CHEMISTRY (B.S.)

PLO Data for Chemistry: FA2019-SP2020

Program Learning Outcome 1

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 percentiles	2012 n=7	2013 n=9	2015 n=3	2016 n=5	2017 n=4	2018 n=5	2019 n=4	2021 n=6
Overall group mean	90th	93rd	58th	53rd	78th	42nd	64th	67th
Analytical mean	95th	89th	42nd	52nd	76th	23rd	57th	70th
Biochemistry mean	N/A	N/A	45th	52nd	64th	52nd	52nd	53rd
Inorganic mean	86th	94th	52nd	55th	66th	47th	65th	81st
Organic mean	79th	88th	60th	49th	76th	49th	59th	50th
Physical mean	92nd	93rd	76th	69th	81st	51st	71st	59th

*ETS-MFT not administered in spring 2020 due to COVID-19.
**No graduating chemistry majors in 2014.

Senior Exit Survey*	2015 n=3	2016 n=5	2017 n=3	2019 n=4	2021 n=4
% feel prepared or better in analytical chemistry	100%	100%	100%	75%	100%
% feel prepared or better in biochemistry	100%	100%	100%	75%	100%
% feel prepared or better in inorganic chemistry	100%	100%	67%	100%	100%
% feel prepared or better in organic chemistry	100%	100%	100%	100%	100%
% feel prepared or better in physical chemistry	100%	100%	100%	100%	75%

*Senior exit survey not administered in Chemistry Senior Seminar during spring 2018 or spring 2020 (COVID-19).

Conclusions Drawn from Data: When looking at the data we see that in most cases, our students meet or exceed the 50th percentile before 2021. However, there are some years where the numbers fluctuate (2015 and 2018) and in these years, the criteria for success are not always met. This can be explained by two main factors: 1- Sometime, we have weaker chemistry major students who have great lab skills but are not great test takers and 2- our number of chemistry major is still small (n=3-7) thus making general statistical analyses less reliable and more prone to drastic changes.

Changes to be Made Based on Data: There are no substantial changes that need to be made at this point. However, we need to make sure to give the ETS MFT exam at a time where students can take it seriously in order to obtain valuable information. Moreover, we hope to grow our number of majors and collect data that will be a little more valuable.

Rubric Used: ETS Comparative Data Guides – MFT for Chemistry

Chemistry PLO Data

Program Learning Outcome 2
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	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
GC CHE2096	60% (n=5)	100% (n=3)	100% (n=4)	100% (n=6)	COVID-19	COVID-19
GC-MS CHE4054	not offered	N/A	not offered	100% (n=9)	not offered	COVID-19
HPLC CHE3070	75% (n=4)	N/A	100% (n=3)	100% (n=5)	HPLC not working	COVID-19
IR CHE2096	100% (n=6)	100% (n=3)	100% (n=4)	83.3% (n=6)	COVID-19	COVID-19
NMR CHE3051	100% (n=8)	not offered	100% (n=7)	100% (n=3)	not offered	COVID-19
UV-vis CHE3025	100% (n=6)	100% (n=3)	100% (n=4)	100% (n=4)	COVID-19	100% (n=4)

Senior Exit Survey*	2015, n=3	2016, n=5	2017, n=3	2019, n=4	2021, n=4
% feel prepared or better	100%	100%	100%	100%	75%

*Senior exit survey not administered in Chemistry Senior Seminar during spring 2018 or spring 2020 (COVID-19).

Conclusions Drawn from Data: Direct assessment using the rubric began in 2015-2016 because this PLO was modified at the end of 2014-2015. The criteria for success were met on all six instruments that were assessed (GC, GC-MS, IR, HPLC, UV-vis and NMR) from 2015 until 2018-2019. Due to COVID19, instrument assessment in CHE 2096, CHE 3070, CHE 3051 could not be performed in the Spring 2020 because after Spring break, we went fully online and during Spring 2021, we offered face to face lab with half capacity students for half the time and as such could not assess these valuable skills. CHE 3025 (Physical chemistry) was the exception to the rule and the assessment showed that all our chemistry majors were able to successfully use the UV-Vis which is this context.

Changes to be Made Based on Data: We need to assess these skills in the Spring 2022 in order to decide if changes are needed. We will also be discussing more systematic ways to assess these skills and make sure they are done every year.

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.

Chemistry PLO Data

Program Learning Outcome 3
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	2015, n=3	2016, n=5	2017, n=4	2018, n=5	2019, n=4	2021 n=4
% participate in three or more department related activities	100%	80%	100%	80%	100%	100%

*Data not collected in spring 2020 due to COVID-19.

Senior Exit Survey*	2015, n=3	2016, n=5	2017, n=3	2019, n=4	2021 n=4
% feel prepared or better	100%	80%	100%	100%	100%

*Senior exit survey not administered in Chemistry Senior Seminar during spring 2018 or spring 2020 (COVID-19).

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

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

Rubric Used: Not applicable.

Chemistry PLO Data

Program Learning Outcome 4
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*	2015, n=3	2016, n=5	2017, n=3	2019, n=4	2021 n=4
% feel prepared or better	100%	100%	100%	100%	100%

*Senior exit survey not administered in Chemistry Senior Seminar during spring 2018 and spring 2020 (COVID-19).

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 2021 (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.