Program: Biology-Chemistry B.S. (BCHM)

Learning Outcome: PLO1: Demonstrate an understanding of the process of science and of the concepts and theories of biology across a broad range of organizational levels: cellular, molecular, and organismal.

Outcome Measure: ETS Major Field Test in Biology

Criteria for Success: The overall group mean on the ETS exam will be ≥ 75th percentile and at least 50% of our students will have an overall score ≥ 60th percentile. Additionally, the same criteria established for the overall ETS score will be applied to each of the 3 sub-disciplines, which are 1) Cell, 2) Genetic & Molecular, and 3) Organismal.

Longitudinal Data:

	2015, n=9	**2014, n=16**	**2013, n=11**
Overall group mean	87th %ile	82nd %ile	93rd %ile
% above 60th %ile	67%	44%	73%
Cell Biology mean	87th %ile	93rd %ile	97th %ile
% above 60th %ile	67%	56%	91%
Genetics/Molecular mean	62nd %ile	83rd %ile	96th %ile
% above 60th %ile	57%	44%	73%
Organismal mean	75th %ile	78th %ile	88th %ile
% above 60th %ile	67%	50%	73%

Conclusions Drawn from Data: The Biology content knowledge of the BCHM majors is excellent. The difference in not meeting the criteria (gray numbers) is based on the performance of only 1-2 students in both 2014 and 2015, so it is probably not statistically valid.

Changes to be Made Based on Data: This year some of the BCHM majors did not take the ETS Major Fields Test because they were participating in the Chemistry Senior Seminar. We plan to ask these students to take the ETS exam next year, such that we will have a more complete set of data.

Rubric Used: ETS 2014 Comparative Data Guides – MFT for Biology

Learning Outcome: PLO2: Apply key concepts and principles in quantitative analysis, biochemistry, bioinorganic chemistry, organic chemistry, and physical chemistry (thermodynamics and kinetics).

Outcome Measure: ETS Major Field Test in Chemistry and Senior Exit Survey

Criteria for Success: The overall group mean on each subsection of the ETS exam (Analytical, Biochemistry, Inorganic, Organic, Physical) will be at or above the 50th percentile. At least 80% of students surveyed will feel prepared or better in meeting this PLO.

Longitudinal Data:

ETS – MFT Chemistry	2015, n=7*
Overall group mean	87th %ile
Analytical mean	81st %ile
Biochemistry mean	
Inorganic mean	85th %ile
Organic mean	83rd %ile
Physical mean	91st %ile

*Only includes BCHM majors who took Chemistry Senior Seminar. ETS-MFT Chemistry exam first administered in spring 2015.

Senior Exit Survey*	2015, n=7
% feel prepared or better in quantitative analysis	100%
% feel prepared or better in biochemistry	86%
% feel prepared or better in bioinorganic chemistry	100%
% feel prepared or better in organic chemistry	100%
% feel prepared or better in physical chemistry (thermodynamics and kinetics)	86%

*Senior exit survey first administered in Chemistry Senior Seminar during spring 2015.

Conclusions Drawn from Data: When looking at the data we see that in every case our students exceed the 50th percentile. We have not yet been able to collect data in Biochemistry from the MFT-ETS because this requires ETS to analyze the exams further and report back on this score. The student surveys yield positive results in each category.

Changes to be Made Based on Data: We will obtain data from the ETS on the biochemistry scores. The BCHM majors who participated in Biology Senior Seminar did not take the ETS-MFT Chemistry exam. We plan to ask these students to take the ETS-MFT Chemistry exam next year, such that we will have a more complete set of data.

Rubric Used: ETS Comparative Data Guides – MFT for Chemistry

Learning Outcome: PLO3: Use standard instrumentation and laboratory equipment to conduct scientific experiments and perform chemical characterization and analyses.

Outcome Measure: Faculty laboratory instructors' observation of students' use of various standard instruments in different courses (see below) and Senior Exit Survey.

GC: Chemistry 304 (Organic Chemistry II)
IR: Chemistry 304 (Organic Chemistry II)
UV-vis: CHE325 (Physical Chemistry I)

Criteria for Success: At least 80% of students will be able to use each of the various instruments with little or no guidance. At least 80% of students surveyed will feel prepared or better in meeting this PLO.

Longitudinal Data: Direct assessment using the rubric below will begin in 2015-2016 because this PLO was modified at the end of 2014-2015. With that being said, we are confident that all 2015 Biology-Chemistry B.S. graduates are able to use each of the various instruments with little or no guidance based on their course and lab curriculum and various positions as researchers or teaching assistants.

Senior Exit Survey*	2015, n=7
% feel prepared or better	100%

*Senior exit survey first administered in Chemistry Senior Seminar during spring 2015.

Conclusions Drawn from Data: At this point we have not officially collected data involving a direct measure of this outcome because this PLO was only recently added to our assessment plan. Indirect measures indicate we are successful in this PLO.

Changes to be Made Based on Data: Begin collecting direct measures for this PLO.

Rubric Used: The following scale will be used.

Instrument	**4**	**3**	**2**	**1**
GC (CHE304)	Able to use instrument independently.	Able to use instrument with little guidance.	Able to use instrument with guidance.	Unable to use instrument even with guidance.
IR (CHE304)	Able to use instrument independently.	Able to use instrument with little guidance.	Able to use instrument with guidance.	Unable to use instrument even with guidance.
UV-vis (CHE325)	Able to use instrument independently.	Able to use instrument with little guidance.	Able to use instrument with guidance.	Unable to use instrument even with guidance.

Learning Outcome: PLO4: Participate in the life of the Biology and/or Chemistry Department by involvement in one or more of the following areas: research, biology and/or chemistry clubs, and/or various positions of responsibility serving as graders, tutors, stockroom workers and/or teaching assistants.

Outcome Measure: Self-reported data of participation and Senior Exit Survey

Criteria for Success: At least 80% of our students will participate in one or more department related activities (research, science clubs, positions of responsibility) during their time at PLNU. At least 80% of students surveyed will feel prepared or better in meeting this PLO.

Longitudinal Data: 15 of the 16 BCHM majors (94%) participated in clubs or positions of responsibility (**criteria met**).

Data were not collected in 2014.

In 2013, of the 11 students who took the survey, 91% participated in one of these positions (**criteria met**).

Senior Exit Survey*	2015, n=7
% feel prepared or better	100%

*Senior exit survey first administered in Chemistry Senior Seminar during spring 2015.

Conclusions Drawn from Data: The BCHM majors are participating in the life of the department.

Changes to be Made Based on Data: No changes to the program.

Rubric Used: Not applicable to self-reported data.

Learning Outcome: PLO5: Develop a rationally defensible integration of science and faith.

Outcome Measure: During their senior year, students will defend the integration of their faith with various scientific topics via a written essay.

Criteria for Success: At least 80% of our students will achieve a score of 85% or higher on the science/faith integration essay. The essay will be scored with a rubric that considers science/faith integration, critical thinking, integration of concepts from other classes, written communication, and information literacy.

Longitudinal Data: 78% of the students (n=9) achieved a score of 85% or higher on the essay (**criteria almost met**). In 2015, we switched the rubric for this assignment, so data from previous years cannot be compared to the data from this year.

Conclusions Drawn from Data: The BCHM majors are able to develop a rationally defensible integration of science and faith. The scoring for this rubric needs to be improved, as this was the first year we used it. We need to assess our inter-reader reliability.

Changes to be Made Based on Data: No changes to the program.

Rubric Used: See attached.

Learning Outcome: PLO6: Be prepared for post graduate studies or a science-related career.

Outcome Measure: Tracking of alumni data regarding their postgraduate education and profession along with Senior Exit Survey.

Criteria for Success (if applicable): Success rates for alumni who apply for graduate or professional schools will be >75% and the percentage of graduates who obtain jobs in science-related occupations will be >70%. At least 80% of students surveyed will feel prepared or better in meeting this PLO.

Longitudinal Data:

1) The success rate for alumni who apply to graduate or professional schools has been well over 90% for at least 20 years. For dental, medical, optometry, pharmacy, and veterinary schools, there have been 166 acceptances out of 181 applicants (91.7%) between 2004 – 2014.
2) An alumni survey was conducted by the Biology and Chemistry Departments in January 2015 that included graduates from 2004 – 2014. 408 alumni were emailed and 115 responded (28% response rate). The lowest response rate was from the class of 2007 (7%). All other classes had a response rate of 21 – 42%, which is fairly typical of alumni surveys.
3) 32 BCHM majors responded (27% response). Of these alumni, 97% are employed or attending school in a Biology or STEM-related field (**criteria met**). 1 is applying to medical school.

Senior Exit Survey*	2015, n=7
% feel prepared or better	100%

*Senior exit survey first administered in Chemistry Senior Seminar during spring 2015.

Conclusions Drawn from Data: The BCHM majors are successful at obtaining jobs and entering graduate/professional schools.

Changes to be Made Based on Data: No changes to program.

Rubric Used: Not applicable to self-reported data. Survey instrument is attached.

Grading aspect	poor	developing	good	expert
Integration of science and faith (evolution or environmental stewardship)	There is no indication of personal reflection and thought into the integration of faith and science.	Some integration of science and faith. Evidence of clear and deep reflection is not very apparent, and the position taken is not well-defended.	Obvious evidence of reflection on the integration of science and faith, but the author is only marginally effective at defending his/her position.	→ deep personal reflection is evident → clear and well-defended position that merges faith and scientific reasoning (note: the exact position is not important, but rather the evidence of reflection, understanding, and ability to defend that position)
Critical thinking	Position is not defended There is no reference to any other position on this issue.	Position is weakly defended Other, perhaps conflicting, positions on this issue are mentioned, but are poorly addressed	Fairly strong support of the argument. Alternate positions are addressed and the author's own position is supported against these positions, full understanding of other positions was not apparent, and a strong argument against them did not emerge.	→ Issue is stated clearly → Position is well-supported with evidence and sources. → Alternate positions are clearly addressed in a manner that flows well with the author's argument → Clear arguments against these alternate positions using personal reflection and scientific information → Evaluation of altering positions demonstrate grace and understanding
Incorporation of concepts discussed in various classes while at PLNU	No concepts or discussions from PLNU classes are clearly included in the argument	Concepts and discussions from specific PLNU classes are part of his/her defendable position, but there is no reflection on how/if these have affected the author's position.	Concepts and discussion from specific PLNU classes are included and discussed appropriately, but these are not clearly interwoven into the author's defense and explanation of his/her own position or how this position has changed while at PLNU	→ Concepts from specific PLNU classes, including science and religion classes, are included as part of the author's reflection and defense of his/her position. → Includes a clear reflection of how the position has changed while at PLNU . If his/her position has not changed, essay still includes a clear explanation of why it did not change, that demonstrates personal reflection.
Written communication	Writing is very poor with several grammatical and spelling errors. No evidence of revision. (Essay is <800 words)	Writing is OK, but grammatical and spelling errors are still frequent. Further revisions are still required. Essay length does not provide for sufficient support.	Few grammatical and spelling errors are apparent in the writing. Writing shows evidence of revision, but the argument does not flow very well. Essay is of sufficient length	→ No, or very few, grammatical and spelling errors. → Essay flow is excellent with a clear introduction, argumentative reasoning, and a strong conclusion. → Writing effectively communicates with a college science audience. → sufficient length to make a good, complete defense (estimated ~1200 – 1600 words; can be less if essay is sufficiently and concisely supported)
Information literacy	Includes no appropriate sources. No in-text references.	Includes 1 – 2 appropriate sources. In-text references show little connection to the essay. Quotes are overly used or long.	Includes 3-4 appropriate sources. Includes some references in the text that are incorporated into the essay well.	→ Includes 4-5 or more appropriate sources, including sources of more than one type (websites, books, articles, etc.). → Includes substantial references in the text that enhance the essay and support the author's argument. → paraphrasing is done well, and quotes (when appropriate) are used correctly, but not overly frequently.

Chemistry Seminar Exit Survey 2015 (Biology-Chemistry Major)

1) What is your current career goal?
   a) Professor
   b) Teacher
   c) Health professional – please specify
   d) Biotechnology or pharmaceutical industry
   e) Academic or government lab
   f) Graduate student – please specify field or specialty
   g) Other – please specify

2) Rank how well prepared you were to meet the following program learning outcomes (goals) that were set for your major.

I. Students will demonstrate an understanding of the process of science, and of the concepts and theories of biology across a broad range of organizational levels: molecular, cellular, and organismal.
unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

II. Students will apply key concepts and principles in quantitative analysis.
unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

III. Students will apply key concepts and principles in biochemistry.
unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

IV. Students will apply key concepts and principles in bioinorganic chemistry.
unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

V. Students will apply key concepts and principles in organic chemistry.
unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

VI. Students will apply key concepts and principles in physical chemistry (thermodynamics and kinetics).
unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

VII. Students will use standard instrumentation and laboratory equipment to conduct scientific experiments and perform chemical characterization and analyses.
unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

VIII. Students will participate in the life of the Biology and/or Chemistry Department by involvement in one or more of the following areas: research, biology and/or chemistry clubs, and/or various positions of responsibility serving as graders, tutors, stockroom workers and/or teaching assistants.
unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

IX. Students will develop a rationally defensible integration of science and faith.
unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

X. Students will be prepared for post graduate studies or a science-related career.
unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

3) Were you involved in the PLNU chemistry summer research program?
   a) Yes – describe what role this experience played in your learning of chemistry
   b) No – describe why not

4) Do you have any suggestions related to the summer research program?

5) What were one or two aspects of the chemistry curriculum that might have been improved?

6) Do you feel prepared to take the next step academically?
   a) Yes – describe what experiences (classes) helped you to get there
   b) No – describe what additional or different experiences would have helped

7) If you were starting over as a freshman next fall, would you make any different decisions about your major, or about elective course choices, etc.?

8) Are there chemistry courses that PLNU does not offer that you would have liked to take?

9) Do you feel like you are a part of the chemistry department community? Why or why not?

Alumni Survey 2015

The Biology and Chemistry Departments are doing an extensive Program Review. We would greatly appreciate your feedback as a PLNU alum on your experience as a Biology or Chemistry major. This 15-question survey should take about 15 minutes to complete. If you provide your email address, we will also enter you into a drawing for one of three $100 Amazon cards as a thank you for your time!

1) What year did you graduate from PLNU?

2) What was your major?
   a) Biology-BA
   b) Biology-BS
   c) Chemistry
   d) Biology-Chemistry
   e) Environmental Science

3) What is your highest degree earned?
   a) BA/BS
   b) MA/MS
   c) PhD
   d) MD/DO
   e) PA
   f) DDS
   g) DVM
   h) OD
   i) PharmD
   j) Other – please specify

4) What is your current professional situation?
   a) Professor
   b) Teacher
   c) Health professional
   d) Biotechnology or pharmaceutical industry
   e) Academic or government lab
   f) Graduate student – please specify field or specialty
   g) Other – please specify

5) Rank how well we prepared you to meet the following goals that were set for your major. (Only PLOs for specified major selected in #2 will appear.)
   a) Unprepared
   b) Somewhat unprepared
   c) Prepared
   d) Well prepared
   e) Extremely well prepared

6) Were you involved in the PLNU biology or chemistry summer research programs?
   a) Yes – describe how this experience is impacting your career.
   b) No

7) Which classes or experiences do you appreciate more now as opposed to when you had just graduated?

8) Is there any course, topic, or skill you've repeatedly encountered that you wish you had been taught at PLNU? Please explain.

9) If you are pursuing a career in environmental science, do you wish you had substituted an internship experience for a science elective while you were at PLNU?
   a) I am not pursuing a career in environmental science.
   b) I did an internship.
   c) Yes, I wish I had done an internship while at PLNU.
   d) No, I did not need to do an internship while at PLNU.

   Comments?

10) Do you wish you had taken any of the following options at PLNU?
   a) BIO130/140 (Human Anatomy & Physiology)
   b) Upper-division anatomy class
   c) No, I didn't need an Anatomy class

   Comments?

11) What were one or two aspects of the biology curriculum that might have been improved to better prepare you for your profession or for further studies?

12) What were one or two aspects of the chemistry curriculum that might have been improved to better prepare you for your profession or for further studies?

13) Have you done any of the following? Check all that apply.
   a) Recommended PLNU to a prospective student
   b) Promoted PLNU to another person
   c) Been involved with the alumni association
   d) Donated to Research Associates
   e) Other – please specify.

14) Since you left PLNU, have you ever had a conversation in which you had to integrate Christian faith with scientific knowledge? Did you feel prepared scientifically? Did you feel prepared theologically? Check all that apply. Please describe the situation and your feelings about your preparation.
   a) I've never had such a conversation.
   b) I felt prepared scientifically.
   c) I didn't feel prepared scientifically.

d) I felt prepared theologically.
e) I didn't feel prepared theologically.

15) Since you left PLNU, have you made any decisions that were influenced by your knowledge of creation care and sustainability? If so, did you feel prepared to make those decisions from a scientific understanding of sustainability?
a) I do not tend to make decisions based on sustainability considerations.
b) I often feel unprepared to make those decisions as it is rarely clear to me which options would best benefit the planet.
c) I usually feel prepared to make those decisions as I am generally confident in my understanding of how my choices affect, and which options are best for, the planet.
d) I feel very comfortable in my scientific knowledge of how various decisions will affect the earth, either negatively or positively.

16) Please provide your email address to be entered into the drawing for an Amazon gift card. Your email address will not be associated with your responses on this survey.