Environmental Science B.S. (ENVS)
Program Learning Outcomes, F2023-S2024

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, as defined by the Vision and Change nationally-validated set of core biology concepts (AAAS, 2011).

Outcome Measure: Bio-MAPS Assessment (https://cperl.lassp.cornell.edu/bio-maps)

Criteria for Success: The overall group mean on the exam will be ≥ 70% correct, and at least 50% of our students will have an overall score ≥ 60% correct. Additionally, the same criteria established for the overall ETS score will be applied to each of the 8 sub-disciplines, which are 1) Evolution, 2) Information Flow, 3) Structure/Function, 4) Energy & Matter, 5) Systems, 6) Cellular & Molecular Biology, 7) Physiology, and 8) Ecology and Evolution.

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

Longitudinal Data:

	2024, n=5	
	Mean % correct	**% of students scoring above 60%**
Overall group mean	68%	80%
Evolution mean	62%	60%
Information Flow mean	62%	80%
Structure/Function mean	74%	100%
Energy & Matter mean	65%	60%
Systems mean	68%	80%
Cell. & Molec. Mean	62%	80%
Physiology mean	65%	60%
Ecology & Evolution mean	79%	80%

Conclusions Drawn from Data:
This year we changed our assessment from the ETS major field test in Biology to the Bio-MAPS assessment. We wanted an assessment that is aligned with nationally-validated concepts in Biology, and that also measures overarching concepts instead of extremely specialized knowledge. The assessment goals were close to being met (see gray highlighting for goals that were not met). Interestingly, the goal for >50% of the students to have a score >60% correct was met in every sub-discipline. Further analysis revealed that the scores for one student pulled down the mean scores quite a bit.

Changes to be Made Based on Data: No changes are planned currently. However, we also tested our incoming freshmen with this assessment. The plan is to compare the scores of individuals from freshman year to senior year in order to assess the change in each sub-discipline. This information will allow us to specifically target sub-disciplines in which the pedagogy/content may need to be modified.

Learning Outcome: PLO2
Apply key concepts and principles in analytical chemistry including quantitative and instrumental analysis.

Outcome Measure: American Chemical Society (ACS) standardized exam in Analytical Chemistry and Senior Exit Survey

Criteria for Success: The overall group mean on the ACS Analytical Chemistry exam will be at or above the 35th 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

ACS Standardized Exam*	2024	2023	2022	2021	2020	2019	2018	2017
Analytical mean	Not assessed	Not assessed	Not assessed	COVID-19	COVID-19	28.4 out of 50, 56.8% (n=5)	27 out of 50, 54.0% (n=6)	28th %ile (n=5)

*ACS standardized exam in Analytical Chemistry not administered in spring 2020 due to COVID-19.

No ENVS majors took Chemistry Senior Seminar in 2015 – 2024, so there is no survey data.

Conclusions Drawn from Data: We did not use the ACS exam for this course so no data was collected.

Changes to be Made Based on Data: We have yet to find a better way to assess our students in CHE 2013 since the ACS exam does not seem to match with what is taught in the class.

Rubric Used: N/A

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 Chemistry 3070, Instrumental Analysis (see below) or Chemistry 4070, Environmental Chemistry

HPLC, ICP, IR, UV-vis: Chemistry 4070 (Environmental Chemistry) or CHE 3070 (Instrumental Analysis)

Criteria for Success: At least 80% of students will be able to use each of the various instruments with little or no guidance.

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	Fall 2024 (n=4)	Fall 2023	Fall 2022	Fall 2021	Fall 2020	Fall 2019
HPLC	100%	100%	100%	100%	COVID-19	HPLC not working
ICP	100%	100%	100%	100%	COVID-19	100% (n=4)
IR	Not assessed	100%	100%	100%	COVID-19	100% (n=4)
UV-vis	100%	100%	100%	100%	COVID-19	100% (n=4)

Conclusions Drawn from Data: Our students met the criteria for success.

Changes to be Made Based on Data: We do not need to make changes to the program as students are typically successful in using these instruments.

Rubric Used: The following scale will be used.

Instrument	**4**	**3**	**2**	**1**
HPLC	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.
ICP	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	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	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.

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:

	Number of students responding of total	% participated in life of dept	Criteria met?	Notes
Sp 2024	5 of 5	100%	Yes	
Sp 2023	5 of 5	100%	Yes	
Sp 2022	5 of 8	40%	No	
Sp 2021	5 of 5	60%	No	
Sp 2020	--	--	--	Survey not given (COVID)
Sp 2019	1 of 3	33%	No	Small sample size
Sp 2018	--	--	--	Survey not given
Sp 2017	3 of 4	75%	Almost	Small sample size

Conclusions Drawn from Data: In general, the ENVS majors are participating in the life of the department. However, with such small numbers of students, there is a lot of fluctuation from year to year.

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, particularly with regard to environmental stewardship.

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 score at a level of 3 or higher on the science/faith integration essay rubric, which considers both science/faith integration and critical thinking.

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:

	Number of students	% scoring 3 or above	Criteria met?	Notes
Sp 2024	5	100%	Yes	
Sp 2023	4	100%	Yes	Small sample size
Sp 2022	8	88%	Yes	
Sp 2021	2	100%	Yes	Small sample size
Sp 2020	3	67%	No	Small sample size
Sp 2019	4	100%	Yes	Small sample size
Sp 2018	2	100%	Yes	Small sample size
Sp 2017	4	100%	Yes	Small sample size

Conclusions Drawn from Data: The ENVS majors are able to develop a rationally defensible integration of science and faith.

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

Rubric Used: See attached.

BIO 4097 Grading Rubric for *Integration of Science & Faith* Essay (100 points)

Grading aspect	Capstone 4	Milestone 3	Milestone 2	Benchmark 1
Integration of science and faith (evolution or creation care) **0 -20 points**	☐ Deep personal reflection is evident ☐ Question for this assignment was clearly answered ☐ Clear statement of position. ☐ 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)	Meets 3 of the criteria for a Capstone 4. Comments:	Meets 2 of the criteria for a Capstone 4. Comments:	Meets 1 or none of the criteria for Capstone 4 Comments:
Critical Thinking **0 – 20 points**	☐ Issue is stated clearly & position is well-supported with evidence & sources. ☐ Alternate position(s) is/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 position(s) demonstrate(s) grace and understanding	Meets 3 of the criteria for a Capstone 4. Comments:	Meets 2 of the criteria for a Capstone 4. Comments:	Meets 1 or none of the criteria for Capstone 4 Comments:
Incorporation of concepts discussed in PLNU classes **0 – 20 points**	☐ Specific concepts from specific PLNU classes, including science and/or religion classes, are included as part of reflection and defense of 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.	Meets 1 of the criteria for a Capstone 4. Comments:		Meets none of the criteria for a Capstone 4. Comments:
Written Communication **0 – 20 points**	☐ 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 coll. sci. audience. ☐ Sufficient length to make a good, complete defense (1200 – 1600 words)	Meets 3 of the criteria for a Capstone 4. Comments:	Meets 2 of the criteria for a Capstone 4. Comments:	Meets 1 or none of the criteria for Capstone 4 Comments:
Information Literacy **0 – 20 points**	☐ Sources are current, authoritative, and relevant to the topic ☐ Communicates, organizes and synthesizes information from sources to achieve a specific purpose, with clarity and depth ☐ Use of in-text citations as well as the annotated bibliography ☐ Excellent choice of paraphrasing, summarizing, or quoting to enhance the essay and support the author's argument ☐ Distinguishes between common knowledge and ideas requiring attribution ☐ Source for the alternate view actually holds that viewpoint	Meets 3 of the criteria for a Capstone 4. Comments:	Meets 2 of the criteria for a Capstone 4. Comments:	Meets 1 or none of the criteria for Capstone 4 Comments:

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.

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.

2) In addition, an alumni survey is conducted by the Office of Institutional Research at PLNU every year. This survey is sent to alumni who graduated 5 years previously. These data are not disaggregated by specific degree, but are applicable to all Biology Department majors. The same can be said about Chemistry Department Majors and the data is shown in the table below.

Year of Summary	**2023** (Biology)	**2023** (Chemistry)	**2022** (Biology)	**2022** (Chemistry)
Population Surveyed	264	123	262	122
Response Rate	41%	39.8%	44%	41%
Year of Graduation	2014-2018	2014-2018	2012-2016	2012-2016
Employed Full-Time OR Currently in Graduate School Full-Time	82%	88%	85%	88%
Went to graduate school and graduated (of those who are employed full-time)	59%	63%	55%	67%
Satisfied or Very Satisfied with PLNU Education	92% ± 7%(SD)	93% ± 4.7%(SD)	94% ± 6%(SD)	96% ± 4.8%(SD)

No ENVS majors took Chemistry Senior Seminar in 2015 – 2024, so there is no survey data.

Conclusions Drawn from Data: The Biology Department and Chemistry Department majors are successful at obtaining jobs and entering graduate/professional schools. They also seem to be highly satisfied with their PLNU education.

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

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