

## Assessment Plan: Environmental Science B.S. Majors

**Overview:** PLO 1, 2, 3, 4, 5 will be assessed yearly; PLO 6 will be assessed every 1 and 5 years.

**PLO 1: 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, organismal, and ecological (population, community, ecosystem).**

This PLO will be measured directly via summative assessment during the senior year. Students will take the ETS Major Fields Test in Biology as part of the capstone course in biology, Biology 497, Biology Seminar.

Criteria for success: The overall group mean on the ETS exam will be at or above the 75<sup>th</sup> percentile and at least 50% of our students will have an overall score at or above the 60<sup>th</sup> percentile. Additionally, the same criteria established for the overall ETS score will be applied to each of the 4 sub-disciplines, which are *Cell, Genetic & Molecular, Organismal, and Population, Ecological, & Evolutionary Biology*.

Rubric: ETS Comparative Data Guides – MFT for Biology

**PLO 2: Students will apply key concepts and principles in analytical chemistry including quantitative and instrumental analysis.**

This PLO will be measured directly via summative assessment. Students will take the American Chemical Society Analytical Chemistry Exam as part of the required course in chemistry, Chemistry 213, Analytical Chemistry. This PLO will also be measured indirectly via self-reporting on a senior exit survey (see below) administered in the capstone courses in biology (Biology 497, Biology Seminar) and chemistry (Chemistry 495, Chemistry Seminar).

Criteria for success: The overall group mean on the ACS Analytical Chemistry exam will be at or above the 35<sup>th</sup> percentile. At least 80% of students surveyed will feel prepared or better in meeting this PLO.

Rubric: ACS National Normed Percentiles

**PLO 3: Students will use standard instrumentation and laboratory equipment to conduct scientific experiments and perform chemical characterization and analyses.**

This PLO will be measured directly via faculty laboratory instructors' observation of their students' use of various standard instruments in Chemistry 370, Instrumental Analysis (see

below). This PLO will also be measured indirectly via self-reporting on a senior exit survey (see below) administered in the capstone courses in biology (Biology 497, Biology Seminar) and chemistry (Chemistry 495, Chemistry Seminar).

HPLC, ICP, IR, UV-vis: Chemistry 370 (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.

Rubric: The following scale will be used.

<b>Instrument</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>HPLC (CHE370)</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 (CHE370)</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 (CHE370)</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 (CHE370)</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.

**PLO 4: 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.**

This PLO will be measured indirectly via summative assessment during the senior year. Students will self-report their involvement in research, science clubs, and positions of responsibility as part of the capstone courses in biology (Biology 497, Biology Seminar) and chemistry (Chemistry 495, Chemistry Seminar). This PLO will also be measured indirectly via self-reporting on a senior exit survey (see below) administered in the capstone courses in biology (Biology 497, Biology Seminar) and chemistry (Chemistry 495, Chemistry Seminar).

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.

Rubric: Not applicable.

**PLO5: Students will develop a rationally defensible integration of science and faith, particularly with regard to environmental stewardship.**

This PLO will be measured directly via summative assessment during the senior year. Students will defend the integration of their faith with various scientific topics via a written essay as part of the capstone course in biology, Biology 497, Biology Seminar.

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.

Rubric: See below.

**PLO 6: Students will be prepared for post-graduate studies or science-related careers.**

This PLO will be measured directly via data collection of school acceptances or jobs obtained. This PLO will be measured indirectly via self-reporting on an alumni survey (see below). This PLO will also be measured indirectly via self-reporting on a senior exit survey (see below) administered in the capstone courses in biology (Biology 497, Biology Seminar) and chemistry (Chemistry 495, Chemistry Seminar).

Criteria for success: 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.

Rubric: Not applicable.

<b>Grading aspect</b>	<b>poor</b>	<b>developing</b>	<b>good</b>	<b>expert</b>
<b>Integration of science and faith (evolution or environmental stewardship)</b>	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)
<b>Critical thinking</b>	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
<b>Incorporation of concepts discussed in various classes while at PLNU</b>	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 defensible 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.
<b>Written communication</b>	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)
<b>Information literacy</b>	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 (Environmental Science 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, organismal, and ecological (population, community, ecosystem).

unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

II. Students will apply key concepts and principles in analytical chemistry including quantitative and instrumental analysis.

unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

III. 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

IV. 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

V. Students will develop a rationally defensible integration of science and faith, particularly with regard to environmental stewardship.

unprepared / somewhat unprepared / prepared / well prepared / extremely well prepared

VI. 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 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.