

**Environmental Science B.S. (ENVS)**  
**Program Learning Outcomes, F2022-S2023**

**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, organismal, and ecological (population, community, ecosystem).

**Outcome Measure:** ETS Major Field Test in Biology

**Criteria for Success:** The overall group mean on the ETS exam will be  $\geq$  75th percentile and at least 50% of our students will have an overall score  $\geq$  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, 3) Organismal, and 4) Population, Ecological, & Evolutionary Biology.

**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:**

	2023, n=4	2022, n=8	2021, n=5	2018, n=2	2017, n=4
<b>Overall group mean</b>	14 <sup>th</sup> %ile	26 <sup>th</sup> %ile	64 <sup>th</sup> %ile	31 <sup>st</sup> , 35 <sup>th</sup> %ile	64 <sup>h</sup> %ile
% above 60 <sup>th</sup> %ile	0%	13%	40%	0%	25%
<b>Cell Biology mean</b>	12 <sup>th</sup> %ile	18 <sup>th</sup> %ile	41 <sup>st</sup> %ile	3 <sup>rd</sup> , 33 <sup>rd</sup> %ile	57 <sup>th</sup> %ile
% above 60 <sup>th</sup> %ile	0%	13%	20%	0%	25%
<b>Genetics/Molecular mean</b>	10 <sup>th</sup> %ile	2 <sup>nd</sup> %ile	12 <sup>th</sup> %ile	9 <sup>th</sup> , 43 <sup>rd</sup> %ile	29 <sup>th</sup> %ile
% above 60 <sup>th</sup> %ile	0%	0%	0%	0%	25%
<b>Organismal mean</b>	43 <sup>rd</sup> %ile	37 <sup>th</sup> %ile	54 <sup>th</sup> %ile	31 <sup>st</sup> , 37 <sup>th</sup> %ile	37 <sup>th</sup> %ile
% above 60 <sup>th</sup> %ile	0%	13%	40%	0%	25%
<b>Pop/Eco/Evol. Biol. mean</b>	27 <sup>th</sup> %ile	61 <sup>st</sup> %ile	94 <sup>th</sup> %ile	39 <sup>th</sup> , 73 <sup>rd</sup> %ile	98 <sup>th</sup> %ile
% above 60 <sup>th</sup> %ile	0%	25%	100%	50%	75%

**Conclusions Drawn from Data:**

In general, we have not had a large enough population of ENVS majors to get statistically meaningful data about their Biology content knowledge. (Gray numbers indicate criteria not met.) However, we have noticed that some of the weaker students overall tend to self-select into this major. Due to this fact, we worked with several other departments to create an Environmental Studies major that has less science courses and more writing and policy

courses. This major is housed in the Department of Literature, Journalism, and World Languages.

Clearly, however, these students are doing better in the area of population biology, ecology and evolution, which best fits with the focus of this major.

**Changes to be Made Based on Data:** We are considering the use of an alternative exam, as the ETS exam is heavily weighted on content knowledge rather than on critical thinking and scientific process skills.

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

**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*	2023	2022	2021	2020	2019	2018	2017
Analytical mean	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)	28 <sup>th</sup> %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 – 2023, 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 are trying 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) and Senior Exit Survey.

HPLC, ICP, IR, UV-vis: Chemistry 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. 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	Fall 2022	Fall 2021	Fall 2020	Fall 2019	Fall 2018	Fall 2017
HPLC CHE3070	100%	100%	COVID-19	HPLC not working	100% (n=4)	100% (n=2)
ICP CHE3070	100%	100%	COVID-19	100% (n=4)	25% (n=4)	100% (n=2)
IR CHE3070	100%	100%	COVID-19	100% (n=4)	100% (n=4)	100% (n=2)
UV-vis CHE3070	100%	100%	COVID-19	100% (n=4)	100% (n=4)	100% (n=2)

No ENVS majors took Chemistry Senior Seminar in 2015 – 2023, so there is no survey data.

**Conclusions Drawn from Data:** In the Fall 2022, 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.

<b>Instrument</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>HPLC (CHE3070)</b>	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.
<b>ICP (CHE3070)</b>	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.
<b>IR (CHE3070)</b>	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.
<b>UV-vis (CHE3070)</b>	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
<b>Sp 2023</b>	5 of 5	100%	Yes	
<b>Sp 2022</b>	5 of 8	40%	No	
<b>Sp 2021</b>	5 of 5	60%	No	
<b>Sp 2020</b>	--	--	--	Survey not given (COVID)
<b>Sp 2019</b>	1 of 3	33%	No	Small sample size
<b>Sp 2018</b>	--	--	--	Survey not given
<b>Sp 2017</b>	3 of 4	75%	Almost	Small sample size
<b>Sp 2016</b>	5 of 6	83%	Yes	
<b>Sp 2015</b>	3 of 3	100%	Yes	Small sample size

**Conclusions Drawn from Data:** Some of 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 achieve a level of 3 or higher on each area of 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 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* annotated bibliography (Info Literacy Assign #2) (25 points)**

Grading aspect	Capstone 4	Milestones 3	Milestones 2	Benchmark 1
<b>Number of references 0 – 10 points</b>	<input type="checkbox"/> At least 5 references <input type="checkbox"/> At least 3 references are journal articles or books.	<input type="checkbox"/> 3-4 references <input type="checkbox"/> 2 or fewer references are journal articles or books.	<input type="checkbox"/> 2 or fewer references, <input type="checkbox"/> No references are journal articles or books	<input type="checkbox"/> No references
<b>Choice of references 0 – 15 points</b>	<input type="checkbox"/> Annotated bibliography includes 1 – 2 sentences describing choice, use, and purpose of each reference (including bias) <input type="checkbox"/> Particular aspects (chapter, pages, figures) of each source are indicated for which the student anticipates using. <input type="checkbox"/> Sources are of more than one type such as websites, books, and journal articles. <input type="checkbox"/> Credibility of the author is verified <input type="checkbox"/> References are properly formatted <input type="checkbox"/> Includes at least one source from an alternate viewpoint, <u>written</u> by an author that holds that viewpoint.	<input type="checkbox"/> Missing 2 of the details	<input type="checkbox"/> Missing 3 of the details	<input type="checkbox"/> Little evidence of thought and consideration towards the use, purpose, and ideas derived from each source.

**BIO 4097 Grading Rubric for *Integration of Science & Faith* outline (25 points)**

Grading aspect	Capstone 4	Milestones 3	Milestones 2	Benchmark 1
<b>Thesis and direction of the paper 0 – 15 points</b>	<input type="checkbox"/> Thesis is clear <input type="checkbox"/> The outline reflects a clear organization of the paragraphs with supporting ideas, as well as reference to how each source will be used.	<input type="checkbox"/> Thesis is somewhat clear <input type="checkbox"/> Overall organization of outline is somewhat clear	<input type="checkbox"/> Thesis is unclear <input type="checkbox"/> No real indication of any thought towards organization of the ideas and supporting evidence within the paper.	<input type="checkbox"/> No outline
<b>Ideas and organization of the individual supporting paragraphs 0 – 10 points</b>	<input type="checkbox"/> Thoughtful and organized flow of ideas <input type="checkbox"/> Sub-bullets for each main paragraph / supporting idea show evidence of deep thought about the paper <input type="checkbox"/> Mention of multiple concepts from PLNU courses that have influenced position	<input type="checkbox"/> Evidence of overall structure, but student has not yet thought deeply about how to put the main ideas together <input type="checkbox"/> Outline has main ideas, but has few sub-bullets <input type="checkbox"/> Mention of 1-2 concepts from PLNU courses that have influenced position.	<input type="checkbox"/> Very little evidence of thought towards organization, main ideas, and structure for the paper. <input type="checkbox"/> Outline is highly incomplete. <input type="checkbox"/> No mention of how PLNU courses have influenced position.	<input type="checkbox"/> No outline



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

Grading aspect	Capstone 4	Milestone 3	Milestone 2	Benchmark 1
<b>Integration of science and faith (evolution or creation care)</b> <b>0 -20 points</b>	<input type="checkbox"/> Deep personal reflection is evident <input type="checkbox"/> Question for this assignment was <u>clearly answered</u> <input type="checkbox"/> Clear statement of position. <input type="checkbox"/> 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:
<b>Critical Thinking</b> <b>0 – 20 points</b>	<input type="checkbox"/> Issue is stated clearly & position is well-supported with evidence & sources. <input type="checkbox"/> Alternate position(s) is/are clearly addressed in a manner that flows well with the author’s argument <input type="checkbox"/> Clear arguments against these alternate positions using personal reflection and scientific information <input type="checkbox"/> 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:
<b>Incorporation of concepts discussed in PLNU classes</b> <b>0 – 20 points</b>	<input type="checkbox"/> Specific concepts from specific PLNU classes, including science and/or religion classes, are included as part of reflection and defense of position. <input type="checkbox"/> 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:
<b>Written Communication</b> <b>0 – 20 points</b>	<input type="checkbox"/> No, or very few, grammatical and spelling errors. <input type="checkbox"/> Essay flow is excellent with a clear introduction, argumentative reasoning, and a strong conclusion. <input type="checkbox"/> Writing effectively communicates with a coll. sci. audience. <input type="checkbox"/> 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:
<b>Information Literacy</b> <b>0 – 20 points</b>	<input type="checkbox"/> Sources are current, authoritative, and relevant to the topic <input type="checkbox"/> Communicates, organizes and synthesizes information from sources to achieve a specific purpose, with clarity and depth <input type="checkbox"/> Use of in-text citations as well as the annotated bibliography <input type="checkbox"/> Excellent choice of paraphrasing, summarizing, or quoting to enhance the essay and support the author’s argument <input type="checkbox"/> Distinguishes between common knowledge and ideas requiring attribution <input type="checkbox"/> 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	2022 (Biology)	2022 (Chemistry)
Population Surveyed	262	122
Response Rate	44%	41%
Year of Graduation	2012-2016	2012-2016
Employed Full-Time OR Currently in Graduate School Full-Time	85%	88%
Went to graduate school and graduated (of those who are employed full-time)	55%	67%
Satisfied or Very Satisfied with PLNU Education	94% ± 6%(SD)	96% ± 4.8%(SD)

No ENVS majors took Chemistry Senior Seminar in 2015 – 2023, 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.