on the recommendations of the Vision and Change in Undergraduate Biology Education and is the same source that we used for content and curriculum mapping for the Bio-BA and Bio-BS majors.

Chemistry: We use guild standards as defined by the American Chemical Society (ACS). http://www.acs.org/content/dam/acsorg/about/governance/committees/training/2015-acs-guidelines-for-bachelors-degree-programs.pdf The ACS promotes excellence in chemistry education for undergraduate students through approval of baccalaureate chemistry programs. While the Biology-Chemistry major cannot be ACS certified for the reasons stated above, the major standards of Organic, Physical, Analytical, Biochemistry and Inorganic chemistry will be followed and assessed throughout the curriculum. The level of mastery is different than for our Chemistry major in certain areas yet we keep consistent standards.

2. Indicate if and how your curriculum satisfies the standards (this can be done in a table or narrative form). If applicable, indicate areas where your curriculum falls short of the standards.

Background: In the Biology-Chemistry major, students are exposed to the fundamentals of both biology and chemistry. While this is not a double major, it is intended to apply many of the principles of a double major whereby students get a strong basis of understanding of both programs. However, unlike a traditional double major, this program is also designed to help students understand the core connections between these two linked disciplines.

Unlike a full double major, these students cannot possibly obtain and master all of the content that would be required of a full chemistry major and/or a full biology major. These two disciplines are extremely diverse in their specialties, with biology encompassing ecology, evolution, organismal biology, physiology, biochemistry, and cellular / molecular biology, and chemistry encompassing general, physical, organic, analytical, inorganic and biochemistry. We believe that the Biology-Chemistry major gives the students a broad exposure to the breadth of both disciplines as listed above, with the ability to master the core competencies that bridge the two disciplines. The electives also allow students some flexibility to specialize in, and therefore master, areas of particular interest. This is particularly important for our population of students who chose the Biology-Chemistry major, many of whom are pre-health (~80%).

Results: Indirect measurements, including surveys from current and former students in the Biology-Chemistry program, suggest that the connecting principles between biology and chemistry are important, and evident, to our students. In a recent survey (2015) of 45 current students, over 73% of the students responded that the connections between biology and chemistry were either sufficiently, or abundantly clear. Only 4% responded that it felt like two separate majors.

Biology: BioCore analysis of Curriculum content (see Appendix A): The biology curriculum of the Biology-Chemistry major was mapped to the principles outlined by the BioCore guide. While not all of these principles can be mastered in a program such as this, which encompasses biology and chemistry together, all of the 40 principles are introduced in the required course sequence. All except four of these (red highlights) are at least developed within the required course sequence, and within the remaining group of 36 principles, all except five (yellow highlights) can be mastered depending on which electives the student chooses to take. It is important to note that only four of the nine highlighted principles are classified within the physiology or molecular / cellular / developmental biology categories towards which the Biology-Chemistry major is emphasized, the rest fall within the ecology / evolution category. Even the four highlighted principles within the physiology or molecular / cellular / developmental biology categories have strong connections to ecology and evolution. Thus, we believe that the students are getting a very strong foundation in these principles.

While ecology and evolution are a very important aspect of all biology, and we definitely feel that all majors should have a strong basis in these principles, these are generally not the areas that our Biology-Chemistry majors specialize in post-graduation. With increased expectations of these majors within the realms of both biology and chemistry, some sacrifices must be made to the breadth of both biology and chemistry. While we considered eliminating some of the major principles that we felt were not as critical to this particular major, we decided to keep every one of the biology principles to determine if there were any important deficiencies generated by these sacrifices. It is important to note that 7 of the 12 ecology / evolution core principles are still able to be mastered within the program and to remind that all of the biology principles are at least introduced, with most introduced and developed. Thus, we believe that our students are exposed to the vast majority of the nationally-recognized core biology principles as defined by the BioCore guide and have the option to master several distinct specialized areas within the breadth of biology. (Mention lab hours)

Chemistry: ACS analysis of Curriculum content http://www.acs.org/content/dam/acsorg/about/governance/committees/training/2015-acs-guidelines-for-bachelors-degree-programs.pdf: The Chemistry curriculum of the Biology-Chemistry major was mapped to the principles outlined by the American Chemical Society guide. According to the ACS: "The content areas encompass five of the traditional subdisciplines of chemistry: analytical, biochemistry, inorganic, organic, and physical, and include both small molecules and macromolecules." All the Biology-Chemistry majors have to take two semesters of General Chemistry thus meeting the ACS standards, which states that: "The introductory or general chemistry experience plays a vital role in educating all students." Moreover, this chemistry course provides at least 100 hours of hands on laboratory experience where the use instrumentation and laboratory equipment is introduced.

The Biology-Chemistry major also includes a variety of required foundation chemistry courses such as Organic Chemistry (2 semesters + 3.5 hour laboratory), Analytical Chemistry (1 semester + 3.5-hour laboratory), Physical Chemistry (1 semester + 3.5 hour laboratory), Biochemistry (1 semester + 3 hour laboratory) and Bioinorganic chemistry (1 quad course). The ability to apply key concepts and principles of quantitative analysis, Biochemistry, Bioinorganic Chemistry, Organic Chemistry, Physical Chemistry (Kinetics and Thermodynamics) are mastered in Analytical Chemistry, Biochemistry, Bioinorganic Chemistry, Organic Chemistry II and Physical Chemistry I courses, respectively.

The ACS standards require instruction equivalent to a one-semester course of at least three semester credit hours in each of the five traditional sub-disciplines of chemistry: Analytical chemistry, Biochemistry, Inorganic chemistry, Organic chemistry, and Physical Chemistry. We can conclude that the Biology-Chemistry major fulfills the ACS standards with the exceptions of inorganic chemistry. We understand that teaching a Bioinorganic Chemistry course does not meet the ACS inorganic chemistry standards yet it fits our population of students better.

Finally, as highlighted earlier, all of our foundation courses and most upper division courses require a laboratory with the exception of Bioinorganic chemistry. The ACS standards require at least 400 hours of laboratory experience and our Biology-Chemistry major meets this requirement.

Based on the analysis of standard and reflection on the menu and elective ratio above, consider and discuss the following questions:

3. Are there courses in your program that should be modified? Why or why not.

Biology: Based on ETS data, the biology department recently split BIO215 into two separate required courses for Biology and Biology-Chemistry majors. BIO215, which incorporated ecology, evolution, and organismal biology, was separated into BIO211 (ecology and evolution), and BIO212 (organismal biology). This was based on the idea that to teach all of those three major concepts in a single semester course was unreasonable, particularly for our students who often require a bit more focus on evolution in order to bridge science and faith (another of our program learning outcomes). This was further proven by the relatively low performances by the Biology-Chemistry majors in the ecology and organismal areas of the ETS exam. Although still early, initial indications demonstrate improvement in these areas since this course was split.

Chemistry: Similar modifications took place in the chemistry portion of the curriculum in 2013. The Chemistry Department rearranged the units assigned to the organic chemistry sequence, CHE294 and CHE304, from 5 units and 2 units to 4 units and 4 units. This more closely aligns with how most universities assign units for this sequence. At the same time the unit credit for the analytical chemistry course, CHE213, was increased from 2 to 3 to more closely conform with common practice. An upper division 2 unit course was removed from the chemistry requirements to keep these changes unit neutral. With the arrival of Matthieu Rouffet the department had a faculty member prepared to teach a bioinorganic chemistry course more appropriate for the needs and interests of the Biology-Chemistry students. That course, CHE466, was then substituted for the previously required, traditional advanced inorganic chemistry course. The latter became an upper-division elective for those who want to go deeper. These modifications are evidence of the continuous monitoring of student needs and the recognized best practices in the discipline. They have also been enabled by the expansion of the number and expertise of the Chemistry Department faculty.

Most recently with the addition of Ariane Jansma in the Chemistry Department and Kris Koudelka in the Biology Department, Advanced Biochemistry (BIO/CHE450) and Molecular Biology (BIO380) have been reconceived into a cohesive two course sequence. Instructors are guest lecturing in each other's class, and careful planning is ensuring thorough coverage of these complementary fields.

We have no recommendations for further modification of courses at this time. All of the goals of the program appear to be met appropriately. As mentioned above, over 73% of the students surveyed in 2015 responded that the connections between biology and chemistry were either sufficiently or abundantly clear.

4. Are there courses that should be eliminated? Why or why not.

No. We carefully considered the question of eliminating courses 2 years ago in the prioritization process. The conclusion then was that our curriculum was lean and efficient. Nothing has changed in the intervening time. All courses are full and the program is currently achieving its goals. Also, each course in the major is a required or elective course in the individual biology or chemistry majors, therefore achieving multiple purposes.

5. Are there courses that could be merged? Why or why not.

No. All courses are full and the program is currently achieving its goals. Again this question was previously considered during prioritization and the same conclusions were drawn.

6. Are there courses that should be added? Why or why not. Note that in general, in order to create the space to add a new course, another course will need to be eliminated or taught less frequently.

At this time, there are no courses that we feel need to be added.

7. What did you learn about your overall curricular structure in terms of its complexity, breadth and depth in light of the guild standards and our institutional size and scope? Are there any structural changes that need to be made in light of your analysis (e.g. sequencing of courses, % and or grouping of electives, overall units required, use of concentrations, etc…)?

Some of the curricular changes made in the last few years, although beneficial, have created some sequencing problems that may need attention. In particular, we may need to give students more consistent advice about when to take the newly required organismal biology courses, BIO212, and the newly expanded analytical chemistry course, CHE213. Right now some students are taking those as late as their senior year.

The set of topics on the newly revised MCAT exam has been expanded. This could affect the sequencing of courses. For example, with the exam now containing biochemistry questions it is more advisable for pre-med Biology-Chemistry majors to take Biochemistry BIO450/CHE450 in their junior year before taking the MCAT. That would be more specific instruction than we have given in the past.

Other changes that could be beneficial for pre-health students in this major involve courses in the GE program. Biology-Chemistry students could benefit from a more specialized required writing course as a substitute for the general writing they take now. They could also benefit by taking a general psychology course, PSY103 (now a topic on the MCAT) instead of the currently required PSY101.

On a positive note, this program review exercise has once again reminded us of the strength of these two departments and of the wisdom of this major. The curriculum offered has never before been so diverse and so well taught. As a consequence, the students graduating with this major have never before been so well prepared to find work, or pursue advanced degrees. That claim is significant since many of our departments' most accomplished alumni are graduates of this major.

If using comparator institutions:

1. Begin by working with your Dean to identify a list of 5-8 comparator schools to use. In selecting schools, consideration should be given to type of institution, mission of the institution and the number of students majoring in the program.

Institution 1
Institution 2
Institution 3
Institution 4
Institution 5
Institution 6

Gather the curricular requirements for the program in question at each of the comparator institutions.

2. Use this collection of curricular requirements to develop a list of curricular features that are essential for programs of this type. In addition, make note of any innovative or creative curricular feature that may be useful in enhancing the quality of you program.

NA

Review this list with your Dean before using it to analyze your own curriculum.

3. Indicate how your curriculum compares to the list of curricular features from your analysis (this can be done in a table or narrative form).

NA

Based on the analysis of comparator programs and reflection on the menu and elective ratio above:

4. Are there courses in your program that should be modified? Why or why not.

NA

5. Are there courses that should be eliminated? Why or why not.

NA

6. Are there courses that could be merged? Why or why not.

NA

7. Are there courses that should be added? Why or why not. Note that in general, in order to create the space to add a new course, another course will need to be eliminated or taught less frequently.

NA

8. What did you learn about your overall curricular structure in terms of its complexity, breadth and depth in light of the comparator schools and our institutional size and scope? Are there any structural changes that need to be made in light of your analysis (e.g. sequencing of courses, % and or grouping of electives, overall units required, use of concentrations, etc…)?

NA

Burning Glass Skills Data Biology-Chemistry		
1. Communication Skills ***Virtually every course between presentations of primary literature articles, data communication, and scientific writing.***	5. Quality Assurance and Control ***Che294, 304, 325, 351, 370, 466, 468.***	9. Planning ***Bio210, 211, 301, 345, 380, 390, 400. Che 152, 153, 213, 294, 304, 325, 450.***
2. Writing ***Virtually every course with assigned lab reports and scientific writing.***	6. Problem Solving ***Bio210, 211, 301, 345, 380, 390, 400. Virtually every Chemistry course.***	10. Management ***Basic skills developed in our teaching assistant* and summer research programs**, as well as in Biology internships.***
3. Research ***Virtually every course as each science course has a required, associated lab portion. This is also mastered with summer research opportunities, Bio499, Biology internships, and honor's projects.***	7. Leadership ***Basic skills developed in our teaching assistant* and summer research programs**, as well as in Biology internships.***	11. Project Management ***None.***
4. Organizational Skills ***Bio210, 211, 301, 345, 380, 350, 400. Che152, 153, 213, 294, 304, 325, 450.***	8. Detail-Oriented ***Bio210, 211, 301, 345, 380, 350, 390. Che152, 153, 213, 304, 325.***	12. Supervisory Skills ***Basic skills developed in our teaching assistant* and summer research programs**, as well as in Biology internships.***

* While the Teaching Assistant Program is not a required course, we highly encourage every student within the major to participate and many of them do. As a TA, they directly interface with the students in laboratory courses, providing assistance with data collection, analysis and report generation. Some are also in charge of lab set-up, breakdown, writing weekly quizzes and grading lab reports. It is a position designed to develop basic skills in leadership, management, and supervisory capacities.
**The Summer Research Program is not a required course, but it is very highly recommended and the majority of our majors participate, either within the Chemistry department or the Biology department. Participating students are required to commit to two summers so that many labs have some new students and some returning students. As such, the returning students act as mentors working with the new students. This situation highly encourages the development of basic skills in leadership, management, and supervisory capacities.

Analysis of the curriculum against preparation for employment

9. The Burning Glass data provides a list of skills for students entering common professions that are often linked to your major. Indicate in the table if and where each skill is being taught in your program. Based on reflecting on this data, are there changes you would recommend making to your curriculum?

Interestingly, we had already decided as a department what skills are important for our majors to have, and we added them to the AAAS document discussed above (see Appendix A and answer to #10). The top four Burning Glass skills are a close match with the skills we had already identified, and they are all highly developed in our curriculum, as shown in Appendix A. In addition, problem solving and an orientation to minding details are a natural part of a standard chemistry or biology curriculum. The other skills listed above (e.g. project management, supervisory skills) could be gained through on-the-job experience or through Business classes. Students who are interested in careers in Biotechnology or the Pharmaceutical Industry, where those skills would be crucial in addition to their Biology background, also have the option of the Science-Business minor. Finally, much of the quality assurance and control aspects are a foundational part of certain Chemistry labs, where students study and perform analytical chemistry.

10. Some programs may serve to prepare students with professional qualities and skills that can serve them well in a great variety of professions that may not show up in data sets like Burning Glass. If this is indicative of your program, please identify the unique skills and/or professional qualities that your program develops in your students and indicate where in the curriculum this is being taught or developed.

We have broken down the categories of communication skills, reading and writing, and research into several other aspects that we believe to be important skills for our students. See the curriculum map for course association.	
Communication skills	Students can effectively express scientific information in standard science formats, including overall purpose, introduction, methods, results, discussion, and overall conclusions.
	Students can effectively analyze and communicate data using graphs, tables, and appropriate scientific figures.
	Students can effectively interpret and communicate scientific information orally (journal club, oral presentations of experiments, etc.).
Reading and understanding primary scientific literature	Students can understand, describe, and analyze key components, including hypothesis, background rationale, data, results, discussion of results and conclusions, of scientific literature. Students are able to evaluate if the data and conclusions are valid, including evaluation of proper controls, statistics, and appropriate assumptions. This is accomplished through both course work and the Summer Research Program.
Research	Students can perform important techniques, including the use of technical instrumentation. Students can also determine which techniques and equipment are appropriate for various experimental purposes.
	Students design, implement, and evaluate research experiments through upper-division courses, summer research and Honor's projects.
	Students can generate valid hypotheses.
	Students utilize appropriate statistical and quantitative methods to analyze data.
As mentioned previously, the fact that nearly every Biology and Chemistry class has an associated lab is crucial to the skill set of Biology-Chemistry majors. In these labs, students learn not only laboratory skills, but also how to formulate hypotheses, and how to evaluate data. Many will also learn how to do independent research, and how to write a research proposal. Through our intensive summer research program, students hone these skills even further. Yet, since only two-thirds of our Biology-Chemistry students participate in the intensive summer research program, it is crucially important that the laboratory courses remain a foundational part of our curriculum.	

Analysis of the teaching of your curriculum

11. How do the pedagogical features of your program compare with the best practices for teaching in your discipline?

Note: This is the same answer for all of our undergraduate programs for Biology.
In 2011, the National Science Foundation (NSF) and the American Association for the Advancement of Science (AAAS) issued a report articulating much needed changes in biology education across the country. The document, titled "Vision and Change in Undergraduate Biology Education: A Call to Action," argued for a transition from faculty-centered education to student-centered education. As a Department, we have chosen the guidance in this document as our benchmarks for best practices in the discipline. Below, we describe each Vision and Change benchmark and then discuss how our program falls short, meets, or exceeds the standard.

The student-centered classroom, sometimes called active learning, is one that is "interactive, inquiry-driven, cooperative, collaborative, and relevant." In short, it is designed with student learning in mind rather than faculty teaching in mind. One approach to accomplishing a student-centered classroom is by way of what is commonly referred to as "scientific teaching", or sometimes "backward design." This strategy for designing a course starts not with the teacher's favorite topics or what they will say in class. Instead, careful time and attention are given to developing and precisely articulating learning outcomes. Once the learning outcomes are clear, the teacher designs the best assessments to determine if the students have achieved the desired outcomes. Finally, teaching methods are considered that can provide the best opportunity for the students to achieve the stated learning outcomes.

PLNU Biology Department faculty members have been proactive in learning new techniques for student-centered teaching. We have three Ph.D.-trained science educators in our department who consult with each of us frequently and regularly offer training sessions. Many of us have attended workshops on active learning, such as the National Academies Summer Institute on Undergraduate Education in Biology offered by HHMI and NSF. We participate in a twice-monthly Faculty Learning Community focused on teaching in the STEM disciplines. Many of us take advantage of (and sometimes help lead) training opportunities offered by the Center for Teaching and Learning, such as the hugely successful Teachers Noticing Teachers program. We meet every Thursday for lunch to discuss teaching issues, and have read books (e.g., *Scientific Teaching* by Handelsman et al.) and journal articles (e.g., *Active Learning Increases Student Performance in Science, Engineering, and Mathematics* by Freeman et al. PNAS 2013) together on active learning.

Some of the student-centered teaching techniques recommended in the Vision and Change document include authentic research experiences, case studies, immediate feedback assessment technique, personal response systems, inquiry-driven learning, concept mapping, peer-led team learning, problem-based learning, process-oriented guided inquiry learning, and team-based learning. We have already implemented many of these techniques and are in the process of experimenting with others.

For example, the lab component of our upper division Microbiology course was converted several years ago to a research experience. Students learn fundamental microbiological lab techniques in the context of a bona fide research project within the expertise of the instructor. At the end of the semester, student teams present their research to the campus community in a mini-conference poster session, complete with judges and prizes.

Another example takes place in Developmental Biology. Students study assigned pieces of a complex story at home, then in class they meet in groups to bring their pieces together (process-oriented guided inquiry learning).

Several Biology professors further make use of flipped classrooms, case studies, online adaptive learning tools, personal response systems (clickers), concept mapping, peer-led team learning, and team-based learning, to name a few.

Chemistry: The American Chemical Society (ACS) has stated in their Guidelines for Bachelor's Degree Programs the following regarding pedagogy: "An approved program should use effective pedagogies in classroom and laboratory course work. Programs should teach their courses in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles. Additionally, a program should provide opportunities for faculty to maintain their knowledge of effective practices in chemistry education and modern theories of learning and cognition in science. An approved program should regularly review its pedagogical approaches to ensure that they promote student learning and build the skills needed to be an effective professional. Faculty should incorporate pedagogies that have been shown to be effective in undergraduate chemistry education. Examples include problem- or inquiry based learning, peer-led instruction, learning communities, and technology-aided instruction such as the use of personal response systems and flipped or hybrid classes. Laboratory work provides a particularly attractive opportunity for inquiry-driven and open-ended investigations that promote independent thinking, critical thinking and reasoning, and a perspective of chemistry as a scientific process of discovery."

The pedagogical features used in our program compare favorably with the best practices from within our discipline. The details of pedagogy used in our program are described in #12.

12. What new pedagogical practices have been tried by members of your department in the last few years? What has your department learned from these experiments?

See answer to #11 for Biology.

Chemistry faculty participate in many activities designed to understand best practices in teaching, and to put them to use on a daily basis. Chemistry faculty have attended a variety of events directed at LEARNING about best practices which include:

- Scientific Faculty Learning Community
- Chemical Education session at national ACS conference
- Project Kaleidoscope (conferences in STEM education)
- Team-Based Learning Workshop
- NSF funded project developing interdisciplinary course modules
- Training opportunities offered by Center for Teaching and Learning

Chemistry faculty have also been invited to give talks related to teaching best practices in the following areas:

- General Chemistry Technology with McGraw-Hill Publishing
- Student engagement techniques at SDSU
- Use of iClickers for assessment at Claremont Colleges

Some of the pedagogical features used in our courses includes:

- Team-Based Learning
- Inquiry-Based Learning
- Use of sophisticated modeling software
- Use of clickers
- Enhancement of student engagement using mini whiteboards and iPads
- Online homework systems

As a faculty, we value student engagement and will continue to strive for the best possible student learning experience. In the Chemistry Department, new pedagogical practices have been added incrementally over the last 5 years and some of these practices (Team Based Learning and Inquiry-based learning) are still limited to a few courses. Since these methods are more recent, we have not yet collected data to see the direct impact on students. However, it is broadly accepted that student engagement is directly correlated with improved learning and long term retention of concepts. One example is the use of group activities and modeling software (PyMOL) in Biochemistry. These two pedagogical features have greatly improved our students' understanding of proteins and their function. The understanding was such that in Bioinorganic Chemistry (CHE 466, usually taken the following spring semester) students were able to apply these concepts readily without any need for a refresher. Therefore, the course content was shifted to a more in-depth understanding of metals in biology rather than basics of biochemistry which had to be done in the past.

Overall, we have learned that student centered teaching is worth applying and, while it will look different from one class to another, it improves student retention and student learning. Finally, these strategies allow for a stronger faculty-student interaction, thus fulfilling our mission to shape our students.

13. Are there new developments in pedagogy in your discipline? What would be required to implement these changes in pedagogy in your department?

The 2011 Vision and Change document discussed above represents the most recent pedagogical developments that have been widely adopted by the STEM teaching community. Possibly the two greatest hindrances to implementing active learning practices are (1) class sizes (in some cases), and (2) faculty time to develop the methods and assessment tools.

BCHM-F4) Potential Impact of National Trends

Top Burning Glass Occupations for the Program Biology-Chemistry		
Occupation	**Hiring Demand**	**Salary Range**
Chemist	Medium	$64K - $68K
Clinical Research Coordinator	Medium	$46K - $50K
Medical Laboratory Technologist	Medium	$58K - $60K
Quality Control Analyst	Medium	$50K - $54K
Biochemist	Low	$55K - $112K
Chemical Technician	Low	$32K - $56K
Environmental Compliance Specialist	Low	$42K - $65K
Microbiologist	Low	$48K - $92K
Physical Scientist	Low	$91K - $101K
Research Scientist	Low	$60K - $87K

Note that some programs do not have as many professions listed in the Burning Glass data as others do. In these cases we will want to get a list of professions from the chair/school dean to supplement the Burning Glass data.

1. Which professions in the Burning Glass data were you already aware of and for which are you already intentionally preparing students and does the hiring demand in these professions signal anything about the future that you need to be aware of regarding the design and structure of your program ?

We are aware of all of these positions and are appropriately preparing our majors. The majority of Biology-Chemistry majors are actually pre-health (medicine, dentistry, etc.). These possible positions are not included in the Burning Glass data. In the pre-health fields we have an excellent track record of getting our graduates into the appropriate professional school (above 90%). Of the Burning Glass careers that are listed, we prepare our students through a lab intensive curriculum that mimics the skills and problem-solving situations they will encounter in these occupations. Although the Burning Glass data above list hiring demand as medium or low, the national trend for employment of our STEM majors is quite encouraging. 76% of all STEM job postings required at least a bachelor's degree. Of those postings that were entry-level, 48% required a bachelor's degree or higher. For every newly minted STEM graduate, there are an average of 2.5 entry-level job postings, and this number is continuing to grow. This is especially positive when considering all non-STEM graduates average 1.1 entry-level job postings per graduate. Finally, entry-level STEM jobs that require a bachelor's degree in the sciences have an average salary that is 26% higher than non-STEM entry-level positions. 65% of STEM job postings were in the field of healthcare, which historically the Biology-Chemistry major does an outstanding job of preparing our students for.

2. Are there additional professions in the Burning Glass list or from your knowledge of occupations your alumni have entered, for which you should be preparing students?

All of the pre-health careers, and we are doing an excellent job preparing these students.

3. What changes in your program would be necessary in order to prepare students for the skills and professional qualities needed to succeed in these additional professions?

There are no current changes required.

4. Are there national trends in higher education or industry that are particularly important to your discipline? If yes, how is your program reacting to those trends?

There are two major trends in higher education and sciences that we are paying particular attention to. 1) The political, social, and economic climate toward STEM. There is a huge push from all three of the aforementioned spheres of influence to prepare more STEM graduates, which bodes well for the future of Biology-Chemistry graduates. 2) Increased incorporation of authentic research experiences for students. Our departments have done an excellent job being ahead of the curve in this area for decades. Students have the opportunity to complete full-time, intensive research in the summer, part-time research during the semester, and many required and elective courses have open-ended research experiences within them.

BCHM-F5) Quality Markers

Retention/Graduation Rates (First-Time Freshmen)							
	Matriculation Term						
Biology-Chemistry	**Fall 2008**	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**
First-Year Retention	**92.3%**	**88.9%**	**90.0%**	**96.9%**	**88.5%**	**90.5%**	**91.3%**
PLNU First-Year Retention	*84.2%*	*84.1%*	*81.1%*	*82.9%*	*89.3%*	*84.5%*	*84.5%*
	Matriculation Term						
	Fall 2005	**Fall 2006**	**Fall 2007**	**Fall 2008**	**Fall 2009**	**Fall 2010**	**Fall 2011**
Four-Year Graduation Rate	**81.0%**	**61.9%**	**40.0%**	**61.5%**	**72.7%**	**71.4%**	**56.5%**
PLNU Four-Year Graduation Rate	*62.0%*	*65.2%*	*61.7%*	*59.1%*	*63.4%*	*62.2%*	*63.2%*
	Matriculation Term						
	Fall 2003	**Fall 2004**	**Fall 2005**	**Fall 2006**	**Fall 2007**	**Fall 2008**	**Fall 2009**
Six-Year Graduation Rate	**47.8%**	**100.0%**	**81.0%**	**61.9%**	**60.0%**	**69.2%**	**81.8%**
PLNU Six-Year Graduation Rate	*72.4%*	*73.2%*	*73.0%*	*74.9%*	*72.2%*	*73.6%*	*75.0%*
Degree Completions							
Majors	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
Biology-Chemistry	**18**	**14**	**4**	**10**	**11**	**15**	**16**
Share of PLNU Bachelor's Degrees	*3.0%*	*2.7%*	*0.7%*	*1.8%*	*1.9%*	*2.5%*	*2.9%*
Minors	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
No minors in this program							
FTF Time to Degree *(in semesters)*	**8.0**	**8.0**	**sm**	**8.4**	**8.7**	**8.4**	**8.4**
PLNU FTF Time to Degree	*8.2*	*8.2*	*8.3*	*8.2*	*8.3*	*8.3*	*8.3*
Study Abroad Participants	3	3	1	2	1	1	1
sm = cell size too small							

1. Based on comparing the quality marker data for your program with the PLNU averages:
   a. What does this tell you about your program?

Retention, graduation rates and FTF time to degree is generally at or above the PLNU average.

   b. If your values are below the PLNU averages, what changes could you make to address any areas of concern?

NA

   c. If your values are above the PLNU averages, what do you believe contributes to this success?

NA

2. Describe regular opportunities for students to apply their knowledge (internships, practicums, research projects, senior projects, etc.). Estimate what percentage of your students in this program participates in these kinds of opportunities.

Both Biology and Chemistry have an intensive undergraduate research program, where students gain an 800 hour research experience over the course of two summers. Of the Biology-Chemistry students who graduated from 2007-2015, 66% participated in an intensive research experience. This percentage is higher than the rates for Biology BA and Biology BS majors, in part because Biology-Chemistry majors have the opportunity to do research in two departments, rather than in just the Biology department. Biology-Chemistry majors also tend to be stronger students than the straight Biology majors.

Since 2013 the Biology department has been trying to develop more internship opportunities for our students as an alternative way of developing crucial career skills in the students who do not participate in the intensive research experience. In Spring 2015, six students interned throughout San Diego county and in Fall 2015 eight students interned. The intern sites include everything from entering and analyzing research data (e.g. at Cabrillo National Monument), to learning to care for animals (e.g. Project Wildlife), or working in a science classroom (e.g. St. Charles Borromeo Middle School). Over the past two years, we have expanded the number of internship opportunities to about 10. It should be noted that this requires a lot of effort! To truly expand these opportunities for our students, we would need release time for an internship coordinator (see program recommendations). A coordinator would (a) cultivate new internship opportunities, (b) act as a liaison between the organization and the PLNU biology department, (c) meet with interns one-on-one to identify appropriate internship possibilities, (d) assist students with internship applications (when needed), (e) communicate regularly with the students during the internship, (f) communicate with the site internship supervisor to follow up on the progress and success of the student intern.

In addition, students are highly encouraged to participate in the life of the department, including work as Teaching Assistants and/or graders for the courses, particularly the laboratory portions. This helps students apply their knowledge by making solutions, setting up reagents, working with advanced equipment, and teaching fellow students as part of their TA position. While the professor is the main instructor for every course, these opportunities of engagement for the students also help facilitate learning within the student community. In the last few years, over 50% of our students have participated as TAs in the department, many TAing for several semesters and multiple courses. However, we do not have this data broken down into individual programs within the departments.

3. Describe any public scholarship of your undergraduate and graduate students in this program (conference presentations, publications, performances, etc.). What percentage of your undergraduate students are involved in these kinds of activities?

As described above, about 66% of our Biology-Chemistry students are involved in the intensive research experience with the faculty. At least half of these students then have peer-reviewed publications and/or presentations based on this research. Many of them present at the West Coast Undergraduate Research Conference in Biology, which the Biology department hosts every 2-3 years. Biology-Chemistry students who do their research in the Chemistry department are also frequently co-authors on peer-reviewed publications and attend annual conferences to present their research findings.

4. How many of your students participate in study abroad opportunities in general? Describe any study abroad opportunities specifically organized by your program. What percentage of your majors are involved annually (annualize the number)? How many students outside of your department participate in this departmentally organized program (Annualize the number)?

Because of the large size of the Biology-Chemistry major (68-70 units), most of these students have a difficult time studying abroad. We have one opportunity that is organized by our department, Costa Rica Study Abroad, which is described in the Biology-BA/BS sections. Because of the large size of the Biology-Chemistry major (68-70 units), most of these students have a difficult time studying abroad. However, students who bring in AP credit or do summer school are able to spend a semester abroad. These are individualized programs designed by the student in consultation with the Study Abroad Office.

5. What are any other distinctives of your program? Describe how they contribute to the program's success.

A top priority of our departments is for students to do biology and chemistry, not just learn about them. To accomplish this, we have a laboratory rich curriculum. Almost all of our classes have a required laboratory experience. We are proud of the deliberate mentoring of students that occurs while they are at PLNU and the relationships we have been able to maintain with a large number of our alums. Our students work as prep-room workers, graders, review session leaders, tutors, and lab assistants under the supervision of faculty. Our alumni are constantly giving back through guest lectures, mentoring, shadowing opportunities, etc., and are extremely willing to help current students. Alumni tell us that they are very well prepared for post-baccalaureate education and jobs in the discipline.

All of the full-time faculty in biology and chemistry earned a Ph.D. prior to coming to PLNU. Moreover, all of our faculty have completed postdoctoral research beyond the Ph.D. This indicates that our program has a track record of attracting faculty highly-qualified in both teaching and scientific research.

Another distinctive shared by both the Biology and Chemistry Departments is our pre-health professions advising. We have a dedicated advisor (currently Sara Choung) for students preparing for medical, dental, optometry, pharmaceutical, or veterinary school. This program includes two preparatory interviews for the students, sessions with alumni and local health professionals, and a committee-written letter of recommendation. This program has almost certainly contributed to the high rate of acceptance of our students into the health professional schools (over 90% for over 15 years).

6. Does your program have an advisory board? If so, describe how it has influenced the quality of your program? If not, could it benefit from creating one?

NA

7. Describe any current joint interdisciplinary degrees (majors or minors) offered by your department. Are there additional areas where interdisciplinary programs should be considered?

The Biology-Chemistry major and the Environmental Science major are joint between Chemistry and Biology. There are also science-business and science-marketing minors for business or science majors and the computational science minor. We are not currently considering additional interdisciplinary programs.

8. Describe your success with students acquiring jobs related to their discipline.

As mentioned previously, we assess these data every five years. In our most recent survey, 88% of our alumni were employed or attending graduate school in a STEM-related field. In addition, our acceptance rate of students into graduate and health profession's schools continues to be at least 90%. Of the 32 Biology-Chemistry majors who responded to the survey, 97% are employed or in graduate school in a STEM-related field.

9. Describe your undergraduate and graduate student success rate for passing licensure or credentialing exams (if they exist in your discipline).

NA

10. Describe your success with undergraduate student acceptance into post-baccalaureate education.

A large number of our graduates continue their education at health professions schools or graduate schools and they have been very successful at getting into these various programs. As mentioned previously, the success rate for alumni who apply to graduate or professional schools has been well over 90% for at least 20 years. In recent years, students have gone to prestigious programs at University of California San Diego, University of California Irvine, Yale University, Georgia Tech University, Vanderbilt University, etc. For dental, medical, optometry, pharmacy, and veterinary schools, there have been 166 acceptances out of 181 applicants (91.7%) between 2004 – 2014. They have gone on to a number of schools across the country such as University of California San Diego, University of Southern California, Loma Linda University, University of Washington, Duke University, Purdue University, etc. Between 2001 and 2011, 46 Biology and Chemistry Department alumni earned a Ph.D. This speaks very highly of their undergraduate preparation in both the chemistry and biology courses.

11. What kind of support does your program provide for students encountering academic difficulties? How do you intentionally facilitate these students' connection with institutional support services?

Our departments have multiple means of supporting students with academic difficulties. First, these students are usually identified in the freshman classes (BIO210 and BIO211), where the instructors contact students who are doing poorly on exams and offer specific advice on study habits, extra office hours, and direction to tutoring. Second, the Chemistry department offers a weekly tutorial for students in the first semester of General Chemistry (CHE151), as well as student-led weekly review sessions for both semesters of General Chemistry and Organic Chemistry. Third, during the twice yearly advising sessions, we meet with our advisees for 15-30 minutes and discuss both academic and non-academic factors, as well as vocation. Fourth, on some occasions, we have directly referred students to the Wellness Center, the DRC, or even contacted Caye Smith, Jeff Bolster, or Mark Pitts, depending on the situation. Finally, we are hoping to use the new capabilities of the SSC to bolster these efforts by identifying students who may be in the middle ground but could use some resources to make their college experience even better.

BCHM-F6) Infrastructure and Staffing

Full-Time Faculty Program Contribution Department UG Total			
	2012-13	**2013-14**	**2014-15**
Percentage of UG classes taught by FT faculty	71.9%	72.2%	83.9%
PLNU percentage of UG classes taught by FT Faculty	*TBD*	*TBD*	*TBD*
Includes: regular lectures, labs, seminars Excludes: independent studies, private lessons, internships			

1. Are your program's current technological resources and support adequate? If not, what is needed? Do you foresee any additional needs in this area?

Biology: At present our technological resources and support are superior with the recent addition of the Latter Hall classrooms and Sator Hall laboratories. Our current needs are well met; however, instrumental technology is continually evolving. The faculty actively pursues grants to support these needs. In addition, administration has been supportive of many of these changing needs as well. We need this continued support to provide our graduates with the most up-to-date education and experiences to be truly competitive. (Note: This is the same answer as for the Biology-BA/BS.)

Chemistry: Special instrument funds accompanying the building of Sator Hall allowed for the addition to several state-of-the-art instruments for use in the Chemistry major courses and related research. These instruments include an Inductively Coupled Plasma – Optical Emission Spectrometer (ICP-OES), high performance liquid chromatograph (HPLC), infrared (IR) spectrometer, fluorescence spectrometer, glove box, lyophilizer, microwave reactor, magnetic susceptibility balance, potentiostat, and spectrometers. Additional funding from the Provost's office made possible the purchase of a much-needed, used 400 MHz nuclear magnetic resonance (NMR) spectrometer. We also negotiate access to remaining necessary equipment via local connections (at UCSD, USD, and TSRI).

In order to keep these instruments running, we do need ongoing support for instrumentation. Currently, the institution has no replacement schedule (or line item in the budget) for scientific equipment. The new instruments mentioned above require solvents, gases, cryogens and consumables in order to run, while older instruments (like our ultraviolet and visible spectrophotometer (UV-vis), gas chromatographs (GCs), and gas chromatograph-mass spectrometer (GC-MS)), are likely to require maintenance and repairs in the near future beyond what is covered in our existing budget.

We still need at least two additional instruments commonly used in an undergraduate chemistry curriculum: an X-ray diffractometer and a liquid chromatograph-mass spectrometer (LC-MS). As mentioned above, faculty actively pursue grants to support department needs. It will require continuing support (external and institutional) to provide our graduates with the most up-to-date educational experiences necessary to maintain our competitive edge.

2. Are your program's current facilities adequate? If not, what is needed? Do you foresee any additional needs in this area?

Biology: The classrooms and facilities in the new building are wonderful and adequate, as long there is stable enrollment in the Nursing, Allied Health, and Biology programs. Our office space is not adequate. Cho is in MICS space, which he will soon need to vacate. Koudelka is in a trailer outside the building. We thus need a minimum of two more offices. (Note: This is the same answer as for the Biology-BA/BS.)

Chemistry: The classrooms and facilities in Sator and Latter halls are excellent and are expected to be adequate for our needs assuming stable enrollment in our courses that serve other departments such as Nursing and Kinesiology. Maintaining one general purpose teaching laboratory in Rohr Science would provide capacity for growth. Office space in the Chemistry Department is old and inadequate, with no space for adjunct faculty. It would also be great if students had a space to congregate to study together and work on projects together.

3. Is your program's current staffing (administrative, clerical, technical and instructional) adequate? If not, what is needed? Do you foresee any additional needs in this area?

Biology: Staffing is close to adequate, again as long there is stable enrollment in the Nursing, Allied Health, and Biology programs. Ideally, we need a long-term adjunct or part-time professor so that we can split up the overly large sections of BIO130 and BIO140 that have 72 students. As discussed previously, this would require at least 6 units of extra load per year. (Note: This is the same answer as for the Biology-BA/BS.)

Chemistry: Our instructional staffing is not adequate. We are in need of a Physical Chemist to replace Ken Martin, who is in the final year of his phased retirement. Physical chemistry is one of the five pillars of a solid chemistry curriculum and no one else in the department is trained to teach those courses.

Current and projected enrollments in Chemistry Department programs as well as other departments/programs served by Chemistry have been growing dramatically. As a result, enrollments in our largest courses have more than doubled in the past ten years (the numbers of students in CHE103, CHE152, and CHE153 have grown by 38.5%, 165.0%, and 129.5%, respectively). With the hire of a full-time Physical Chemist, the number of teaching units taught by full-time faculty would still be below 80% each academic year (2016-2017: 78.9%, 2017-2018: 76.2%).

Moreover, a Physical Chemist is necessary to maintain the curricular balance required of a quality chemistry teaching and research program. A Physical Chemist is also necessary to successfully seek American Chemical Society (ACS) Program Approval.

BCHM-F7) Challenges and Opportunities

1. Are there any particular challenges regarding this program that have not been addressed through the analysis and reflection on data or questions in sections F1-F6 that you would like to include here?

NA

2. Are there any particular opportunities regarding this program that have not been addressed through the analysis and reflection on data or questions in sections F1-F6 that you would like to include here?

NA

BCHM-F8) Recommendations for Program Improvement

List the recommendations you are making regarding this program analysis with a brief rationale for each recommendation.

This recommendation is the same as for the Biology-BA/BS.

- We have ramped up our internship opportunities over the past two years and have also begun intentionally advising students to take advantage of these opportunities. From 2012-14, we only had 1-4 units of student internships. In both 2014-15 and 2015-16, we had 12-14 units of student internships per year. Currently, four different faculty are overseeing various internships and being paid overload pay to coordinate them. In order to make this program more effective, we request 1 unit of load release per year for an internship coordinator, which is the standard rate for 12 internship units. This coordinator would (a) cultivate new internship opportunities, (b) act as a liaison between the organization and the PLNU biology department, (c) meet with interns one-on-one to identify appropriate internship possibilities, (d) assist students with internship applications, (e) communicate regularly with the students during the internship, and (f) communicate with the site internship supervisor to follow up on the progress and success of the student intern. This coordinator would interact with the students in all of the undergraduate Biology programs, hence this recommendation will be made in each program section.

Bachelor of Science in Environmental Science

ENVS-F1) Trend and Financial Analysis

First-Time Freshman Admissions Funnel							
Environmental Science	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Inquiries	**22**	**68**	**82**	**97**	**106**	**133**	**118**
Share of PLNU inquiries	*0.2%*	*0.4%*	*0.5%*	*0.5%*	*0.6%*	*0.6%*	*0.7%*
Completed Applications	**13**	**21**	**17**	**14**	**29**	**25**	**24**
Share of PLNU Applications	*0.6%*	*0.8%*	*0.6%*	*0.5%*	*1.0%*	*0.9%*	*1.0%*
Applicant Conversion Rate	**59.1%**	**30.9%**	**20.7%**	**14.4%**	**27.4%**	**18.8%**	**20.3%**
PLNU Applicant Conversion Rate	*18.6%*	*17.3%*	*17.0%*	*15.7%*	*16.1%*	*12.1%*	*15.0%*
Admits	**12**	**15**	**8**	**11**	**23**	**22**	**20**
Share of PLNU Admits	*0.7%*	*0.8%*	*0.4%*	*0.6%*	*1.1%*	*1.0%*	*1.0%*
Selection Rate	**92.3%**	**71.4%**	**47.1%**	**78.6%**	**79.3%**	**88.0%**	**83.3%**
PLNU Selection Rate	*87.4%*	*72.9%*	*68.9%*	*69.0%*	*70.5%*	*79.5%*	*79.8%*
New Transfer Admissions Funnel							
Environmental Science	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Inquiries	**2**	**0**	**1**	**8**	**13**	**14**	**16**
Share of PLNU inquiries	*0.2%*	*0.0%*	*0.1%*	*0.5%*	*0.9%*	*0.8%*	*0.8%*
Completed Applications	**1**	**--**	**1**	**4**	**3**	**3**	**3**
Share of PLNU Applications	*0.2%*	*--*	*0.2%*	*0.9%*	*0.6%*	*0.4%*	*0.7%*
Applicant Conversion Rate	**sm**	**--**	**sm**	**50.0%**	**23.1%**	**21.4%**	**18.8%**
PLNU Applicant Conversion Rate	*50.2%*	*55.5%*	*56.2%*	*28.4%*	*33.2%*	*36.9%*	*21.7%*
Admits	**1**	**--**	**1**	**2**	**3**	**2**	**3**
Share of PLNU Admits	*0.3%*	*--*	*0.4%*	*0.7%*	*0.9%*	*0.5%*	*0.8%*
Selection Rate	**sm**	**--**	**sm**	**sm**	**sm**	**sm**	**sm**
PLNU Selection Rate	*79.3%*	*57.9%*	*54.8%*	*60.5%*	*65.4%*	*64.1%*	*79.2%*
sm = cell sizes too small							

1. What does this data tell you about the external demand for your program? What does this say about the future viability of your program?

We have very high external demand for all of the undergraduate Biology programs. We have asked Admissions to limit enrollment of all Biology majors (Biology-BA, Biology-BS, Biology-Chemistry-BS, Environmental Science-BS) to 100 students per year, as we do not have the faculty to deal with larger numbers of students.

First-Time Freshman Admissions Yield							
Environmental Science	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Admits	12	15	8	11	23	22	20
Matriculants	**5**	**3**	**1**	**4**	**4**	**6**	**5**
Share of PLNU Matriculants	*0.9%*	*0.5%*	*0.2%*	*0.7%*	*0.6%*	*1.0%*	*0.8%*
Yield Rate	**41.7%**	**20.0%**	**12.5%**	**36.4%**	**17.4%**	**27.3%**	**25.0%**
PLNU Yield Rate	*29.3%*	*30.5%*	*27.7%*	*30.3%*	*31.0%*	*27.9%*	*29.9%*
New Transfer Admissions Yield							
Environmental Science	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Admits	1	--	1	2	3	2	3
Matriculants	**1**	**--**	**1**	**1**	**2**	**0**	**1**
Share of PLNU Matriculants	*0.6%*		*0.7%*	*0.7%*	*1.4%*	*0.0%*	*0.6%*
Yield Rate	**sm**	**--**	**sm**	**sm**	**sm**	**sm**	**sm**
PLNU Yield Rate	*51.1%*	*60.2%*	*54.7%*	*47.3%*	*44.6%*	*46.0%*	*48.0%*
sm = cell sizes too small							

2. How does your yield rate (percentage of students who enroll at PLNU after being admitted) compare to the PLNU average? If your rate is more than 8 percentage points above the PLNU average, what factors do you believe are contributing to this positive outcome? If your rate is more than 8 percentage points below the PLNU average for more than one year, what factors do you believe are contributing to this difference?

Our yield for this major is generally at or above the PLNU average, but as stated above, we cannot easily handle more students.

Enrollment							
Majors	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Environmental Science	**21**	**22**	**18**	**19**	**22**	**22**	**19**
Share of PLNU Undergraduates	*0.9%*	*0.9%*	*0.8%*	*0.8%*	*0.9%*	*0.9%*	*0.7%*
Minors	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
No minors in this program							
Major Migration of Completers*							
Top Importing Programs:	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**6-yr Total**
Undeclared			2			2	4
Biology-Chemistry			1		2		3
Biology (BA)		1	1				2
Chemistry				1	1		2
Top Export Destinations:	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**6-yr Total**
Biology (BA)					1		1
Biology-Chemistry				1			1
Exercise Science				1			1
Philosophy				1			1
* Based on degree completions of students who either started or finished within the program and who originally matriculated as first-time freshmen							

3. What does this data tell you about the internal demand for your program? Does this raise any questions about the viability and/or sustainability of your program as it is currently configured? Explain why or why not. Are there any actionable strategies that you can do that might make a difference if your trends are in the wrong direction?

Again, we have a very high demand for our programs. They are highly sustainable. Most people leaving this major go to other Biology majors.

General Education and Service Credit Hour Production Department UG Total				
	2011/12	**2012/13**	**2013/14**	**2014/15**
Total Dept UG student credit hours	5,421.0	5,880.0	5,742.0	5,648.0
Number of GE sections taught	?	?	?	?
% of SCH that are GE	47.0%	51.6%	52.1%	51.5%
Share of PLNU GE SCH	*7.3%*	*8.4%*	*8.3%*	*8.1%*
Number of service course sections taught	?	?	?	?
% of SCH that are service	18.2%	20.5%	21.2%	21.2%
Share of PLNU service SCH	*TBD*	*TBD*	*TBD*	*TBD*

4. What does this data tell you about how your program is impacted by the needs of GE and other academic disciplines? Does this raise any questions about the viability and/or sustainability of your program if these non-programmatic trends continue? Explain why or why not.

Note: This is the same answer as for the Biology-BA/BS.
We teach a lot of GE units and service units. As discussed already, the GE units help to offset the cost of the unfunded load in the department that is due to the laboratory experiences for the service courses and the majors. We do not anticipate a decrease in service units as the Nursing and Allied Health programs are also in high demand. If PLNU restructures GE such that a Biology course is no longer required by all students, this would obviously have a dramatic impact on our teaching loads.

Delaware Study Data Department Total												
	2010/11			**2011/12**			**2012/13**			**2013/14**		
Program Cost per SCH	**$244**			**$239**			**$237**			**$260**		
Benchmark Percentiles	$148	$194	$244	$153	$201	$235	$161	$198	$243	$174	$217	$266
Ranking	Medium-High			High			Medium			Medium		

5. We know that the following factors influence the Delaware cost per credit hour:
   - Large amount of GE and service classes taught by the program
   - The career stage of the program faculty (early career faculty are less expensive)
   - The number of elective courses in the program
   - The amount of unfunded load (faculty receiving more credit for a course than the number of units received by a student – e.g. 4 units of faculty load for teaching a 3 unit class)
   - The amount of release time associated with the program
   - Faculty members on sabbatical
   - The size of the department budget and the cost of specialized equipment

   Please reflect on your program's Delaware data in light of this information. In particular, what factors contribute to your program having a high (above 75th percentile), medium (50th-75th percentile), or low (below 50th percentile) ranking?

Note: This is the same answer as for the Biology-BA/BS.
As discussed in prioritization, the Biology department has a high unfunded load due to the many laboratory courses we offer. We feel that these courses are essential to students' education because they must learn how to DO Biology, not just read, write, and think about Biology. The unfunded load is offset by the high amount of GE and service courses that we teach. This brings us into the medium cost range for the Delaware study comparison.

6. Recognizing that not all factors above are under departmental control, what kinds of adjustments might be made to reduce the cost per student credit hour?

Note: This is the same answer as for the Biology-BA/BS.
We reduced the unfunded load of the GE courses by making the laboratory experience worth 1 unit. This is not possible for the service and major courses, however, because it would increase the sizes of the affected majors beyond their acceptable limits.

***** Future *****
Financial Data: (possibly delayed to the future)
Extra Revenue Generated by Program (lab fees, studio fees, etc.)
Extra Revenue per student credit hour
Extra Costs for the program (equipment not purchased outside of department budget, etc.)
Extra costs per student credit hour
Modified Delaware values: Delaware – extra revenue per SCH + extra costs per SCH

7. Do these modified Delaware values tell you anything new about the future viability and/or sustainability of your program as it is currently configured? Please explain.

Data not provided.

ENVS-F2) Findings from Assessment

Links to the department's assessment wheel
• Student Learning Outcomes • Curriculum Maps • Assessment Plan • Evidence of Student Learning • Use of the Evidence of Student Learning

Reflection on longitudinal assessment of student learning data:

1. What have you learned from this program's student learning assessment data?

*Since this is a joint major, only the Biology-specific assessment will be addressed here. The Chemistry-specific assessment will be addressed in their program review document.
Our first priority as an academic department is to ensure that our students are learning the essential content in the field of biology. We use the ETS Major Field Test in Biology to measure the performance of the Biology-Chemistry majors in four major areas of Biology: Cell Biology, Molecular Biology & Genetics, Organismal Biology, and Population, Ecological & Evolutionary Biology. At least 50% of the students are expected to score above the 60th percentile on the overall exam, and in each sub-discipline. Additionally, the overall group mean and the group mean in each sub-discipline are expected to be above the 75th percentile. The Environmental Science students (n=12) mostly did not meet these criteria from 2013-2015. In general, we have not had a large number of these majors, so the statistical validity of these data is questionable. However, we have noticed that weaker students tend to self-select into this major or into the Biology-BA major (as discussed above). Note that this observation is one reason we would like to explore the option of offering an Environmental Studies B.A. major that would be lighter in science and stronger in interdisciplinary studies.

Since many students struggle with the integration of their Christian faith with science, another priority of our department is that students will develop a rationally defensible integration of science with their faith. In our most recent measurement, 67% of the graduating Environmental science students were able to write an essay with a strong defensible integration of their faith with science.

Finally, a top priority is that our students should be prepared to gain admittance to graduate programs and science-related careers. We assess these data every five years. In our most recent survey, 88% of our alumni were employed or attending graduate school in a STEM-related field. In addition, our acceptance rate of students into graduate and health profession's schools continues to be at least 90%. Of the eight Environmental Science majors who responded to the survey, 88% are employed or in graduate school in a STEM-related field. Additional records kept by Mike McConnell indicate that 29 Environmental Science students have graduated since the program began, of which we know outcomes for 19. Of these, 14 are either in graduate school or in the environmental sciences (74%). 18 of the 19 are in STEM-related fields, and the remaining graduate is currently applying for graduate school in environmental science.

2. What changes (curricular and others) have you made based on the student learning assessment data?

Note: This is the same answer as for the Biology-BA/BS.
At our last program review, we determined that we needed to split a freshman course that was attempting to introduce Ecology, Evolution, and Organismal Biology in one semester into two semester-long courses: Ecological and Evolutionary Systems and Organismal Biology. This change was recommended based on the poor performance of our majors in the sub-categories of Animal Biology and Plant Biology on the ETS Major Field Test in Biology. After implementing these changes to our curricula, we then discovered that we needed to modify two upper-division courses: BIO360 (Ecology) and BIO310 (Botany). Our students were getting a much better background in ecology and plant biology, such that these two upper-division courses no longer needed to teach the background content. We discovered this disconnect via our senior exit interview process. Thus, we significantly changed the content of the upper-division courses. Instead of Botany, we now offer BIO312 (Applied Plant Science), and instead of Ecology, we now offer BIO363 (Conservation Ecology), which focuses on conservation and sustainability.

In addition, after hiring a Marine Biologist, we significantly changed the content of all of our Marine Biology courses, as we discovered that they did not reflect how modern Marine Biology is taught. We now offer Introduction to Oceanography, Marine Biology, and Experimental Marine Ecology.

3. What additional changes are you recommending based on your review of the student learning assessment data?

We are recommending changes based on surveys of comparator institutions (see below).

DQP Outcomes with Scores
***** TBD *****
DQP Definitions
Intellectual Skills Intellectual Skills define proficiencies that transcend the boundaries of particular fields of study: analytic inquiry, use of information resources, engaging diverse perspectives, ethical reasoning, quantitative fluency, and communicative fluency.
Specialized Knowledge What students in any specialization should demonstrate with respect to the specialization, often called the major field. All fields call more or less explicitly for proficiencies involving terminology, theory, methods, tools, literature, complex problems or applications and cognizance of limits.
Applied and Collaborative Learning Applied learning suggests what graduates can do with what they know. This area focuses on the interaction of academic and non-academic settings and the corresponding integration of theory and practice, along with the ideal of learning with others in the course of application projects.
Broad and Integrative Knowledge Students integrate their broad learning by exploring, connecting and applying concepts and methods across multiple fields of study to complex questions—in the student's areas of specialization, in work or other field-based settings and in the wider society.
Civic and Global Learning Civic and Global Learning proficiencies rely principally on the types of cognitive activities (describing, examining, elucidating, justifying) that are within the direct purview of the university, but they also include evidence of civic activities and learning beyond collegiate settings. These proficiencies reflect the need for analytic inquiry and engagement with diverse perspectives.

Reflection on DQP related data:

Understanding that the DQP framework provides one particular lens on the meaning, quality and integrity of your curriculum, reflect on the DQP data and framework provided for your program.

4. What have you learned from this program's DQP comparison?

The DQP roll-up is based on current department assessment, so we have nothing to add here.

5. What changes (curricular and others) have you made based on the DQP comparison?

None.

6. What additional changes are you recommending based on your review of the DQP comparison?

None.

Links to stakeholder assessment data (if present this will be department housed data)
• Surveys • Focus Groups • Market Analysis • Etc…

Reflection on stakeholder feedback data:

7. What have you learned from this program's stakeholder assessment data? If you do not have stakeholder data, please provide a plan for how you will regularly collect this in the future.

We conducted an alumni survey in 2015. 408 alumni from 2004-2014 were mailed and 115 replied (28% response). 60% of the respondents were currently in a graduate program or had already obtained an advanced degree. The most common occupations were currently in a graduate program (35%), health professional (23%), research (12%: biotechnology, academic, government, etc.) and K-12 teacher (5%). 73% of the respondents overall said that they felt well-prepared scientifically. Of the 6 Environmental Science majors who answered this question, all said that they felt well-prepared scientifically. As mentioned above, of the eight Environmental Science majors who responded to the survey (33% response rate for this major), 88% are employed or in graduate school in a STEM-related field. Additionally, the McConnell alumni data records indicate that 18 of 19 graduates are in STEM-related fields, and the remaining graduate is currently applying for graduate school in environmental science.

8. What changes (curricular and others) have you made based on the stakeholder assessment data?

None based on stakeholder data.

9. What additional changes are you recommending based on your review of the stakeholder assessment data?

None based on stakeholder data.

ENVS-F3) Curriculum Analysis

In looking at your curriculum, the program review process is asking you to analyze it through three different lenses. The first lens is looking at your content and structure from the perspective of guild standards or standards gleaned from looking at programs at comparator institutions. The second lens that of employability and is asking you to look at your curriculum and educational experiences from the perspective of skills and professional qualities that you are developing in your students that will serve them will in their future work and vocational callings. The third lens is that of pedagogy and is asking you to look at the delivery of your curriculum to ensure a high quality student learning experience.

Menu and Elective Unit Analysis Environmental Science	
Number of menu and elective units required by the program	14
Number of menu and elective units offered by the program	26
Menu/Elective Ratio	1.86
Longitudinal Class Section Enrollment Data	
• Link to Class Section Enrollment Report	

Comparison of current curriculum to guild standards and/or comparator institutions.

If your guild standards are associated with a specialized accreditation that your program has, these should be the basis of your analysis. If your guild standards are associated with specialized accreditation that we do not have, then you should primarily use comparator institutions as the basis for your analysis.

If your guild has standards that are not associated with specialized accreditation, then you may choose to use those standards and/or comparator institutions.

After consultation with your Dean, provide the set of guild standards or a list of the comparator institutions that you are using in your analysis.

If using guild standards:

1. Please provide a list of the guild standards that you are using to evaluate your curriculum.

   NA

2. Indicate if and how your curriculum satisfies the standards (this can be done in a table or narrative form). If applicable, indicate areas where your curriculum falls short of the standards.

   NA

Based on the analysis of standard and reflection on the menu and elective ratio above, consider and discuss the following questions:

3. Are there courses in your program that should be modified? Why or why not.

   NA

4. Are there courses that should be eliminated? Why or why not.

   NA

5. Are there courses that could be merged? Why or why not.

   NA

6. Are there courses that should be added? Why or why not. Note that in general, in order to create the space to add a new course, another course will need to be eliminated or taught less frequently.

   NA

7. What did you learn about your overall curricular structure in terms of its complexity, breadth and depth in light of the guild standards and our institutional size and scope? Are there any structural changes that need to be made in light of your analysis (e.g. sequencing of courses, % and or grouping of electives, overall units required, use of concentrations, etc…)?

NA

If using comparator institutions:

1. Begin by working with your Dean to identify a list of 5-8 comparator schools to use. In selecting schools, consideration should be given to type of institution, mission of the institution and the number of students majoring in the program.

1. Abilene Christian
2. Bethel University
3. Biola University
4. Cedarville University
5. Geneva College
6. Goshen College
7. Grace College
8. North Park University
9. Southern Nazarene University
10. Tabor College
11. Taylor University
12. Whitworth University
13. Messiah College
14. Redeemer College
15. Calvin College
16. Wheaton College
17. University of Redlands
18. Trinity University
19. University of San Diego

Note that 1-14 are considered "comparator" institutions, while 15-19 are "aspirant" institutions. Institutions 1-16 are members of the CCCU and are participating colleges with the Au Sable Institute of Environmental Studies. We included these particular institutions to ensure that our survey contained primarily institutions like us (small Christian liberal arts institutions involved in Christian environmental education), as well as 5 institutions that are larger, have more resources, and are renowned for their environmental programs. (Note that we obtained curriculum data for Redeemer College but they never responded to our interview questions.)

Gather the curricular requirements for the program in question at each of the comparator institutions.

2. Use this collection of curricular requirements to develop a list of curricular features that are essential for programs of this type. In addition, make note of any innovative or creative curricular feature that may be useful in enhancing the quality of you program.

General Overview of Environmental Science Programs

Given the wide range of resources and academic specializations represented by the comparison institutions, there was significant variation in the curricula of the environmental science programs surveyed. The total number of units to complete major courses ranged from 42-78 (mean = 59). PLNU is towards the upper end of required units for our environmental science major (71-72 units). Most programs were housed in the Biology Department and had a foundation of biology and chemistry coursework similar to our program. Required biology courses in the core curriculum ranged from 1-8 courses (4-29 units; mean = 16 units), with PLNU requiring 7 biology courses (23 units) in the core ENVS program. Required chemistry courses in the core ranged from 1-6 courses (3-24 units; mean = 10 units), with PLNU's chemistry requirement being the heaviest with 6 courses. Some programs were housed or allied with other departments, such as Geology, Agriculture, or Environmental Science, and included core courses in those areas. About a third of the programs had a single option program like ours. However, two-thirds of the programs (12/18 = 67%) had 2-4 concentrations (tracks) or had both a BA and BS option. Thus, most programs offered more flexibility in areas of specialization than we currently do. Depending on historical aspects of their location, faculty strengths, or facilities, some programs included emphases in agricultural ecology, wildlife biology, urban ecology, marine biology, outdoor education, field technology and survey skills, environmental public policy, and so forth. Thus many programs offered a variety of elective courses, some of which were unique to their faculty strengths (e.g., Agribusiness Management, Rangeland Ecology, Human Impacts on Coral Reefs, Environmental Geology, Environmental Literature, Environmental Law and Policy). Since many offerings of comparator institutions are not replicable for most schools, we chose to focus our attention on areas of the curriculum that were common to most programs beyond foundational courses in biology and chemistry.

We note that there was significant variation in the science content among the different programs. We therefore conducted an additional "sub-survey" using only programs that called themselves Environmental "Science" as opposed to Environmental "Studies", presuming that the former programs have a strong science focus like our program, while the latter programs would be more interdisciplinary. Of the 19 programs surveyed, 13 called themselves "Environmental Science" (one "Environmental Biology") compared with 6 that called themselves "Environmental Studies." Looking only at the 13 environmental science programs, total units required in the major ranged from 42-75, with the mean being the same as with the full survey. Required biology courses ranged from 2-7 courses (6-29 units), and required chemistry courses ranged from 1-6 courses (3-18 units), with PLNU again having the heaviest Chemistry requirements. Nine of the 13 programs had multiple options (69%), essentially the same as the full survey (67%).

Geographical Information Systems (GIS) – The survey showed that 50% of all programs surveyed and 38% of the Environmental Science programs had a dedicated course in GIS, and many offered more than one course. GIS involves taking geospatial data from GPS points to map features in space using sophisticated software like the Arc GIS system. The elements that are incorporated into GIS maps may be biological, geological, hydrological, or other environmental aspects including human features. GIS has become an essential skill in many disciplines, not just in the sciences, and those students that have a background in GIS are highly sought after by employers.

Environmental Chemistry – The survey showed that 40% of all programs surveyed and 54% of Environmental Science programs offered an Environmental Chemistry course, which is an interdisciplinary science that includes atmospheric, aquatic, and soil chemistry, and relies heavily on analytical chemistry. Environmental chemistry is used by environmental agencies and research bodies around the world to detect and identify the nature and source of pollutants, including heavy metals, nutrients that produce eutrophication and dead zones, urban runoff, and organometallic compounds.

Environmental Ethics – The survey showed that 50% of all programs surveyed and 54% of Environmental Science programs have some sort of environmental ethics course. Environmental Ethics is the discipline in philosophy that studies the moral status of nature and the ethical relationship of human beings to the environment. Such a course addresses the question of "Why should we care for the environment when there is no economic incentive to do so?" At a Christian institution such as ours, such a course would be heavily based on creation theology and biblical stewardship.

Physics – Surprisingly, the survey showed that 75% of all programs surveyed and 85% of Environmental Science programs DO NOT have a Physics requirement. Although some graduate programs require Physics, we realized that many career options in the environmental science field do not require a strong background in physics.

Internship Program – The survey showed that 61% of all programs surveyed and 54% of Environmental Science programs required either an internship or a research experience. The internship requirement ranged from 30 hours to 180 hours. In addition, some programs required their students to do a presentation to their peers on their internship experience in addition to a paper or reflection assignment. Internship programs address the importance for students to acquire non-academic skills such as communication, writing, organization, planning, and project management.

Review this list with your Dean before using it to analyze your own curriculum.

3. Indicate how your curriculum compares to the list of curricular features from your analysis (this can be done in a table or narrative form).

In structure and content, our environmental science program does not differ substantially from those we surveyed in our comparator and aspirant institutions. Our program is stronger in the science emphasis than many other programs, with our biology and chemistry requirements at the top end of the range, as is the total required units for the major. We are unusual among most programs in requiring 2 semesters of Physics. Our major is also in the minority in that we do not offer a dedicated course for GIS, Environmental Chemistry, or Environmental Ethics. We also have an internship option, although historically most of our ENVS majors have not chosen to do an internship, nor have we emphasized the importance of internships enough. Finally, our program is weaker than many others in the interdisciplinary upper division course offerings that help environmental science students incorporate other disciplinary skills into their training.

Based on the analysis of comparator programs and reflection on the menu and elective ratio above:

4. Are there courses in your program that should be modified? Why or why not.

Internship Program – We believe that the internship program is essential in helping our students gain the non-academic skills required to obtain a job in the environmental field, and we propose to strengthen it. Given that ENVS students already have the requirement of completing 8-12 units of an off-campus field immersion program (either as semester abroad or the summer Au Sable program), we do not think it wise to make it a requirement for students to do an internship, as some other programs do. However, we all agree that we should strongly encourage and expect students to participate in at least one internship or research experience in order to develop non-academic skills that will both prepare them for professional careers and simultaneously help them decide on their career path. We will put this expectation into the wording of the catalog description of the major. We would also like to develop an internship directory to help students obtain internships in the area (and also communicate that internships are really valuable and expected, although not required). Such a directory has been a valuable tool at Wheaton College, which graduates highly employable students able to obtain entry-level positions in the environmental field. Finally, and as mentioned elsewhere in this report, we believe that the hiring of an internship coordinator for all the Biology and Chemistry majors (including ENVS majors) is essential to take our program to the next level.
(Note that internships also come up in question 8 under Non-academic Skills and question 9.)

5. Are there courses that should be eliminated? Why or why not.

Physics – In order to make room for the new courses we will propose below, we intend to remove the 2-semester Physics requirement, thus opening up 8 units. Because the variety of disciplinary directions that ENVS graduates could take is so great, it is impossible to predict whether graduates would even need Physics, and as mentioned above, most environmental science programs do not have a physics requirement. [Note: Paul Schmelzenbach has been approached regarding this change and has no problem with it.]

6. Are there courses that could be merged? Why or why not.

No, although some elements of Instrumental Analysis will be incorporated into the new Environmental Chemistry course.

7. Are there courses that should be added? Why or why not. Note that in general, in order to create the space to add a new course, another course will need to be eliminated or taught less frequently.

Geographical Information Systems (3 unit semester course) – Walter Cho will develop an introductory course to GIS that will teach students the fundamentals they need to work in the field. Although the GIS course would be required for ENVS students, it would be offered as an upper division elective for other science majors and other majors across campus. Walter will reach out to other PLNU departments whose students may benefit from this course (e.g., Sociology, History Political Science, Business, Computer Science). We believe this would be a popular course that would attract students from across many departments, especially if it can be offered as one requiring minimal prerequisites.

Environmental Chemistry (3 unit semester course + 1 unit lab) – Tracey Schalnat will develop this course. Because of overlap with the new course material, CHE 370-Instrumental Chemistry will be dropped as a requirement for ENVS students and the new Environmental Chemistry course will become the requirement. However, ENVS students will still be able to take Instrumental Chemistry as an elective if they take Physics.

Environmental Ethics – Although this is a course that we have identified as one that is common to other environmental science programs and that we lack, our faculty do not have the expertise to develop such a course. One option would be to collaborate with Theology faculty. We will explore with Mark Wright the feasibility of incorporating a module on environmental ethics to THE 306-Ethics to try to bring this piece into the curriculum. We believe that such an addition will be valuable for other students as well.

Statistics – An existing course, MTH 363-Calculus-based Statistics (3 units), is currently required for ENVS majors. This course was just expanded to a 3-unit semester course and will be made a required upper division for ENVS students. Of the 8 comparator institutions that require a statistics course, all offer a full-semester course of 3-4 units. We have found that computational skills are essential for graduate studies and employment in many areas of environmental science.

Interdisciplinary Electives – In the general overview of the survey, we observed that many programs had broader offerings of interdisciplinary electives than we do. We therefore intend to find ways to deepen and broaden our lower and upper division electives outside of biology and chemistry. This acknowledges that many of the jobs available in the environmental field are not purely science, but require interdisciplinary skills. Environmental planners, land managers, environmental educators, and technical staff must be proficient in writing, speaking, planning, networking, and so forth, as noted in the section on the Internship program above.

First, we will add the following existing courses into the elective offerings for the major:

- POL 290-World Regional Geography (3 units) will be added to “Public Policy and Stewardship Electives” (note that this course will not count for upper division credits).
- BUS 475-Sustainability in Action will be added to “Public Policy and Stewardship” (the BIO 102/105 prerequisite will be waived).

Second, we intend to reach out to different departmental faculty to assess their interest in developing a series of 490-Special Topics courses that would incorporate an environmental module. In our reaching out, we hope to emphasize the benefits to both their department and the ENVS students. In particular, we think that the following faculty may be interested in developing the following Special topics courses that could be offered every 2-3 years and would increase the interdisciplinary offerings for our ENVS students:

- Environmental Economics – Harry Watkins
- Environmental History – Rick Kennedy
- Environmental Writing/Journalism – currently being developed at LJML
- Environmental Philosophy/Ethics – Mark Wright, see Environmental Ethics above
- Environmental Policy – Lindsey Lupo
- Environmental Social Justice – Jamie Gates
- Environmental Theology – Mike Lodahl

8. What did you learn about your overall curricular structure in terms of its complexity, breadth and depth in light of the comparator schools and our institutional size and scope? Are there any structural changes that need to be made in light of your analysis (e.g. sequencing of courses, % and or grouping of electives, overall units required, use of concentrations, etc…)?

Environmental Studies B.A. Major

As mentioned earlier, several of the comparator programs offered an Environmental "Studies" B.A. option as a "science light" option. We discussed the desirability of exploring an 'Environmental Studies BA' major that would have fewer science courses and room for more electives compared with the Environmental Science B.S. We agreed that this option would be worth exploring for several reasons: (1) An Environmental Studies B.A. would provide a way to retain those students that find the science part of the ENVS B.S. major too daunting. Rather than have them transfer to a completely different discipline (e.g., Psychology, Business), it would enable this pool of students to remain in the field of their passion by preparing them to work with scientists but not be scientists themselves; (2) Many jobs in the environmental field are not purely science, but only require a broad understanding of science. Instead, they must be proficient in non-science areas such as writing, speaking, planning, networking, GIS, and so forth; (3) Such a major would be highly interdisciplinary and thus very desirable from a liberal arts perspective. The science curriculum for an Environmental Studies major might include: foundational sequence of Biology and Chemistry, Research Methods, Statistics, Conservation Ecology, Environmental Chemistry, Global Information Systems, and a range of both science and interdisciplinary electives. The interdisciplinary courses to be developed might include scientific writing, speaking, and management. We would want to start a conversation with the provost, deans, and other departments that would need to be involved.

Non-academic Skills

Although the focus of this section is on the academic curriculum of the ENVS program, an important finding of the survey was the high priority given by virtually all these programs to providing opportunities for students to acquire "non-academic" skills vital to employment in the environmental field. An important insight emerging from this process is that academic qualifications are not enough to obtain an environmental job, especially for the recently graduated student trying to get their first entry-level position in the field. Employers are looking at much more than courses taken and grades obtained. While students will have opportunities to practice some of these non-academic skills in our core curriculum (see question 9 below), this is not enough. Students will need to seek out a variety of experiences to develop these skills and articulate them in a resume. In our program review, we worked to (1) identify the set of non-academic skills sought by employers in the environmental field, and (2) identify the most effective strategies for helping our students obtain those skills.

We identified the most sought-after skills through the following sources:

- 'Graduate student's guide to necessary skills for nonacademic conservation careers'. This is a recent publication that analyzed job advertisements and interview data (Blickley et al. 2012, Conservation Biology 27: 24-34). The skills highlighted in this publication ran parallel to the Burning Glass Skills data.
- Burning Glass Skills Data for Environmental Science, discussed below.
- An interview with a local environmental consultant, Mike Page, who has many years of experience in the field and is involved in the hiring of new personnel.

Mike Page identified the following skill sets that are desired by environmental consultants –

1. A well-rounded and intelligent person who can communicate.
2. A generalist biologist who has a broad knowledge base.
3. Ability to write well, communicate orally, synthesize material, and analytical skills.
4. Extracurricular work that is pertinent to environmental work (e.g., student environmental club).
5. Volunteer work with local parks, conservancies, environmental education, etc.
6. Summer jobs or internships in positions that demonstrate leadership, planning, and work ethic.
7. Understanding of environmental economics and government policy.
8. Technical skills such as understanding of GIS, CAD and Arc GIS applications, watershed skills.

These skill sets are widely confirmed by the top ten nonacademic skills of the 'Graduate Student Guide':

1. Project management – managing complex projects
2. Interpersonal – ability to engage in cooperative projects with a team of people
3. Written communication – ability to write effectively in any relevant forum
4. Program leadership – leading and developing projects
5. Networking – ability to bring together many individuals on the basis of common goals
6. Personnel leadership – managing people in an organization
7. Oral communication – ability to speak effectively in any relevant forum
8. Outreach communication – ability to connect ideas or practices to other people
9. Self-starter, independent – motivated to accomplish new endeavors on his/her own
10. Fund raising, monetary – experience raising money or managing budgets

The Burning Glass Skills Data list also mentions most of these skillsets (see below).

We identified the best strategies for helping students obtain important non-academic skills through interviews with 18 comparator institutions in which we asked about their internship program and field immersion opportunities for environmental science students.

- Internships – The survey revealed that 67% (12/18) of comparator institutions have an internship requirement, and those that do not require an internship strongly encourage students to do one in order to gain experience and skills. We are making efforts to significantly improve and expand internship opportunities for the ENVS students, as detailed under question 4.
- Field Immersion Experiences – The ENVS major requires that students complete a minimum of 8 units in an Off Campus Program (OCP) that is characterized by "field immersion" in which at least 25% of teaching and learning occurs in the field. Virtually every other program we surveyed either required or encouraged students to get this kind of field immersion experience either through the Au Sable summer program, semester abroad programs such as School for Field Studies, or programs uniquely associated with the institution's own field station, reserve, summer program, or study abroad program. The ENVS major currently has 4 field immersion programs that are approved by the ENVS program and supported by OGS (Au Sable Institute of Environmental Studies, Creation Care Study Program, Quetzal Education Research Center, and School for Field Studies). These types of programs are often life-changing experiences for our students, especially the Au Sable program.

Burning Glass Skills Data Environmental Science		
1. Communication Skills ***Virtually every course between presentations of primary literature articles, data communication, and scientific writing.***	5. Project Management ***None.***	9. Quality Assurance and Control ***Che294, 304, 325, 351, 370, 466, 468.***
2. Writing ***Virtually every course with assigned lab reports and scientific writing.***	6. Leadership ***Basic skills developed in our teaching assistant* and summer research programs**, as well as in Biology internships.***	10. Supervisory Skills ***Basic skills developed in our teaching assistant* and summer research programs**, as well as in Biology internships.***
3. Organizational Skills ***Bio210, 211, 301, 345, 363, 430. Che152, 153, 213, 294, 304, 325.***	7. Research ***Virtually every course as each science course has a required, associated lab portion. This is also mastered with summer research opportunities, Bio499, Biology internships, and honor's projects.***	11. Budgeting ***None.***
4. Planning ***Bio210, 211, 301, 345, 363, 430. Che 152, 153, 213, 294, 304, 325, 450.***	8. Management ***Basic skills developed in our teaching assistant* and summer research programs**, as well as in Biology internships.***	12. Problem Solving ***Bio210, 211, 301, 345, 490, 499. Virtually every Chemistry course.***

* While the Teaching Assistant Program is not a required course, we highly encourage every student within the major to participate and many of them do. As a TA, they directly interface with the students in laboratory courses, providing assistance with data collection, analysis and report generation. Some are also in charge of lab set-up, breakdown, writing weekly quizzes and grading lab reports. It is a position designed to develop basic skills in leadership, management, and supervisory capacities.

**The Summer Research Program is not a required course, but it is very highly recommended and the majority of our majors participate, either within the Chemistry department or the Biology department. Participating students are required to commit to two summers so that many labs have some new students and some returning students. As such, the returning students act as mentors working with the new students. This situation highly encourages the development of basic skills in leadership, management, and supervisory capacities.

Analysis of the curriculum against preparation for employment

9. The Burning Glass data provides a list of skills for students entering common professions that are often linked to your major. Indicate in the table if and where each skill is being taught in your program. Based on reflecting on this data, are there changes you would recommend making to your curriculum?

> The Burning Glass data by itself does not cause us to recommend changes to the curriculum, although (as mentioned in question 4 above), we intend to strengthen our Internship Program and to encourage more students to take advantage of internship opportunities as a means of obtaining these valuable non-academic skills.

10. Some programs may serve to prepare students with professional qualities and skills that can serve them well in a great variety of professions that may not show up in data sets like Burning Glass. If this is indicative of your

program, please identify the unique skills and/or professional qualities that your program develops in your students and indicate where in the curriculum this is being taught or developed.

The required Off Campus Program (OCP), characterized by "field immersion", provides students with a practical knowledge of environmental stewardship and, in the case of experience abroad, cross-cultural adaptability as well. In addition, the OCP typically equips students with marketable skills in field data collection, report writing, data analysis, and other research skills.

Analysis of the teaching of your curriculum

11. How do the pedagogical features of your program compare with the best practices for teaching in your discipline?

Biology: In 2011, the National Science Foundation (NSF) and the American Association for the Advancement of Science (AAAS) issued a report articulating much needed changes in biology education across the country. The document, titled "Vision and Change in Undergraduate Biology Education: A Call to Action," argued for a transition from faculty-centered education to student-centered education. As a Department, we have chosen the guidance in this document as our benchmarks for best practices in the discipline. Below, we describe each Vision and Change benchmark and then discuss how our program falls short, meets, or exceeds the standard.

The student-centered classroom, sometimes called active learning, is one that is "interactive, inquiry-driven, cooperative, collaborative, and relevant." In short, it is designed with student learning in mind rather than faculty teaching in mind. One approach to accomplishing a student-centered classroom is by way of what is commonly referred to as "scientific teaching", or sometimes "backward design." This strategy for designing a course starts not with the teacher's favorite topics or what they will say in class. Instead, careful time and attention are given to developing and precisely articulating learning outcomes. Once the learning outcomes are clear, the teacher designs the best assessments to determine if the students have achieved the desired outcomes. Finally, teaching methods are considered that can provide the best opportunity for the students to achieve the stated learning outcomes.

PLNU Biology Department faculty members have been proactive in learning new techniques for student-centered teaching. We have three Ph.D.-trained science educators in our department who consult with each of us frequently and regularly offer training sessions. Many of us have attended workshops on active learning, such as the National Academies Summer Institute on Undergraduate Education in Biology offered by HHMI and NSF. We participate in a twice-monthly Faculty Learning Community focused on teaching in the STEM disciplines. Many of us take advantage of (and sometimes help lead) training opportunities offered by the Center for Teaching and Learning, such as the hugely successful Teachers Noticing Teachers program. We meet every Thursday for lunch to discuss teaching issues, and have read books (e.g., *Scientific Teaching* by Handelsman et al.) and journal articles (e.g., *Active Learning Increases Student Performance in Science, Engineering, and Mathematics* by Freeman et al. PNAS 2013) together on active learning.

Some of the student-centered teaching techniques recommended in the Vision and Change document include authentic research experiences, case studies, immediate feedback assessment technique, personal response systems, inquiry-driven learning, concept mapping, peer-led team learning, problem-based learning, process-oriented guided inquiry learning, and team-based learning. We have already implemented many of these techniques and are in the process of experimenting with others.

For example, students in Conservation Ecology are required to complete a field research project conducted in collaboration with local conservation organizations. These bona fide research projects are designed to collect useful data that can be used to further local conservation action. Another example is Animal Behavior, a popular upper division elective course in which student teams conduct behavioral research at the San Diego Zoo, concentrating on projects requested by the Zoo to assist them in improving their management.

Several Biology professors further make use of flipped classrooms, case studies, online adaptive learning tools, personal response systems (clickers), concept mapping, peer-led team learning, and team-based learning, to name a few.

Chemistry: The American Chemical Society (ACS) has stated in their Guidelines for Bachelor's Degree Programs the following regarding pedagogy: "An approved program should use effective pedagogies in classroom and laboratory course work. Programs should teach their courses in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles. Additionally, a program should provide opportunities for faculty to maintain their knowledge of effective practices in chemistry education and modern theories of learning and cognition in science. An approved program should regularly review its pedagogical approaches to ensure that they promote student learning and build the skills needed to be an effective professional. Faculty should incorporate pedagogies that have been shown to be effective in undergraduate chemistry education. Examples include problem- or inquiry based learning, peer-led instruction, learning communities, and technology-aided instruction such as the use of personal response systems and flipped or hybrid classes. Laboratory work provides a particularly attractive opportunity for inquiry-driven and open-ended investigations that promote independent thinking, critical thinking and reasoning, and a perspective of chemistry as a scientific process of discovery."

The pedagogical features used in our program compare favorably with the best practices from within our discipline. The details of pedagogy used in our program are described in #12.

12. What new pedagogical practices have been tried by members of your department in the last few years? What has your department learned from these experiments?

See answer to #11 for Biology.

Chemistry faculty participate in many activities designed to understand best practices in teaching, and to put them to use on a daily basis. Chemistry faculty have attended a variety of events directed at LEARNING about best practices which include:

- Scientific Faculty Learning Community
- Chemical Education session at national ACS conference
- Project Kaleidoscope (conferences in STEM education)
- Team-Based Learning Workshop
- NSF funded project developing interdisciplinary course modules
- Training opportunities offered by Center for Teaching and Learning

Chemistry faculty have also been invited to give talks related to teaching best practices in the following areas:

- General Chemistry Technology with McGraw-Hill Publishing
- Student engagement techniques at SDSU
- Use of iClickers for assessment at Claremont Colleges

Some of the pedagogical features used in our courses includes:

- Team-Based Learning
- Inquiry-Based Learning
- Use of sophisticated modeling software
- Use of clickers
- Enhancement of student engagement using mini whiteboards and iPads
- Online homework systems

As a faculty, we value student engagement and will continue to strive for the best possible student learning experience. In the Chemistry Department, new pedagogical practices have been added incrementally over the last 5 years and some of these practices (Team Based Learning and Inquiry-based learning) are still limited to a few courses. Since these methods are more recent, we have not yet collected data to see the direct impact on students. However, it is broadly accepted that student engagement is directly correlated with improved learning and long term retention of concepts. One example is the use of group activities and modeling software (PyMOL) in Biochemistry. These two pedagogical features have greatly improved our students' understanding of proteins and their function. The understanding was such that in Bioinorganic Chemistry (CHE 466, usually taken the following spring semester) students were able to apply these concepts readily without any need for a refresher. Therefore, the course content was shifted to a more in-depth understanding of metals in biology rather than basics of biochemistry which had to be done in the past.

Overall, we have learned that student centered teaching is worth applying and, while it will look different from one class to another, it improves student retention and student learning. Finally, these strategies allow for a stronger faculty-student interaction, thus fulfilling our mission to shape our students.

13. Are there new developments in pedagogy in your discipline? What would be required to implement these changes in pedagogy in your department?

The 2011 Vision and Change document discussed above represents the most recent pedagogical developments that have been widely adopted by the biology teaching community. Possibly the two greatest hindrances to implementing active learning practices are (1) class sizes (in some cases), and (2) faculty time to develop the methods and assessment tools.

ENVS-F4) Potential Impact of National Trends

Top Burning Glass Occupations for the Program Environmental Science		
Occupation	**Hiring Demand**	**Salary Range**
Project Manager	Very High	$84K - $87K
Environmental Scientist / Specialist	Medium	$54K - $57K
Geographer / GIS Specialist	Medium	$61K - $67K
Alternative Energy Manager	Low	$67K - $86K
Environmental Compliance Specialist	Low	$42K - $65K
Environmental Engineering Technician	Low	$41K - $59K
Environmental Planner	Low	$64K - $72K
Fish / Game Warden	Low	$31K - $41K
Fish Hatchery Manager / Technician	Low	$30K - $33K
Meteorologist	Low	$39K - $60K
Park Ranger / Naturalist	Low	$35K - $38K
Research Manager	Low	$59K - $69K
Sustainability Specialist	Low	$51K - $83K
Water Resource Specialist	Low	$88K - $156K
Wildlife Biologist	Low	$48K - $54K

Note that some programs do not have as many professions listed in the Burning Glass data as others do. In these cases we will want to get a list of professions from the chair/school dean to supplement the Burning Glass data.

1. Which professions in the Burning Glass data were you already aware of and for which are you already intentionally preparing students and does the hiring demand in these professions signal anything about the future that you need to be aware of regarding the design and structure of your program ?

We were already aware of most of the professions listed in the Burning Glass data. We have a strong science focus to our curriculum, and have been intentionally preparing students for many of these careers, especially the more STEM-related careers. However, our program has been weaker at preparing students for some of the more policy or geography focused jobs. As part of program review, we are proposing several changes to the ENVS major, including the addition of two new courses in GIS and Environmental Chemistry, which will better prepare students for many of the listed professions.

Many of these professions require internships or graduate degrees, and we have been successful in preparing students for graduate school (per alumni survey data) and have begun investigating improvements for our internship program.

2. Are there additional professions in the Burning Glass list or from your knowledge of occupations your alumni have entered, for which you should be preparing students?

Based on alumni survey data and the McConnell alumni data mentioned above, most of our students find a STEM-related job or enter graduate school. Not all of these jobs or graduate programs are directly related to the environmental field. Due to the science-heavy nature of our program, many of our graduates are well-qualified to work in the biotech industry or analytical chemistry field as lab technicians, lab assistants, etc.

3. What changes in your program would be necessary in order to prepare students for the skills and professional qualities needed to succeed in these additional professions?

We believe that the proposed curriculum changes for the ENVS program will focus on topics of direct relevance to all of the professions listed above AND address the biggest weaknesses in our program. We are investigating improvements to our internship program that we believe will be instrumental in helping our students forge the network connections they need to find jobs in their field and be successful.

4. Are there national trends in higher education or industry that are particularly important to your discipline? If yes, how is your program reacting to those trends?

The field of environmental science (or studies) should continue to grow as more efforts are placed on finding alternatives to petroleum-based fuels. We continue to have a strong focus on preparing students for STEM-related jobs. However, there is a need to prepare students to work at the interface of science, policy, and business. How do we prepare students for these more interdisciplinary professions? That is a question we are taking to other departments to discuss how we might work together to develop new courses, minors, or programs, such as an Environmental Studies – BA.

ENVS-F5) Quality Markers

Retention/Graduation Rates (First-Time Freshmen)							
	Matriculation Term						
Environmental Science	**Fall 2008**	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**
First-Year Retention	**75.0%**	**sm**	**80.0%**	**sm**	**100.0%**	**80.0%**	**60.0%**
PLNU First-Year Retention	*84.2%*	*84.1%*	*81.1%*	*82.9%*	*89.3%*	*84.5%*	*84.5%*
	Matriculation Term						
Environmental Science	**Fall 2005**	**Fall 2006**	**Fall 2007**	**Fall 2008**	**Fall 2009**	**Fall 2010**	**Fall 2011**
Four-Year Graduation Rate	**sm**	**sm**	**sm**	**54.5%**	**sm**	**57.1%**	**--**
PLNU Four-Year Graduation Rate	*62.0%*	*65.2%*	*61.7%*	*59.1%*	*63.4%*	*62.2%*	*63.2%*
	Matriculation Term						
Environmental Science	**Fall 2003**	**Fall 2004**	**Fall 2005**	**Fall 2006**	**Fall 2007**	**Fall 2008**	**Fall 2009**
Six-Year Graduation Rate	**--**	**--**	**sm**	**sm**	**sm**	**77.8%**	**sm**
PLNU Six-Year Graduation Rate	*72.4%*	*73.2%*	*73.0%*	*74.9%*	*72.2%*	*73.6%*	*75.0%*
Degree Completions							
Majors	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
Environmental Science	**1**	**3**	**4**	**7**	**4**	**5**	**3**
Share of PLNU Bachelor's Degrees	*0.2%*	*0.6%*	*0.7%*	*1.3%*	*0.7%*	*0.8%*	*0.5%*
Minors	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
No minors in this program							
FTF Time to Degree *(in semesters)*	**sm**	**sm**	**sm**	**8.7**	**sm**	**sm**	**sm**
PLNU FTF Time to Degree	*8.2*	*8.2*	*8.3*	*8.2*	*8.3*	*8.3*	*8.3*
Study Abroad Participants	1	3	4	6	3	4	2
sm = cell size too small							

1. Based on comparing the quality marker data for your program with the PLNU averages:
   a. What does this tell you about your program?

With the small number of Environmental Science students, it is difficult to see any trends or draw conclusions from this data.

   b. If your values are below the PLNU averages, what changes could you make to address any areas of concern?

Same answer as above.

c. If your values are above the PLNU averages, what do you believe contributes to this success?

Same answer as above.

2. Describe regular opportunities for students to apply their knowledge (internships, practicums, research projects, senior projects, etc.). Estimate what percentage of your students in this program participates in these kinds of opportunities.

Both the Biology and Chemistry Departments have an intensive undergraduate research program, where students gain 800 hours of research experience over the course of two summers. This research program is the primary source of these opportunities. Because the Environmental Science major is a joint major, students can do research in either department. Of the Environmental Science graduates from 2007-2015, 48% participated in an intensive research experience. In addition, Environmental Science majors are required to take a minimum of 8 units of upper-division electives from approved environmental off-campus programs.

Some students have participated in internships. Since 2013 the Biology Department has been trying to develop more internship opportunities for our students as an alternative way of developing crucial career skills in the students who do not participate in the intensive research experience. In Spring 2015, six students interned throughout San Diego county and in Fall 2015 eight students interned. The intern sites include everything from entering and analyzing research data (e.g. at Cabrillo National Monument), to learning to care for animals (e.g. Project Wildlife), or working in a science classroom (e.g. St. Charles Borromeo Middle School). Over the past two years, we have expanded the number of internship opportunities to about 10. It should be noted that this requires a lot of effort! To truly expand these opportunities for our students, we would need release time for an internship coordinator (see program recommendations). A coordinator would (a) cultivate new internship opportunities, (b) act as a liaison between the organization and the PLNU biology department, (c) meet with interns one-on-one to identify appropriate internship possibilities, (d) assist students with internship applications (when needed), (e) communicate regularly with the students during the internship, (f) communicate with the site internship supervisor to follow up on the progress and success of the student intern.

In addition, students are highly encouraged to participate in the life of the department, including work as Teaching Assistants and/or graders for the courses, particularly the laboratory portions. This helps students apply their knowledge by making solutions, setting up reagents, working with advanced equipment, and teaching fellow students as part of their TA position. While the professor is the main instructor for every course, these opportunities of engagement for the students also help facilitate learning within the student community. In the last few years, over 50% of our students have participated as TAs in the department, many TAing for several semesters and multiple courses. However, we do not have this data broken down into individual programs within the departments.

3. Describe any public scholarship of your undergraduate and graduate students in this program (conference presentations, publications, performances, etc.). What percentage of your undergraduate students are involved in these kinds of activities?

As stated above, 48% of the Environmental Science graduates from 2007-2015 participated in an intensive research experience. At least half of these students then have publications and/or presentations based on this research. Many of them present at the West Coast Undergraduate Research Conference in Biology, which the Biology department hosts every 2-3 years

4. How many of your students participate in study abroad opportunities in general? Describe any study abroad opportunities specifically organized by your program. What percentage of your majors are involved annually (annualize the number)? How many students outside of your department participate in this departmentally organized program (Annualize the number)?

The Environmental Science major requires an off-campus field-immersion experience (8 units). Some of these students choose to attend the Au Sable Institute of Environmental Studies in the summer.

The rest of this answer is the same as for the Biology-BA/BS.
We have one opportunity that is organized by our department. In the mid-2000s we began to explore the possibility of a faculty-led study abroad course in ecosystems of the new world tropics. In the spring of 2008, Biology faculty member David Cummings joined a faculty-led course to Costa Rica offered by Northwest Nazarene University. The following September a PLNU course proposal was drafted and in spring 2009 Cummings along with colleague Mike Mooring led the first course in Neotropical Ecology (now designated BIO340). The 2-unit upper division course comprises 7-8 weeks of instruction on campus during the second quad of the spring semester followed by a two-week trip to Costa Rica, exploring the montane cloud forests and the lowland rain forests. Students study one of the few books on new world tropical ecosystems, give presentations on various plants and animals of the Costa Rican forests, and experience many of the things they have learned first-hand on the trail in Costa Rica.

The course is offered every other year in the spring and is capped at 12 students. Our enrollment has varied from 7-12. To date only one student outside of the Department has participated.

5. What are any other distinctives of your program? Describe how they contribute to the program's success.

A top priority of our departments is for students to do biology and chemistry, not just learn about them. To accomplish this, we have a laboratory rich curriculum. Almost all of our classes have a required laboratory experience. We are proud of the deliberate mentoring of students that occurs while they are at PLNU and the relationships we have been able to maintain with a large number of our alums. Our students work as prep-room workers, graders, review session leaders, tutors, and lab assistants under the supervision of faculty. Our alumni are constantly giving back through guest lectures, mentoring, shadowing opportunities, etc., and are extremely willing to help current students. Alumni tell us that they are very well prepared for post-baccalaureate education and jobs in the discipline.

All of the full-time faculty in biology and chemistry earned a Ph.D. prior to coming to PLNU. Moreover, all of our faculty have completed postdoctoral research beyond the Ph.D. This indicates that our program has a track record of attracting faculty highly-qualified in both teaching and scientific research.

Another distinctive shared by both the Biology and Chemistry Departments is our pre-health professions advising. We have a dedicated advisor (currently Sara Choung) for students preparing for medical, dental, optometry, pharmaceutical, or veterinary school. This program includes two preparatory interviews for the students, sessions with alumni and local health professionals, and a committee-written letter of recommendation. This program has almost certainly contributed to the high rate of acceptance of our students into the health professional schools (over 90% for over 15 years).

6. Does your program have an advisory board? If so, describe how it has influenced the quality of your program? If not, could it benefit from creating one?

NA

7. Describe any current joint interdisciplinary degrees (majors or minors) offered by your department. Are there additional areas where interdisciplinary programs should be considered?

The Biology-Chemistry major and the Environmental Science major are joint between Chemistry and Biology. There are also science-business and science-marketing minors for business or science majors and the computational science minor. We are not currently considering additional interdisciplinary programs.

8. Describe your success with students acquiring jobs related to their discipline.

In our most recent alumni survey, 91% of our alumni were attending graduate school or employed in a Chemistry or STEM-related field. In addition, our acceptance rate of students into graduate and health professions schools continues to be at least 90%. Of the eight Environmental Science majors who responded to the survey, 88% are employed or in graduate school in a STEM-related field.

In looking through a list of the types of jobs that our alumni have, you would see that our students are successful at acquiring jobs in a wide variety of professions. These professional areas include but are not limited to forensic chemistry, environmental science, biotechnology and pharmaceutical research, education, public health, medicine, dentistry, optometry, pharmacy, veterinary medicine, etc. 134 out of 188 (71%) alumni who graduated from the biology and chemistry departments between 2006 and 2010 and 115 out of 135 (71%) alumni who graduated between 2001 and 2005 are in teaching, science, or health related fields. 48 biology and chemistry alumni currently hold faculty positions at 38 different institutions.

9. Describe your undergraduate and graduate student success rate for passing licensure or credentialing exams (if they exist in your discipline).

NA

10. Describe your success with undergraduate student acceptance into post-baccalaureate education.

A large number of our graduates continue their education at health professions schools or graduate schools and they have been very successful at getting into these various programs. As mentioned previously, the success rate for alumni who apply to graduate or professional schools has been well over 90% for at least 20 years. In recent years, students have gone to prestigious programs at University of California San Diego, University of California Irvine, Yale University, Georgia Tech University, Vanderbilt University, etc. For dental, medical, optometry, pharmacy, and veterinary schools, there have been 166 acceptances out of 181 applicants (91.7%) between 2004 – 2014. They have gone on to a number of schools across the country such as University of California San Diego, University of Southern California, Loma Linda University, University of Washington, Duke University, Purdue University, etc. Between 2001 and 2011, 46 Biology and Chemistry Department alumni earned a Ph.D. This speaks very highly of their undergraduate preparation in both the chemistry and biology courses.

11. What kind of support does your program provide for students encountering academic difficulties? How do you intentionally facilitate these students' connection with institutional support services?

Our departments have multiple means of supporting students with academic difficulties. First, these students are usually identified in the freshman classes (BIO210 and BIO211), where the instructors contact students who are doing poorly on exams and offer specific advice on study habits, extra office hours, and direction to tutoring. Second, the Chemistry department offers a weekly tutorial for students in the first semester of General Chemistry (CHE151), as well as student-led weekly review sessions for both semesters of General Chemistry and Organic Chemistry. Third, during the twice yearly advising sessions, we meet with our advisees for 15-30 minutes and discuss both academic and non-academic factors, as well as vocation. Fourth, on some occasions, we have directly referred students to the Wellness Center, the DRC, or even contacted Caye Smith, Jeff Bolster, or Mark Pitts, depending on the situation. Finally, we are hoping to use the new capabilities of the SSC to bolster these efforts by identifying students who may be in the middle ground but could use some resources to make their college experience even better.

ENVS-F6) Infrastructure and Staffing

Full-Time Faculty Program Contribution Department UG Total			
	2012-13	**2013-14**	**2014-15**
Percentage of UG classes taught by FT faculty	71.9%	72.2%	83.9%
PLNU percentage of UG classes taught by FT Faculty	*TBD*	*TBD*	*TBD*
Includes: regular lectures, labs, seminars Excludes: independent studies, private lessons, internships			

1. Are your program's current technological resources and support adequate? If not, what is needed? Do you foresee any additional needs in this area?

Biology: At present our technological resources and support are superior with the recent addition of the Latter Hall classrooms and Sator Hall laboratories. Our current needs are well met; however, instrumental technology is continually evolving. The faculty actively pursues grants to support these needs. In addition, administration has been supportive of many of these changing needs as well. We need this continued support to provide our graduates with the most up-to-date education and experiences to be truly competitive. (Note: This is the same answer as for the Biology-BA/BS.)

Chemistry: Special instrument funds accompanying the building of Sator Hall allowed for the addition to several state-of-the-art instruments for use in the Chemistry major courses and related research. These instruments include an Inductively Coupled Plasma – Optical Emission Spectrometer (ICP-OES), high performance liquid chromatograph (HPLC), infrared (IR) spectrometer, fluorescence spectrometer, glove box, lyophilizer, microwave reactor, magnetic susceptibility balance, potentiostat, and spectrometers. Additional funding from the Provost's office made possible the purchase of a much-needed, used 400 MHz nuclear magnetic resonance (NMR) spectrometer. We also negotiate access to remaining necessary equipment via local connections (at UCSD, USD, and TSRI).

In order to keep these instruments running, we do need ongoing support for instrumentation. Currently, the institution has no replacement schedule (or line item in the budget) for scientific equipment. The new instruments mentioned above require solvents, gases, cryogens and consumables in order to run, while older instruments (like our ultraviolet and visible spectrophotometer (UV-vis), gas chromatographs (GCs), and gas chromatograph-mass spectrometer (GC-MS)), are likely to require maintenance and repairs in the near future beyond what is covered in our existing budget.

We still need at least two additional instruments commonly used in an undergraduate chemistry curriculum: an X-ray diffractometer and a liquid chromatograph-mass spectrometer (LC-MS). As mentioned above, faculty actively pursue grants to support department needs. It will require continuing support (external and institutional) to provide our graduates with the most up-to-date educational experiences necessary to maintain our competitive edge.

2. Are your program's current facilities adequate? If not, what is needed? Do you foresee any additional needs in this area?

Biology: The classrooms and facilities in the new building are wonderful and adequate, as long there is stable enrollment in the Nursing, Allied Health, and Biology programs. Our office space is not adequate. Cho is in MICS space, which he will soon need to vacate. Koudelka is in a trailer outside the building. We thus need a minimum of two more offices. (Note: This is the same answer as for the Biology-BA/BS.)

Chemistry: The classrooms and facilities in Sator and Latter halls are excellent and are expected to be adequate for our needs assuming stable enrollment in our courses that serve other departments such as Nursing and Kinesiology. Maintaining one general purpose teaching laboratory in Rohr Science would provide capacity for growth. Office space in the Chemistry Department is old and inadequate, with no space for adjunct faculty. It would also be great if students had a space to congregate to study together and work on projects together.

3. Is your program's current staffing (administrative, clerical, technical and instructional) adequate? If not, what is needed? Do you foresee any additional needs in this area?

Biology: Staffing is close to adequate, again as long there is stable enrollment in the Nursing, Allied Health, and Biology programs. Ideally, we need a long-term adjunct or part-time professor so that we can split up the overly large sections of BIO130 and BIO140 that have 72 students. As discussed previously, this would require at least 6 units of extra load per year.

Chemistry: Our instructional staffing is not adequate. We are in need of a Physical Chemist to replace Ken Martin, who is in the final year of his phased retirement. Physical chemistry is one of the five pillars of a solid chemistry curriculum and no one else in the department is trained to teach those courses.

Current and projected enrollments in Chemistry Department programs as well as other departments/programs served by Chemistry have been growing dramatically. As a result, enrollments in our largest courses have more than doubled in the past ten years (the numbers of students in CHE103, CHE152, and CHE153 have grown by 38.5%, 165.0%, and 129.5%, respectively). With the hire of a full-time Physical Chemist, the number of teaching units taught by full-time faculty would still be below 80% each academic year (2016-2017: 78.9%, 2017-2018: 76.2%).

Moreover, a Physical Chemist is necessary to maintain the curricular balance required of a quality chemistry teaching and research program, and to successfully seek American Chemical Society (ACS) Program Approval.

Note that two of the recommendations we will make in section F8 on pages 91 and 92 have staffing implications and we have two immediate staffing-related requests: 1) We request a 4-unit course release each for Tracey Schalnat and Walter Cho, who will need this time to develop the Environmental Chemistry and GIS courses, respectively. 2) If approved, these new courses will each correspond to an additional 3 units of teaching load per year.

ENVS-F7) Challenges and Opportunities

1. Are there any particular challenges regarding this program that have not been addressed through the analysis and reflection on data or questions in sections F1-F6 that you would like to include here?

Environmental Science is an interdisciplinary field of study focused on understanding the natural processes of how the world works and also how humans interact with and affect it. This draws on aspects from the natural and social sciences as well as the humanities. Relative to environmental science programs at comparator and aspirant schools, our program has a strong emphasis on the natural sciences and provides our students with an excellent background in these related fields. A significant challenge to our program is developing the social science and humanities-related aspects of environmental science that are focused on studying the interaction and impacts of humans with the natural world. The development of courses such as Environmental Economics, Environmental History, Environmental Writing/Journalism, Environmental Philosophy/Ethics, Environmental Policy, Environmental Social Justice, and Environmental Theology would ideally fill this current limitation in the program. These topics, however, are beyond the expertise of the faculty in the Biology and Chemistry departments and the development of relevant courses would require the participation of other schools and departments at PLNU that have faculty with these expertise, such as the Fermanian School of Business, the School of Theology & Christian Ministry, and the departments of History & Political Science, Literature, Journalism, and Modern Languages, and Sociology and Social Work. This challenge also provides a unique opportunity for interdisciplinary collaboration at PLNU as this need provides a clear context within which multiple departments could work together to improve the major. However, to progress further, this interdisciplinary collaboration would require significant investment from the different schools and departments involved and would also require support from the administration.

Another challenge faced by students in the major is the issue of "identity." ENVS students have greater difficulty in envisioning how their passion for the environment can direct them to an eventual career, more so than biology and chemistry majors that may be following a more traditional career path to professional or graduate school. In order to meet this challenge, we can help our students grapple with these questions and get some answers. This may result in retaining more ENVS majors, and attracting new students to the major. Some possible ways to address this issue include the development and improvement of internship opportunities for students through the appointment of an internship coordinator, the development of a directory of possible internships, and exposing students to internship opportunities with presentations of previous internship experiences shared by peers.

We may also try to foster a greater sense of community within the major through multiple avenues, including the coordination of periodic events that can bring students in the major together, such as career development workshop events, greater promotion and investment in student clubs such as Students for Environmental Action and Awareness (SEAA) and the Association of Environmental Professionals (AEP), the development of a monthly e-newsletter for ENVS (and other "environmental" students) with highlights of what other students are doing, more intentional advising of ENVS majors (perhaps including a group pre-advising session to bring majors together for an overview of the major) and the exploration of a few specific career paths supported by the program that could be the focus of workshops, newsletters, advising, etc. (e.g., environmental public health, environmental chemistry, conservation ecology, zoo conservation). These activities would help students gain both a sense of identity and community as well as have practical benefits by developing clear career goals, pathways to achieve those goals, and help students gain technical skills that would be beneficial in their future careers.

2. Are there any particular opportunities regarding this program that have not been addressed through the analysis and reflection on data or questions in sections F1-F6 that you would like to include here?

The interdisciplinary nature of the environmental science major provides unique opportunities for interdisciplinary collaboration among the different schools and departments at PLNU. Our current program does an excellent job developing the natural sciences aspect of the major, by providing students with a strong background in understanding how the world operates. The challenge mentioned in Question 1 of F7 is providing our students with an adequate background in those aspects of environmental science focused on understanding the human interactions and impacts on the environment from fields related to the social sciences and humanities. In addition to the development of particular courses to help students gain this background, an exciting opportunity would be the development of an Environmental Studies BA major that would incorporate more non-science skills, and have a greater emphasis on the humanities and social science aspects of the field. This major would be appropriate for those students who have a passion for the environment but may not be interested in the scientific research aspect of environmental science, but rather in the various non-technical related fields, such as environmental writing, policy, and sustainability. An Environmental Studies BA would provide students with sufficient scientific background to be proficient in relating to scientists but also the non-technical skills which would allow them to be successful in the various support roles. The development of such a major would require significant investment from the different schools and departments involved and would also require support from the administration.

Another opportunity is to better promote the Environmental Science major and introduce it to prospective students as a great option. We can work with the Admissions office by providing relevant statistics that show evidence of the success of our alumnae (such as the fact that 88% of our alumni were employed or attending graduate school in a STEM-related field; the acceptance rate of students into graduate and health profession's schools continues to be at least 90%; of the eight Environmental science majors who responded to the most recent alumnae survey, 88% were employed or in graduate school in a STEM-related field). In addition to promoting the major in the traditional way as a means of managing, protecting, and restoring the environment, this field can also be marketed in relation to the public health applications of two critical issues of growing importance, the alarming rate of biodiversity loss and the explosion of emerging infectious diseases. Both of these issues are of growing importance and have dramatic consequences for the human population. Environmental Science is a field that is particularly relevant in studying the impact humans have had on these issues and also possible solutions.

ENVS-F8) Recommendations for Program Improvement

List the recommendations you are making regarding this program analysis with a brief rationale for each recommendation.

• Remove the Physics requirement (PHY 141/142 or PHY 241/242) from the major (8 units) – A survey of comparator and aspirant schools revealed that 75% of the programs do not have a Physics requirement and many career options in the environmental science field do not require a strong background in physics.

• Add a new required 3 unit course in Geographical Information Systems (GIS) (to be developed) – A survey of comparator and aspirant schools revealed that 50% of the programs had a dedicated course in GIS. The ability to think and conduct analyses in a geospatial context is an essential skill in environmental science as well as many other disciplines (anthropology, biology, economics, history, political science, sociology, etc.) and a valuable skill for those seeking employment. In support of this recommendation, we request a 4-unit course release for Walter Cho in order to develop the course. It should also be noted that several other departments are interested in having this course as an option for their students, including Engineering students, Business students in the Sustainability Minor, and Sociology/Social Work students.

• Add a new required 3 unit course in Environmental Chemistry (to be developed) – A survey of comparator and aspirant schools revealed that 40% of the programs offered an Environmental Chemistry course, an interdisciplinary science that includes atmospheric, aquatic, and soil chemistry, and relies heavily on analytical chemistry. Environmental chemistry is used by environmental agencies and research bodies around the world to detect and identify the nature and source of pollutants, including heavy metals, nutrients that produce eutrophication and dead zones, urban runoff, and organometallic compounds. In support of this recommendation, we request a 4-unit course release for Tracey Schalnat in order to develop the course.

• Add POL 290-World Regional Geography (3 units) as a possible course to fulfill the "Public Policy and Stewardship Electives" requirement (note that this course will not count for upper division credits). Environmental science is an interdisciplinary field of study focused on understanding the natural processes of how the world works and also how humans interact with and affect it. This course draws on aspects from the natural and social sciences as well as the humanities. The addition of POL 290 will provide students in the major a greater opportunity to take courses outside of the sciences and study the social aspects related to the Environmental science major.

• Add BUS 475-Sustainability in Action (3 units) as a possible course to fulfill the "Public Policy and Stewardship Electives" requirement (the BIO 102/105 prerequisite will be waived). Environmental science is an interdisciplinary field of study focused on understanding the natural processes of how the world works and also how humans interact with and affect it. This draws on aspects from the natural and social sciences as well as the humanities. The addition of BUS 475 will provide students in the major a greater opportunity to take courses outside of the sciences and study the social aspects related to the Environmental science major.

• Emphasize the importance of internships for students in the major by emphasizing its importance in the catalog description of the major. A robust internship program is essential in helping our students gain the non-academic skills required to obtain a job in the environmental field, as identified by the Burning Glass Skills data and interviews with comparator and aspirant schools and local professionals in the field. We have ramped up our internship opportunities over the past two years and have also begun intentionally advising students to take advantage of these opportunities. From 2012-14, we only had 1-4 units of student internships. In both 2014-15 and 2015-16, we had 12-14 units of student internships per year. Currently, four different faculty are overseeing various internships and being paid overload pay to coordinate them. In order to make this program more effective, we request 1 unit of load release per year for an internship coordinator, which is the standard rate for 12 internship units. This coordinator would (a) cultivate new internship opportunities, (b) act as a liaison between the organization and the PLNU biology department, (c) meet with interns one-on-one to identify appropriate internship possibilities, (d) assist students with internship applications, (e) communicate regularly with the students during the internship, and (f) communicate with the site internship supervisor to follow up on the progress and success of the student intern. This coordinator would interact with the students in all of the undergraduate Biology programs, hence this recommendation will be made in each program section.

• Explore opportunities for interdisciplinary collaboration and expand the exposure students in the major have to topics related to environmental science in the social sciences and humanities:
1) Investigate the feasibility of incorporating a module on environmental ethics to THE 306-Ethics – A survey of comparator and aspirant schools revealed that 50% of environmental science programs had a course related to environmental ethics. As current faculty lack expertise in this area we will investigate the possibility of collaborating with the Theology faculty to bring this piece into the curriculum.
2) Assess the interest of faculty from other departments in developing a series of 490-Special Topics courses that would incorporate an environmental module (Environmental Economics, Environmental History, Environmental Writing/Journalism, Environmental Philosophy/Ethics, Environmental Policy, Environmental Social Justice, Environmental Theology). Environmental science is an interdisciplinary field of study focused on understanding the natural processes of how the world works and also how humans interact with and affect it. This draws on aspects from the natural and social sciences as well as the humanities. The development of such courses will provide students in the major a greater opportunity to take courses outside of the natural sciences and study the social aspects related to the Environmental science major.

• Investigate the possibility of an Environmental Studies B.A. major – This major would have a sequence of core science courses but then have space for more electives in related social science and humanities courses. The creation of such a major would enable students that are passionate about environmental issues to remain in the field of their passion, but not be overwhelmed by the rigorous science course requirements of the traditional Environmental Science B.S. In addition, there is a growing demand for jobs within the environmental field which require a broad understanding of science but also have a greater emphasis on non-scientific technical skills such as writing, communication, planning, networking, GIS, etc. This would also provide a unique opportunity for interdisciplinary collaboration.

• Improve promotion of the Environmental Science B.S. major and work with Admissions staff to improve promotion materials. The enrollment in the program may increase with more active promotion of the program with relevant statistics and support.

• Promote the Au Sable program as a way for students to complete a semester of upper division electives (16 units) in 10 weeks of the summer and be able to move into an internship for their final (8th) semester, especially if there are ways to make more financial aid available for summer studies. This would allow students to fulfill the field immersion requirement of the program while at the same time gain important field experience and non-academic skills important for employment and/or graduate school in environmental science.

Program Level Analysis (MA/MS)

General Biology (MA/MS)

Grad-F1) Trend and Financial Analysis

New Graduate Admissions Funnel							
General Biology (MA/MS)	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Inquiries	N/A						
Share of PLNU Graduate inquiries							
Completed Applications	N/A					3	5
Share of PLNU Graduate Applications						*1.5%*	*1.5%*
Applicant Conversion Rate						**--**	**--**
PLNU Grad Applicant Conversion Rate						--	--
Admits	N/A					3	5
Share of PLNU Admits						*1.6%*	*1.5%*
Selection Rate						**sm**	**100.0%**
PLNU Graduate Selection Rate						*94.6%*	*96.8%*
sm = Cell sizes too small							

1. What does this data tell you about the external demand for your program? What does this say about the future viability of your program?

Most of the inquiries come directly to Dianne Anderson or to the Biology Department, so these numbers are not particularly reflective of external demand. Also admission is on a rolling basis with fall, spring, and summer admits, so focusing on only the fall does not provide a true picture of program admissions. We admitted 8 people in 2014 and another 8 in 2015, which is our typical enrollment (see Appendix B). While it is true that the selection rate is typically 100% each year, part of this is due to the fact that most applicants talk to the program director (D. Anderson) before applying; people who have an appropriate background and career goals that match with the program are encouraged to apply, while others are encouraged to seek out other programs, therefore, they do not apply. Since we have room for more qualified students than we have applicants, we normally accept all of the applicants, making our selection rate 100%.

New Graduate Admissions Yield							
General Biology (MA/MS)	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Admits	N/A					3	5
Matriculants						**2**	**3**
Share of PLNU Graduate Matriculants						*1.3%*	*1.3%*
Yield Rate						**sm**	**60.0%**
PLNU Graduate Yield Rate						*82.7%*	*72.3%*
sm = Cell sizes too small							

2. How does your yield rate (percentage of students who enroll at PLNU after being admitted) compare to the PLNU average? If your rate is more than 8 percentage points above the PLNU average, what factors do you believe are contributing to this positive outcome? If your rate is more than 8 percentage points below the PLNU average for more than one year, what factors do you believe are contributing to this difference?

Our yield rate fluctuates quite a bit from year to year since the number of students is so small. As stated above, we have a consistent enrollment of about 8 students per year. Our drop rate is 14% since the inception of the program (see Appendix B). Approximately half of those students dropped within 3 weeks of starting the program because they realized they were unprepared, or they dropped for financial reasons.

Enrollment							
Majors	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
General Biology (MA)	6	3	11	11	8	6	8
General Biology (MS)	19	13	6	8	9	12	11
Total Students	**25**	**16**	**17**	**19**	**17**	**18**	**19**
Share of PLNU Graduate Students	*2.3%*	*1.4%*	*1.6%*	*2.2%*	*2.1%*	*2.2%*	*2.1%*
Minors	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**	**Fall 2015**
Not applicable to graduate programs							
Major Migration of Completers*							
Not applicable for graduate programs							

3. What does this data tell you about the internal demand for your program? Does this raise any questions about the viability and/or sustainability of your program as it is currently configured? Explain why or why not. Are there any actionable strategies that you can do that might make a difference if your trends are in the wrong direction?

The demand for this program is low, but we have a steady pool of students every year. We initially attracted mostly middle school and high school teachers into the program, but many students are now using it as a post-baccalaureate degree. We carefully examined the costs of the program during prioritization, and concluded that we had made it highly efficient. Specifically, costs are controlled via alternate year courses, and by summer courses that are paid via faculty overload.

General Education and Service Credit Hour Production General Biology (MA/MS)				
	2011/12	**2012/13**	**2013/14**	**2014/15**
Total program student credit hours	117.0	107.0	99.0	94.0
Number of GE sections taught	Not applicable for graduate programs			
% of SCH that are GE				
Share of PLNU GE SCH				
Number of service course sections taught	Not applicable for graduate programs			
% of SCH that are service				
Share of PLNU service SCH				

4. What does this data tell you about how your program is impacted by the needs of GE and other academic disciplines? Does this raise any questions about the viability and/or sustainability of your program if these non-programmatic trends continue? Explain why or why not.

NA

Delaware Study Data Department Total												
	2010/11			2011/12			2012/13			2013/14		
Program Cost per SCH	**$244**			**$239**			**$237**			**$260**		
Benchmark Percentiles	$148	$194	$244	$153	$201	$235	$161	$198	$243	$174	$217	$266
Ranking	Medium-High			High			Medium			Medium		

5. We know that the following factors influence the Delaware cost per credit hour:
   - Large amount of GE and service classes taught by the program
   - The career stage of the program faculty (early career faculty are less expensive)
   - The number of elective courses in the program
   - The amount of unfunded load (faculty receiving more credit for a course than the number of units received by a student – e.g. 4 units of faculty load for teaching a 3 unit class)
   - The amount of release time associated with the program
   - Faculty members on sabbatical
   - The size of the department budget and the cost of specialized equipment

   Please reflect on your program's Delaware data in light of this information. In particular, what factors contribute to your program having a high (above 75th percentile), medium (50th-75th percentile), or low (below 50th percentile) ranking?

The Delaware data reflect mostly the undergraduate costs, and are discussed elsewhere.

6. Recognizing that not all factors above are under departmental control, what kinds of adjustments might be made to reduce the cost per student credit hour?

The Delaware data reflect mostly the undergraduate costs, and are discussed elsewhere.

***** Future *****
Financial Data: (possibly delayed to the future)
Extra Revenue Generated by Program (lab fees, studio fees, etc.)
Extra Revenue per student credit hour
Extra Costs for the program (equipment not purchased outside of department budget, etc.)
Extra costs per student credit hour
Modified Delaware values: Delaware – extra revenue per SCH + extra costs per SCH

7. Do these modified Delaware values tell you anything new about the future viability and/or sustainability of your program as it is currently configured? Please explain.

NA

Grad-F2) Findings from Assessment

Links to the department's assessment wheel
• Student Learning Outcomes • Curriculum Maps • Assessment Plan • Evidence of Student Learning • Use of the Evidence of Student Learning

Reflection on longitudinal assessment of student learning data:

1. What have you learned from this program's student learning assessment data?

The assessment strategy for the Master's Program in Biology is quite different from the strategy for the undergraduate programs. First of all, we have rolling admission, not a cohort model. Second, almost every course can be taken in any sequence. The program was purposely developed in this fashion in order to accommodate the needs of working adults. Thus, most of the assessment is summative and is accomplished through a comprehensive exam for the MA and through a thesis for the MS. Due to the nature of graduate work and the summative assessment, we expect 100% of the students to achieve at a "developed" or higher level on these tasks, and they have performed accordingly. Specifically, 100% of the students achieved at this level for
PLO1: discussing major concepts and theories in biology (n=17, 2002-2015),
PLO2: carrying out and communicating various experimental methods and types of data analysis (n=17, 2002-2015), and
PLO3: demonstrating knowledge and skills in critical thinking (n=17, 2002-2015).
These data are not surprising since students who cannot handle the work of the Master's Program drop out.

The final PLO is for students to distinguish between science and faith, and discuss the potential compatibility of the two domains. This is assessed via an alumni survey question where we expect at least 80% of students will "strongly agree" that they are able to do this. In a June 2015 survey only 35% strongly agreed with the statement, while 57% agreed with the statement. The survey was sent to 28 students who graduated within the last 5 years, and 50% of those students responded. While this is a small data set, it suggests that a more intentional and explicit effort needs to be made to be sure that this PLO is met in the future. Two new signature assignments with rubrics were thus implemented in Fall 2015 in BIO 633 (History & Philosophy of Science) to address this learning outcome.

2. What changes (curricular and others) have you made based on the student learning assessment data?

As mentioned above, we just implemented two new signature assignments in BIO 633 (History & Philosophy of Science) to better assess whether students are able to discuss compatibility between the domains of science and faith.

Other significant changes to the program that we have made since its inception include:
In 2008, we changed the unit structure of the summer intensive laboratory courses to a 3 unit structure, and also changed the content of the courses such that there were 6 options for students to take.
In 2012, we further expanded the summer course offerings to 8 courses on a 4-year rotation (two per summer).
In 2015, we deleted the MA option and are now offering MS-thesis and MS-non-thesis.

All of these changes were in response to student feedback, and also to comparisons to other Master's Programs in Biology in the United States.

3. What additional changes are you recommending based on your review of the student learning assessment data?

No additional changes are recommended.

DQP Outcomes with Scores
***** TBD *****
DQP Definitions
Intellectual Skills Intellectual Skills define proficiencies that transcend the boundaries of particular fields of study: analytic inquiry, use of information resources, engaging diverse perspectives, ethical reasoning, quantitative fluency, and communicative fluency.
Specialized Knowledge What students in any specialization should demonstrate with respect to the specialization, often called the major field. All fields call more or less explicitly for proficiencies involving terminology, theory, methods, tools, literature, complex problems or applications and cognizance of limits.
Applied and Collaborative Learning Applied learning suggests what graduates can do with what they know. This area focuses on the interaction of academic and non-academic settings and the corresponding integration of theory and practice, along with the ideal of learning with others in the course of application projects.
Broad and Integrative Knowledge Students integrate their broad learning by exploring, connecting and applying concepts and methods across multiple fields of study to complex questions—in the student's areas of specialization, in work or other field-based settings and in the wider society.
Civic and Global Learning Civic and Global Learning proficiencies rely principally on the types of cognitive activities (describing, examining, elucidating, justifying) that are within the direct purview of the university, but they also include evidence of civic activities and learning beyond collegiate settings. These proficiencies reflect the need for analytic inquiry and engagement with diverse perspectives.

Reflection on DQP related data:

Understanding that the DQP framework provides one particular lens on the meaning, quality and integrity of your curriculum, reflect on the DQP data and framework provided for your program.

4. What have you learned from this program's DQP comparison?

This program readily meets the five outcomes of the DQP. First, specialized knowledge is the core of the program, and each class involves learning both the major theories and challenges pertaining to each specialized area of biology and education. Second, broad integrative knowledge is developed as students address problems crossing the lines between the major subject areas: education, philosophy, history, biology, and religion. Third, students have ample opportunities to hone their quantitative skills in lab courses in which they collect, graph, and analyze data as well as synthesize concepts from the primary literature. Fourth, each student designs and carries out a small original research project that requires them to apply the theories that they have learned to real people in real settings. For the graduate students who are currently teaching, this typically means that they have the opportunity to do a project with their own students to study some aspect of teaching and learning biology. This project allows them to connect their classroom learning with their professional life in deeply meaningful and important ways. Finally, since most of the graduate students have been teachers, there are many opportunities to apply what they are learning to education, both in their own classrooms, as well as to discuss educational issues at a state and national level, particularly in terms of biology content standards. In addition, since this is a biology program, environmental issues are addressed in several of the courses in the form of global climate change, genetic modification of organisms, and concerns related to loss of biodiversity.

5. What changes (curricular and others) have you made based on the DQP comparison?

None.

6. What additional changes are you recommending based on your review of the DQP comparison?

None.

Links to stakeholder assessment data (if present this will be department housed data)
• Surveys • Focus Groups • Market Analysis • Etc…

Reflection on stakeholder feedback data:

7. What have you learned from this program's stakeholder assessment data? If you do not have stakeholder data, please provide a plan for how you will regularly collect this in the future.

An alumni survey will be conducted every three years, with the first one conducted in 2015. The alumni were surveyed in order to get informal feedback as to how they thought they were meeting the program outcomes. As discussed above, the only outcome that students felt they were not meeting well related to science/faith issues. In addition to the alumni survey, we regularly gather informal feedback via yearly dinners with both current students and alumni. Since the program is small, the benefit is that we have intensive contact with each student.

8. What changes (curricular and others) have you made based on the stakeholder assessment data?

As mentioned above, we made the following changes to the program: In 2008, we changed the unit structure of the summer intensive laboratory courses to a 3 unit structure, and also changed the content of the courses such that there were 6 options for students to take. In 2012, we further expanded the summer course offerings to 8 courses on a 4-year rotation. In 2015, we deleted the MA option and are now offering a MS-thesis option and MS-non-thesis option with a comprehensive exam. All of these changes were in response to student feedback, and also to comparisons to other Master's Programs in Biology in the United States.

9. What additional changes are you recommending based on your review of the stakeholder assessment data?

No additional changes are recommended.

Grad-F3) Curriculum Analysis

In looking at your curriculum, the program review process is asking you to analyze it through three different lenses. The first lens is looking at your content and structure from the perspective of guild standards or standards gleaned from looking at programs at comparator institutions. The second lens that of employability and is asking you to look at your curriculum and educational experiences from the perspective of skills and professional qualities that you are developing in your students that will serve them will in their future work and vocational callings. The third lens is that of pedagogy and is asking you to look at the delivery of your curriculum to ensure a high quality student learning experience.

Menu and Elective Unit Analysis General Biology (MA/MS)		
Number of menu and elective units required by the program	MA	N/A
Number of menu and elective units offered by the program		
Menu/Elective Ratio		
Number of menu and elective units required by the program	MS	N/A
Number of menu and elective units offered by the program		
Menu/Elective Ratio		
Longitudinal Class Section Enrollment Data		
• Link to Class Section Enrollment Report		

Comparison of current curriculum to guild standards and/or comparator institutions.

If your guild standards are associated with a specialized accreditation that your program has, these should be the basis of your analysis. If your guild standards are associated with specialized accreditation that we do not have, then you should primarily use comparator institutions as the basis for your analysis.

If your guild has standards that are not associated with specialized accreditation, then you may choose to use those standards and/or comparator institutions.

After consultation with your Dean, provide the set of guild standards or a list of the comparator institutions that you are using in your analysis.

If using guild standards:

1. Please provide a list of the guild standards that you are using to evaluate your curriculum.

   NA

2. Indicate if and how your curriculum satisfies the standards (this can be done in a table or narrative form). If applicable, indicate areas where your curriculum falls short of the standards.

   NA

Based on the analysis of standard and reflection on the menu and elective ratio above, consider and discuss the following questions:

3. Are there courses in your program that should be modified? Why or why not.

   NA

4. Are there courses that should be eliminated? Why or why not.

NA

5. Are there courses that could be merged? Why or why not.

NA

6. Are there courses that should be added? Why or why not. Note that in general, in order to create the space to add a new course, another course will need to be eliminated or taught less frequently.

NA

7. What did you learn about your overall curricular structure in terms of its complexity, breadth and depth in light of the guild standards and our institutional size and scope? Are there any structural changes that need to be made in light of your analysis (e.g. sequencing of courses, % and or grouping of electives, overall units required, use of concentrations, etc…)?

NA

If using comparator institutions:

1. Begin by working with your Dean to identify a list of 5-8 comparator schools to use. In selecting schools, consideration should be given to type of institution, mission of the institution and the number of students majoring in the program.

Programs similar to PLNU's MS in general biology (part-time M.S. programs in biology that are not completely online) are rare, and no similar programs at Christian colleges have been located. Thus, we are using the following programs, as they are most similar to ours: Institution 1: Washington University, St. Louis – M.S. in Biology for Science Teachers Institution 2: University of Arizona – M.S. in Natural Sciences for Teachers (Biology track)

Gather the curricular requirements for the program in question at each of the comparator institutions.

2. Use this collection of curricular requirements to develop a list of curricular features that are essential for programs of this type. In addition, make note of any innovative or creative curricular feature that may be useful in enhancing the quality of you program.

	Washington University, St. Louis	University of Arizona	PLNU
Name of program	Master of Science in Biology for Science Teachers https://ucollege.wustl.edu/node/1278	Master of Science in Natural Science for Teachers (formerly General Biology Program for Teachers) https://grad.arizona.edu/programs/programinfo/NSTMSBLGY	Master of Science in General Biology
Program purpose	Designed for working teachers	Designed for working teachers	Designed for working teachers
Online/hybrid/ traditional format	Online courses (4.5 credits each semester) during the school year, with three 2 credit courses in-residence each summer during a 3-week timeframe	Fully online program with tracks in chemistry and biology	10 units hybrid format courses during school year, 12 units in-person lecture/lab format in summers, 12 units elective in a variety of formats
# of units	30 credits	32 credits	34 units
Typical time to completion	2 years (including 2 summers)	Can't determine from website	2 years (2 years with 3 summers)
Completion options: Thesis, project, exam	Two capstone courses requiring the development of action research related to their own teaching	Thesis (2 units of credit)	Thesis in biology education or comprehensive exam and 6 additional units
Types of courses	All courses are biology content except for 2 capstone (project) classes and one class on use of case studies	BIOC 570 Applications of Cell & Molecular Biology for Teachers BIOC 571 Ecological Principles for Teachers STCH 510A Learning in the Sciences STCH 510B Assessment in the Sciences Biological Research (6 units of credit) Electives (12 units of credit)	10 units of research design, science education and history/philosophy of science, 12 units of biology content courses, 12 units of electives that may include a 6-unit thesis
Cost	$12,350/year (Including summer housing) $11,250/year (not including summer housing)	Can't determine, but other programs range from $800-1150/unit	$705 x 34 units = $23,970 at 2017 tuition rates

Review this list with your Dean before using it to analyze your own curriculum.

3. Indicate how your curriculum compares to the list of curricular features from your analysis (this can be done in a table or narrative form).

Information is included in the table above.

Based on the analysis of comparator programs and reflection on the menu and elective ratio above:

4. Are there courses in your program that should be modified? Why or why not.

Since the student population appears to be changing from mostly teachers or future teachers, to approximately 50% with a variety of backgrounds and career goals, the science education course (BIO 611) could possibly be made more useful with a change from the current focus on learning theory to a broader examination of current topics in science education.

5. Are there courses that should be eliminated? Why or why not.

No. The content of each course is unique, and all of our courses except for one elective typically have 15-20 students, so they are economically viable.

6. Are there courses that could be merged? Why or why not.

No. The content of each course is unique, and all of our courses except for one elective typically have 15-20 students, so they are economically viable.

7. Are there courses that should be added? Why or why not. Note that in general, in order to create the space to add a new course, another course will need to be eliminated or taught less frequently.

No. The current curriculum provides students with a solid core, but also provides enough choices so that they can customize their program based on their interests and career goals.

8. What did you learn about your overall curricular structure in terms of its complexity, breadth and depth in light of the comparator schools and our institutional size and scope? Are there any structural changes that need to be made in light of your analysis (e.g. sequencing of courses, % and or grouping of electives, overall units required, use of concentrations, etc…)?

Our program is unique in terms of the chance for students to have relatively extensive instruction in biology in both lab and lecture/discussion settings. The breadth of curriculum is comparable to others, and the program in similar in size to the others.

Burning Glass Skills Data **General Biology (MA/MS)**
Data not available for graduate programs

Analysis of the curriculum against preparation for employment

9. The Burning Glass data provides a list of skills for students entering common professions that are often linked to your major. Indicate in the table if and where each skill is being taught in your program. Based on reflecting on this data, are there changes you would recommend making to your curriculum?

NA

10. Some programs may serve to prepare students with professional qualities and skills that can serve them well in a great variety of professions that may not show up in data sets like Burning Glass. If this is indicative of your program, please identify the unique skills and/or professional qualities that your program develops in your students and indicate where in the curriculum this is being taught or developed.

NA

Analysis of the teaching of your curriculum

11. How do the pedagogical features of your program compare with the best practices for teaching in your discipline?

As described earlier in this document, the Biology Department has adopted the national call to reform undergraduate biology education as promoted by the National Science Foundation (NSF) and the American Association for the Advancement of Science (AAAS) in 2011. The document, titled "Vision and Change in Undergraduate Biology Education: A Call to Action," argued for a transition from faculty-centered education to student-centered education. While this report was written with undergraduate biology education in mind, this document has also greatly influenced the graduate courses. As a department, we have chosen the guidance in this document as our benchmarks for best practices in the discipline, including the graduate program. All of our graduate courses are student-centered in terms of having the students take a large responsibility for their learning by reading, analyzing, and comparing primary sources, textbook materials, and their own data. A variety of active learning approaches are used during in-person class sessions that are "interactive, inquiry-driven, cooperative, collaborative, and relevant" (Vision and Change, 2011). In short, our courses are designed with student learning in mind rather than faculty teaching in mind. One approach to accomplishing a student-centered classroom is by way of what is commonly referred to as "scientific teaching", or sometimes "backward design." This strategy for designing a course starts not with the teacher's favorite topics or what they will say in class. Instead, careful time and attention are given to developing and precisely articulating learning outcomes. Once the learning outcomes are clear, the teacher designs the best activities to promote student achievement of the outcomes, as well as the best assessments. PLNU Biology Department faculty members have been proactive in learning new techniques for student-centered teaching. We have three Ph.D.-trained science educators in our department; these three professors teach all of the required graduate courses in History & Philosophy of Science, Research Design, Pilot Study, and Science Education Seminar. Many of us have attended workshops on active learning, such as the National Academies Summer Institute on Undergraduate Education in Biology offered by HHMI and NSF. We participate in a twice-monthly Faculty Learning Community focused on teaching in the STEM disciplines. Many of us take advantage of (and sometimes help lead) training opportunities offered by the Center for Teaching and Learning, such as the hugely successful Teachers Noticing Teachers program. We meet every Thursday for lunch to discuss teaching issues, and have read books (e.g., Scientific Teaching by Handelsman et al.) and journal articles (e.g., Active Learning Increases Student Performance in Science, Engineering, and Mathematics by Freeman et al. PNAS 2013) together on active learning. Some of the student-centered teaching techniques recommended in the Vision and Change document include authentic research experiences, case studies, immediate feedback assessment technique, personal response systems, inquiry-driven learning, concept mapping, peer-led team learning, problem-based learning, process-oriented guided inquiry learning, and team-based learning. We have already implemented many of these techniques and are in the process of experimenting with others.

12. What new pedagogical practices have been tried by members of your department in the last few years? What has your department learned from these experiments?

Included in answer above.

13. Are there new developments in pedagogy in your discipline? What would be required to implement these changes in pedagogy in your department?

Included in answer above.

Grad-F4) Potential Impact of National Trends

Top Burning Glass Occupations for the Program General Biology (MA/MS)		
Occupation	**Hiring Demand**	**Salary Range**
Data not available for graduate programs		

Note that some programs do not have as many professions listed in the Burning Glass data as others do. In these cases we will want to get a list of professions from the chair/school dean to supplement the Burning Glass data.

1. Which professions in the Burning Glass data were you already aware of and for which are you already intentionally preparing students and does the hiring demand in these professions signal anything about the future that you need to be aware of regarding the design and structure of your program ?

NA

2. Are there additional professions in the Burning Glass list or from your knowledge of occupations your alumni have entered, for which you should be preparing students?

No.

3. What changes in your program would be necessary in order to prepare students for the skills and professional qualities needed to succeed in these additional professions?

NA

4. Are there national trends in higher education or industry that are particularly important to your discipline? If yes, how is your program reacting to those trends?

Since many of our graduate students will be teaching at some level, it is vital that they experience the kinds of teaching promoted by the Vision & Change document described earlier, and this is current practice in the program.

Grad-F5) Quality Markers

Graduation Rates							
	Matriculation Term						
General Biology (MA/MS)	**Fall 2008**	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**
Graduation Rate *PLNU Grad Student Graduation Rate*	Data is not available						
Degree Completions							
Majors	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
General Biology (MA)	1	1	5	2	5	5	4
General Biology (MS)	4	4	3	6	0	3	3
Total Master's Completions	**5**	**5**	**8**	**8**	**5**	**8**	**7**
Share of PLNU Master's Degrees	*1.6%*	*2.0%*	*3.3%*	*3.2%*	*1.6%*	*3.4%*	*3.0%*
Time to Degree *(in semesters)* *PLNU Graduate Time to Degree*	Data is not available						
Study Abroad Participants	Not applicable for graduate programs						

1. Based on comparing the quality marker data for your program with the PLNU averages:
   a. What does this tell you about your program?

Nearly all of the students who complete their first semester in the program successfully graduate, although some students take considerably longer to finish than others. This reflects the quality of the program, the incredible support of students by the faculty, and the application/interview process that results in candidates who are capable of succeeding.

   b. If your values are below the PLNU averages, what changes could you make to address any areas of concern?

NA

   c. If your values are above the PLNU averages, what do you believe contributes to this success?

NA

2. Describe regular opportunities for students to apply their knowledge (internships, practicums, research projects, senior projects, etc.). Estimate what percentage of your students in this program participates in these kinds of opportunities.

All students complete and defend a small original research project on some aspect of teaching and learning in biology as part of BIO282, Pilot Study. In addition, almost every student completes at least one teaching internship in a college biology lab, usually at a community college. This internship experience is extremely valuable as many of the students are considering teaching community college biology courses after graduation. Approximately 25% of our students complete a major thesis project (6 units) involving designing and carrying out original research on teaching and learning in biology.

3. Describe any public scholarship of your undergraduate and graduate students in this program (conference presentations, publications, performances, etc.). What percentage of your undergraduate students are involved in these kinds of activities?

Approximately 25% of our graduate students complete thesis projects, and all of them either submit an article (coauthored with their thesis advisor) to a publication such as American Biology Teacher, or prepare and give a presentation at a conference such as the annual California Science Education Conference.

4. How many of your students participate in study abroad opportunities in general? Describe any study abroad opportunities specifically organized by your program. What percentage of your majors are involved annually (annualize the number)? How many students outside of your department participate in this departmentally organized program (Annualize the number)?

NA

5. What are any other distinctives of your program? Describe how they contribute to the program's success.

Our program is unique in several ways. First, it is a part-time program scheduled so that working professionals, particularly teachers, can complete it. Second, it is a program that addresses many aspects of biology, rather than focusing on a particular area such as molecular biology or ecology. Third, it is a highly flexible program in terms of both speed of completion and choices of elective units. Fourth, there is an emphasis on the relationship between faith and science unlike any other program that we are aware of in the United States. Finally, almost all of the courses are taught by full-time faculty. For all of these reasons, the program is a wonderful opportunity for students who are balancing the challenges of work and family to complete a rigorous graduate education in biology that can prepare them well to work in a variety of settings.

6. Does your program have an advisory board? If so, describe how it has influenced the quality of your program? If not, could it benefit from creating one?

NA

7. Describe any current joint interdisciplinary degrees (majors or minors) offered by your department. Are there additional areas where interdisciplinary programs should be considered?

NA

8. Describe your success with students acquiring jobs related to their discipline.

While many of our students who currently hold teaching positions plan to continue on in those positions, other students have successfully moved from middle school to high school teaching, or from high school teaching to community college teaching. Other students without teaching experience have been hired as adjunct professors at community colleges following graduation, due in large part to the internships at community colleges that they completed as a part of our program.

9. Describe your undergraduate and graduate student success rate for passing licensure or credentialing exams (if they exist in your discipline).

NA

10. Describe your success with undergraduate student acceptance into post-baccalaureate education.

While we currently have two students planning to apply to dental school following our program, only one other alum has been interested in further programs, and he completed optometry school.

11. What kind of support does your program provide for students encountering academic difficulties? How do you intentionally facilitate these students' connection with institutional support services?

Students with academic difficulty are tracked by the program director (D. Anderson), and are contacted 2-3 times during each semester to ask what kind of help (if any) they need. In general, encouraging students to study with other students or to contact the professor with questions is all that is ever required. The professors are also contacted directly to determine if additional tutorial or emotional support is needed, depending on the student's situation. While students do occasionally earn grades of B- or C, this is rare and does not become a pattern.

Grad-F6) Infrastructure and Staffing

Full-Time Faculty Program Contribution General Biology (MA/MS)			
	2012-13	**2013-14**	**2014-15**
Percentage of Grad classes taught by FT faculty	60.0%	100.0%	100.0%
PLNU percentage of grad classes taught by FT Faculty	*TBD*	*TBD*	*TBD*
Includes: regular lectures, labs, seminars Excludes: independent studies, private lessons, internships			

1. Are your program's current technological resources and support adequate? If not, what is needed? Do you foresee any additional needs in this area?

At present our technological resources and support are superior with the recent addition of the Latter Hall classrooms and Sator Hall laboratories. Our current needs are well met; however, instrumental technology is continually evolving. The faculty actively pursues grants to support these needs. In addition, administration has been supportive of many of these changing needs as well. We need this continued support to provide our graduates with the most up-to-date education and experiences to be truly competitive. (Note: This is the same answer as for all of the Biology programs.)

2. Are your program's current facilities adequate? If not, what is needed? Do you foresee any additional needs in this area?

The classrooms and facilities in the new building are wonderful and adequate, as long there is stable enrollment in the Nursing, Allied Health, and Biology programs. Our office space is not adequate. Cho is in MICS space, which he will soon need to vacate. Koudelka is in a trailer outside the building. We thus need a minimum of two more offices. (Note: This is the same answer as for all of the Biology programs.)

3. Is your program's current staffing (administrative, clerical, technical and instructional) adequate? If not, what is needed? Do you foresee any additional needs in this area?

Staffing is adequate for the graduate program. Dianne Anderson, April Maskiewicz, & Jen Lineback, who have their PhD in Science Education, regularly teach in the program. Other departmental faculty have taught or will soon teach in the intensive laboratory summer classes, including Dave Cummings, Dawne Page, Kris Koudelka, Walter Cho, Kerri Sevenbergen, and Mike Dorrell.

Grad-F7) Challenges and Opportunities

1. Are there any particular challenges regarding this program that have not been addressed through the analysis and reflection on data or questions in sections F1-F6 that you would like to include here?

The quality of the program is strong, and alumni consistently and enthusiastically recommend the program to others. Our main challenge is in attracting a sufficient number of students. While we have had a stable enrollment of 8 or 9 new students each year since 2011, we have capacity for 12 each year giving current staffing levels. Promoting the program as a part-time general biology master's degree appropriate for a variety of careers, rather than having a teaching emphasis, may attract more students.

While we have considered converting the hybrid courses offered during the fall and spring semesters to fully online courses to attract more students from locations outside southern California, our current students have strongly disapproved of this potential change, since they view the monthly personal contact as a program feature that attracted them, and that a shift to fully online courses would diminish the program quality.

2. Are there any particular opportunities regarding this program that have not been addressed through the analysis and reflection on data or questions in sections F1-F6 that you would like to include here?

No.

Grad-F8) Recommendations for Program Improvement

List the recommendations you are making regarding this program analysis with a brief rationale for each recommendation.

No recommendations. We have been consistently modifying the program since its inception in response to student feedback and also to comparisons to other Masters Programs in Biology in the United States.

Departmental Level Synthesis

G) Synthesis of Program Recommendations

Please create a combined list of program recommendations and rank order that list according to the department's priorities. Please provide a brief rationale for the ranking.

1) Provide 1 unit of load release per year for an internship coordinator who will interact with students in all of the undergraduate Biology programs. Since this recommendation affects all of the programs it is first in our ranking.
2) Make the following interlinked changes to the Environmental Science – BS major, of which we note that this is its first program review since its inception:

- Drop the PHY141/142 (or PHY241/242) requirement (8 units)
- Add a required course in GIS (Geographical Information Systems) (3 units)
- Add a required course in Environmental Chemistry (4 units)

3) In order to make the changes above, we request 4 units of load release for Walter Cho to develop the GIS course, and 4 units of load release for Tracy Shalnat to develop the Environmental Chemistry course. (These courses cannot be developed without load release as they will require significant research to develop. For example, Walter will need to take a course in GIS before developing the PLNU course.)
4) The other changes proposed are minor APC changes that can easily be accomplished, e.g. add BIO490 to the list of Biology-BA upper-division electives, add POL290 and BUS475 to the Public Policy and Stewardship electives for the Environmental Science-BS program.
5) Explore offering an interdisciplinary Environmental Studies – BA with the humanities departments on campus. This recommendation would require administrative support from both Holly Irwin and Jim Daichendt.

H) Action Plan Considerations for MOU

Review your prioritized recommendation list with the Dean and in partnership with the Dean develop a draft action plan and timeline to be considered as part of the MOU.

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Dean Level

I) **Compliance Checklist**

In addition to the Dean roles above, The Dean will be responsible to evaluate and generate a brief report on the following areas to be included with the self-study that is sent to the PR committee and external reviewers.

Check the Academic Unit's Assessment Wheel for each program:

1. Do they have learning outcomes? Are they adequate? Are they up to date?
2. Are their syllabi posted? Are they up to date?
3. Do they have course learning outcomes? Are they adequate? Are they up to date?
4. Do they have a curriculum map? Is it adequate? Is it up to date?
5. Do they have a multi-year assessment plan? Is it adequate? Is it up to date?
6. Do they have methods of assessment? Are they adequate? Are they up to date?
7. Do they have direct methods of assessment? Are they adequate? Are they up to date?
8. Do they have evidence of student learning? Are they adequate? Are they up to date?
9. Have they established the criteria of success? Are they adequate? Are they up to date?
10. Have they analyzed their findings? Are they adequate? Are they up to date?
11. Have they made changes based on evidence? Are they adequate? Are they up to date?
12. Credit Hour: Are the courses in the program in compliance with credit hour expectations?
13. Does the department have evidence posted on the assessment wheel for the Core Competencies?

When complete, the Dean signs off on the self-study as being ready to submit to the Program Review Committee and external reviewers (if no outside accreditation exists)

Program Review Committee and External Review

Once the Self-Study is ready, send it to the chair of the Program Review Committee and the Dean approved External Reviewers for their consideration. The Program Review Committee will incorporate the external reviewer feedback into a combined report that will go back to the Dean and Academic unit for their response. The academic unit leader, the Dean and the Provost will finalize an MOU with action plan for cabinet approval. The self-study, the compliance checklist, the PR committee report, the departmental response and the cabinet-approved MOU will comprise a completed program review.