Program: Chemistry B.S. (CHEM)

Learning Outcome: PLO1: Apply key concepts and principles in analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry.

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.

Aligned with DQP Learning Areas (circle one or more but not all five):

1. Specialized Knowledge
2. Broad Integrative Knowledge
3. Intellectual Skills/Core Competencies
4. Applied and Collaborative Learning
5. Civic and Global Learning

Longitudinal Data:

ETS – MFT Chemistry	2017, n= 4	2016, n= 5	2015, n=3	2014, n=0*	2013, n=9	2012, n=7
Overall group mean	78th %ile	53rd %ile	58th %ile	N/A	93rd %ile	90th %ile
Analytical mean	76th %ile	52nd %ile	42nd %ile	N/A	89th %ile	95th %ile
Biochemistry mean				N/A		
Inorganic mean	66th %ile	55th %ile	52nd %ile	N/A	94th %ile	86th %ile
Organic mean	76th %ile	49th %ile	60th %ile	N/A	88th %ile	79th %ile
Physical mean	81st %ile	69th %ile	76th %ile	N/A	93rd %ile	92nd %ile

*No graduating chemistry majors in 2014.

Senior Exit Survey*	2017, n=3	2016, n=5	2015, n=3
% feel prepared or better in analytical chemistry	100%	100%	100%
% feel prepared or better in biochemistry	100%	100%	100%
% feel prepared or better in inorganic chemistry	67%	100%	100%
% feel prepared or better in organic chemistry	100%	100%	100%
% feel prepared or better in physical chemistry	100%	100%	100%

*Senior exit survey first administered in spring 2015.

Conclusions Drawn from Data: It should be noted that no MFT-ETS exam was given in 2014 because we had no students who qualified to take it. When looking at the data we see that in every case but two, our students meet or exceed the 50th percentile. The scores in analytical were low (42nd percentile) in 2015 and the scores in organic were just below the criteria (49th percentile) in 2016. There is not anything particularly troublesome about these scores, however, when you consider that the analytical score came back above the criteria for success in 2016 and 2017 and previous years were stellar in this category. 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 except for inorganic chemistry in 2017, due to the small number of senior chemistry majors who completed the exit survey (n = 3).

Changes to be Made Based on Data: We will obtain data from the ETS on the biochemistry scores.

Rubric Used: ETS Comparative Data Guides – MFT for Chemistry

Learning Outcome: PLO2: 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)
GC-MS: Chemistry 453 (Advanced Organic Chemistry)
HPLC: Chemistry 370 (Instrumental Analysis)
IR: Chemistry 304 (Organic Chemistry II)
NMR: Chemistry 351 (Organic Structure Elucidation)
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.

Aligned with DQP Learning Areas (circle one or more but not all five):

1. Specialized Knowledge
2. Broad Integrative Knowledge
3. Intellectual Skills/Core Competencies
4. Applied and Collaborative Learning
5. Civic and Global Learning

Longitudinal Data:

% students able to use instrument with little or no guidance	2016-2017	2015-2016
GC CHE304	100% (n=3)	60% (n=5)
GC-MS CHE454	N/A	N/A*
HPLC CHE370	N/A	75% (n=4)
IR CHE304	100% (n=3)	100% (n=6)
NMR CHE351	N/A*	100% (n=8)
UV-vis CHE325	100% (n=3)	100% (n=6)

*CHE351 not offered in 2016-2017, CHE453 not offered in 2015-2016.

Senior Exit Survey*	2017, n=3	2016, n=5	2015, n=3
% feel prepared or better	100%	100%	100%

*Senior exit survey first administered in spring 2015.

Conclusions Drawn from Data: Direct assessment using the rubric below just began in 2015-2016 because this PLO was modified at the end of 2014-2015. 2016-2017 HPLC CHE370 data is not available because the instructor who taught the course is no longer at PLNU. The criteria for success were met on three (IR, NMR, UV-vis) of the five instruments that were assessed in 2015-2016 and three (GC, IR, UV-vis) of the three instruments that were assessed in 2016-2017. GC-MS was not assessed because CHE454 was not offered in 2015-2016 and the instrument was not used in 2016-2017. It is difficult to make conclusions without longitudinal data over a few academic years. The student surveys yield positive results in each category.

Changes to be Made Based on Data: We will continue to assess the use of the various instruments.

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.
GC-MS (CHE453)	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.
HPLC (CHE370)	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.
NMR (CHE351)	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: PLO3: Participate in the life of the Chemistry Department by involvement in one or more of the following areas: research, chemistry club, and/or various positions of responsibility serving as graders, tutors, stockroom workers and/or teaching assistants.

Outcome Measure: Data collection of student involvement in research, science clubs, and positions of responsibility and Senior Exit Survey.

Criteria for Success: At least 80% of our students will participate in three 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.

Aligned with DQP Learning Areas (circle one or more but not all five):

1. Specialized Knowledge
2. Broad Integrative Knowledge
3. Intellectual Skills/Core Competencies
4. Applied and Collaborative Learning
5. Civic and Global Learning

Longitudinal Data:

Student Involvement	2017, n=4	2016, n=5	2015, n=3
% participate in three or more department related activities	100%	80%	100%

Senior Exit Survey*	2017, n=3	2016, n=5	2015, n=3
% feel prepared or better	100%	80%	100%

*Senior exit survey first administered in spring 2015.

Conclusions Drawn from Data: The criteria for success have been met and CHEM majors are participating in the life of the department.

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

Rubric Used: Not applicable.

Learning Outcome: PLO4: Be prepared for post graduate studies or a science-related career.

Outcome Measure: Data collection of school acceptances or job offers prior to graduation, Senior Exit Survey, and Alumni Survey.

Criteria for Success (if applicable): At least 80% of our graduates will be accepted to graduate or professional schools or obtain jobs in science-related careers. At least 80% of alumni surveyed will be accepted to graduate or professional schools or obtain jobs in science-related careers. At least 80% of students surveyed will feel prepared or better in meeting this PLO.

Aligned with DQP Learning Areas (circle one or more but not all five):

1. Specialized Knowledge
2. Broad Integrative Knowledge
3. Intellectual Skills/Core Competencies
4. Applied and Collaborative Learning
5. Civic and Global Learning

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) 16 CHEM majors responded (44% response). Of these alumni, 81% are employed or attending school in a Chemistry or STEM-related field (**criteria met**).

Senior Exit Survey*	2017, n=3	2016, n=5	2015, n=3
% feel prepared or better	100%	100%	100%

*Senior exit survey first administered in spring 2015.

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

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

Rubric Used: Not applicable.

Chemistry Seminar Exit Survey 2017 (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 apply key concepts and principles in analytical chemistry.
unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

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

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

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

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

VI. 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

VII. Students will participate in the life of the Chemistry Department by involvement in one or more of the following areas: research, chemistry club, 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

VIII. 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.