Biology Department Assessment of Program Learning Outcomes
MS in General Biology
2024/2025

Learning Outcome:
PLO #1: Discuss major concepts and theories in biology.

Outcome Measures:
MS exam questions on description of major course topics (direct measure)
MS written version of thesis (direct measure)

Criteria for Success (if applicable):
80% of students will score at "developed" or higher on rubric

Longitudinal Data:

Measure	% of students achieving "developed" or "highly developed"						
		'19-20	'20-21	'21-22	'22-23	'23-24	'24-25
MS exam		n=10	n=8	n=13	n=11	n=7	n=6
	No revisions	70%	100%	62%	64%	57%	83%
	Revisions to 1-2 answers	30%	-	38%	36%	29%	17%
	Revisions to 3-4 answers	-	-	-	-	14%	-
	Revisions to 5+ answers	-	-	-	-	-	-
MS thesis-Written portion (Thesis students)		n=1	n=0	n=2	n=1	n-1	n=0
		100%	-	100%	100%	100%	-

Conclusions Drawn from Data:
Our 24/25 results indicate that our students achieved the highest percentage since 20/21 with a large improvement over the last previous 3 years, and surpassed the goal of 80% goal.

Changes to be Made Based on Data:
None

Rubric used:
Appendix A: Rubric for MS exam, Part II: Description of summer course major concepts – shaded rows
Appendix B: Rubric for MS thesis (written) – shaded row

APPENDIX A: Rubric for MS exam, Part II: Description of required lab course major concepts (shaded rows)

Required lab course	Aspect of answer	Initial (fail)	Emerging (fail)	Developed (pass)	Highly Developed (pass)
#1	**Choice of topic**	Topic not addressed in course	Topic of minor importance in course	Identified a major topic of the course with direct relation to the central topic	Clearly identified a central topic from course
#1	**Topic description**	Inaccurately described	Partially accurate and may or may not use vocabulary from the course or refer to class activities	Mostly accurate with some use of vocabulary from the course, and connected to class activities	Accurately described using appropriate vocabulary from the course and connected to class activities
#2	**Choice of topic**	Topic not addressed in course	Topic of minor importance in course	Identified a major topic of the course with direct relation to the central topic	Clearly identified a central topic from course
#2	**Topic description**	Inaccurately described	Partially accurate and may or may not use vocabulary from the course or refer to class activities	Mostly accurate with some use of vocabulary from the course, and connected to class activities	Accurately described using appropriate vocabulary from the course and connected to class activities
#3	**Choice of topic**	Topic not addressed in course	Topic of minor importance in course	Identified a major topic of the course with direct relation to the central topic	Clearly identified a central topic from course
#3	**Topic description**	Inaccurately described	Partially accurate and may or may not use vocabulary from the course or refer to class activities	Mostly accurate with some use of vocabulary from the course, and connected to class activities	Accurately described using appropriate vocabulary from the course and connected to class activities
#4	**Choice of topic**	Topic not addressed in course	Topic of minor importance in course	Identified a major topic of the course with direct relation to the central topic	Clearly identified a central topic from course
#4	**Topic description**	Inaccurately described	Partially accurate and may or may not use vocabulary from the course or refer to class activities	Mostly accurate with some use of vocabulary from the course, and connected to class activities	Accurately described using appropriate vocabulary from the course and connected to class activities

Appendix B: Rubric for MS thesis (written) – selected row pertaining to PLO #1

Component	Initial (70%)	Emerging (80%)	Developed (90%)	Highly Developed (100%)
Problem, question and/or hypothesis	• Fails to identify or summarize problem accurately • No indication of purpose of the research	• Summarizes the problem, though some aspects are incorrect or confusing • Some indication of purpose of the research	• Clearly identifies the problem • Clearly articulates the purpose of the research	• Clearly identifies the problem as well as nuanced aspects or key details • Clearly articulates the purpose of the research, beyond the narrow field
Choice of and use of relevant literature	• References not appropriately integrated into the paper	• Fewer than 35 references appropriately integrated into the paper	• 35-50 references appropriately integrated into the paper	• 50+ ref. appropriately integrated into paper
Knowledge of major biology theories	• Inadequate evidence of understanding of relevant biology concepts	• Basic evidence of understanding of relevant biology concepts	• Clear and adequate evidence of understanding of relevant biology concepts	• Clear and comprehensive evidence of understanding of relevant biology concepts
Methods (data collection/anal)	• No explanation or justification of research design • Methodology is unclear and incomplete	• Some explanation of research design, but no justification • Methodology is basic, but incomplete	• Clearly explains research design, but no justification • Explains methodology	• Clearly justifies and explains research design • Clearly explains methodology
Results	• Graphs and tables are poorly/inaccurately done • One or more pieces of data inaccurately interpreted in text with many opinion statements.	• Graphs and tables are inaccurate/missing labels with some errors • Usually accurately summarizes tables and graphs in text with obvious opinions	• Graphs and tables are adequate • Accurately summarizes the tables and graphs in text with some opinion	• Graphs and tables are professional • Accurately summarizes the tables and graphs in text w/o opinion
Conclusion(s)	• Fails to identify conclusions, or conclusion is a simplistic summary • Conclusion presented as “proof"	• Identifies conclusions and refers to some specific pieces of evidence • Does not relate conclusion to the broader field	• Clearly links evidence with the conclusion • Minimal consideration of limitations	• Clearly links evidence with the conclusion • Considers limitations of the study

Learning Outcome:

PLO #2: Carry out and communicate various experimental methods and types of data analysis.

Outcome Measures:

MS exam questions on analysis of two research papers (direct measure)

MS written version of thesis (direct measure)

Criteria for Success:

80% of students will score at "developed" or higher on rubric

Longitudinal Data:

Measure	% of students achieving "developed" or "highly developed"						
		'19-20	**'20-21**	**'21-22**	**'22-23**	**'23-24**	**'24-25**
MS exam questions (Non-thesis option)		n=10	n=8	n=13	n=11	n=7	n = 6
	No revisions	40%	62.5%	69%	63%	57%	67%
	Revisions to 1-2 answers	30%	25%	31%	18%	29%	33%
	Revisions to 3-4 answers	30%	12.5%	-	9%	-	-
	Revisions to 5+ answers	-	-	-	9%	14%	-
MS thesis-Written portion (Thesis option)		n=1	n=0	n=2	n=1	n=1	n=0
		100%	-	100%	100%	100%	-

Conclusions Drawn from Data:

Over the last 5 years, we have seen improvement compared to 2019/2020, but we have not been successful in improving the ability of students to summarize the methods sections of papers in their own words to reach our goal of 80%.

Changes to be Made Based on Data:

Although all students are strongly encouraged to take at least one of our 1-unit elective "Readings in Biology" courses to have sufficient practice on analyzing papers in addition to those embedded in the lab courses, few students have done so (only 3 during the 2024/2025 year) meaning that they had to register in an independent study due to the small number. This area appears to be a weak spot in the curriculum so ideas will be discussed as we enter program review this year.

Rubric used:

Appendix A: Rubric for MS exam, Part I: Research article analysis – shaded row

Appendix B: Rubric for MS thesis (written) – shaded rows

Appendix A: Rubric for MS exam, Part I: Research article analysis (shaded row pertains to PLO #2)

Aspect of answer	Initial (fail)	Emerging (fail)	Developed (pass)	Highly Developed (pass)
General relevance to field	Missing	Unclear	Clear, but not accurate or unclear, incomplete or lacks depth of analysis	Clear and accurate
General problem/ question	Missing	Unclear	Clear, but not accurate or incomplete	Clear and accurate
1st major claim	Identified claim is inaccurate or not important	Identified claim is inaccurate or incomplete or lacks depth	Accurately identified claim, but not a main claim	Accurately identified one of the most important claims
Evidence	Specific data is not identified or does not match the claim	Relevant tables, figures, etc. are mentioned but no specific areas; only 1 piece of evidence	Specific areas of relevant figures, tables, etc. are correctly identified; 2 pieces of evidence	Specific areas of relevant figures, tables, etc. are correctly identified; 2+ pieces of evidence
Justification	Justification missing for claim	Weak attempt made to justify claim, but inaccurate, incomplete, or unclear	Justification given for why data supports the claim, but not clear or incomplete	Clear justification as to why the data supports the claim
Methods	Methods missing	Missing some major methods or relevance is unclear	Major methods identified in own words, but relevance unclear	Major methods identified and relevance clearly explained

Appendix B: Rubric for MS thesis (written) – shaded row pertains to PLO #2

Component	Initial (70%)	Emerging (80%)	Developed (90%)	Highly Developed (100%)
Problem, question and/or hypothesis	• Fails to identify or summarize problem accurately • No indication of purpose of the research	• Summarizes the problem, though some aspects are incorrect or confusing • Some indication of purpose of the research	• Clearly identifies the problem • Clearly articulates the purpose of the research	• Clearly identifies the problem as well as nuanced aspects or key details • Clearly articulates the purpose of the research, beyond the narrow field
Choice of and use of relevant literature	• References not appropriately integrated into the paper	• Fewer than 35 references appropriately integrated into the paper	• 35-50 references appropriately integrated into the paper	• 50+ ref. appropriately integrated into paper
Knowledge of major biology theories	• Inadequate evidence of understanding of relevant biology concepts	• Basic evidence of understanding of relevant biology concepts	• Clear and adequate evidence of understanding of relevant biology concepts	• Clear and comprehensive evidence of understanding of relevant biology concepts
Methods (data collection/anal)	• No explanation or justification of research design • Methodology is unclear and incomplete	• Some explanation of research design, but no justification • Methodology is basic, but incomplete	• Clearly explains research design, but no justification • Explains methodology	• Clearly justifies and explains research design • Clearly explains methodology
Results	• Graphs and tables are poorly/inaccurately done • One or more pieces of data inaccurately interpreted in text with many opinion statements.	• Graphs and tables are inaccurate/missing labels with some errors • Usually accurately summarizes tables and graphs in text with obvious opinions	• Graphs and tables are adequate • Accurately summarizes the tables and graphs in text with some opinion	• Graphs and tables are professional • Accurately summarizes the tables and graphs in text w/o opinion
Conclusion(s)	• Fails to identify conclusions, or conclusion is a simplistic summary • Conclusion presented as “proof"	• Identifies conclusions and refers to some specific pieces of evidence • Does not relate conclusion to the broader field	• Clearly links evidence with the conclusion • Minimal consideration of limitations	• Clearly links evidence with the conclusion • Considers limitations of the study

Learning Outcome:

PLO #3: Demonstrate knowledge and skills in critical thinking, such as analysis and synthesis, as applied to primary literature in the field of biology.

Outcome Measures:

MS exam questions on analysis of three research papers (direct measure)

MS written version of thesis (direct measure)

Criteria for Success:

80% of students will score at "developed" or higher on rubric

Longitudinal Data:

Measure		% of students achieving "developed" or "highly developed"					
		'19-20	'20-21	'21-22	'22-23	'23-24	'24-25
MS exam – non-thesis option		n=10	n=8	n=13	n=11	n=7	n=6
	No revisions	40%	62.5%	69%	36%	43%	50%
	Revisions to 1-2 answers	30%	25%	15%	27%	14%	33%
	Revisions to 3-4 answers	10%	-	15%	18%	-	17%
	Revisions to 5+ answers	20%	12.5%	-	18%	29%	-
MS thesis-written portion (Thesis option)	n=0	n=1	n=0	n=2	n=1	n=1	n=0
	-	100%	-	100 %	100%	100%	-

Conclusions Drawn from Data:

While the results based on the assessment for 2024-2025 show improvement compared to the two previous years, these sections on the MS exam continue to be the most challenging for students.

Changes to be Made Based on Data:

Although all students are strongly encouraged to take at least one of our 1-unit elective "Readings in Biology" courses to have sufficient practice on analyzing papers in addition to those embedded in the lab courses, few students have done so (only 3 during the 2024/2025 year) meaning that they had to register in an independent study due to the small number. This area appears to be a weak spot in the curriculum so ideas will be discussed as we enter program review this year.

Rubrics used:

Appendix A: Rubric for MS exam, Part I: Research article analysis – shaded rows

Appendix B: Rubric for MS thesis (written) – shaded rows

Appendix A: Rubric for MS exam, Part I: Research article analysis (shaded row pertains to PLO #2)

Aspect of answer	Initial (fail)	Emerging (fail)	Developed (pass)	Highly Developed (pass)
General relevance to field	Missing	Unclear	Clear, but not accurate or unclear, incomplete or lacks depth of analysis	Clear and accurate
General problem/ question	Missing	Unclear	Clear, but not accurate or incomplete	Clear and accurate
1st major claim	Identified claim is inaccurate or not important	Identified claim is inaccurate or incomplete or lacks depth	Accurately identified claim, but not a main claim	Accurately identified one of the most important claims
Evidence	Specific data is not identified or does not match the claim	Relevant tables, figures, etc. are mentioned but no specific areas; only 1 piece of evidence	Specific areas of relevant figures, tables, etc. are correctly identified; 2 pieces of evidence	Specific areas of relevant figures, tables, etc. are correctly identified; 2+ pieces of evidence
Justification	Justification missing for claim	Weak attempt made to justify claim, but inaccurate, incomplete, or unclear	Justification given for why data supports the claim, but not clear or incomplete	Clear justification as to why the data supports the claim
Methods	Methods missing	Missing some major methods or relevance is unclear	Major methods identified in own words, but relevance unclear	Major methods identified and relevance clearly explained

Appendix B: Rubric for MS thesis (written) – shaded row pertains to PLO #2

Component	Initial (70%)	Emerging (80%)	Developed (90%)	Highly Developed (100%)
Problem, question and/or hypothesis	• Fails to identify or summarize problem accurately • No indication of purpose of the research	• Summarizes the problem, though some aspects are incorrect or confusing • Some indication of purpose of the research	• Clearly identifies the problem • Clearly articulates the purpose of the research	• Clearly identifies the problem as well as nuanced aspects or key details • Clearly articulates the purpose of the research, beyond the narrow field
Choice of and use of relevant literature	• References not appropriately integrated into the paper	• Fewer than 35 references appropriately integrated into the paper	• 35-50 references appropriately integrated into the paper	• 50+ ref. appropriately integrated into paper
Knowledge of major biology theories	• Inadequate evidence of understanding of relevant biology concepts	• Basic evidence of understanding of relevant biology concepts	• Clear and adequate evidence of understanding of relevant biology concepts	• Clear and comprehensive evidence of understanding of relevant biology concepts
Methods (data collection/anal)	• No explanation or justification of research design • Methodology is unclear and incomplete	• Some explanation of research design, but no justification • Methodology is basic, but incomplete	• Clearly explains research design, but no justification • Explains methodology	• Clearly justifies and explains research design • Clearly explains methodology
Results	• Graphs and tables are poorly/inaccurately done • One or more pieces of data inaccurately interpreted in text with many opinion statements.	• Graphs and tables are inaccurate/missing labels with some errors • Usually accurately summarizes tables and graphs in text with obvious opinions	• Graphs and tables are adequate • Accurately summarizes the tables and graphs in text with some opinion	• Graphs and tables are professional • Accurately summarizes the tables and graphs in text w/o opinion
Conclusion(s)	• Fails to identify conclusions, or conclusion is a simplistic summary • Conclusion presented as “proof"	• Identifies conclusions and refers to some specific pieces of evidence • Does not relate conclusion to the broader field	• Clearly links evidence with the conclusion • Minimal consideration of limitations	• Clearly links evidence with the conclusion • Considers limitations of the study

Learning Outcome:
PLO #4: Distinguish between science and faith and discuss the potential compatibility of the two domains.

Outcome Measure:
Indirect assessment: Alumni survey question
Direct assessment: Signature assignment added in 2015 to BIO 6033 (History & Philosophy of Science)

Criteria for Success:
Indirect assessment: At least 80% of students will "agree" or "strongly agree" that they are able to "Distinguish between science and faith and discuss the potential compatibility of the two domains" as a result of the program.
Direct assessment: At least 80% of students will score at "developed" or higher for both rows on the rubric

Longitudinal Data:

Assessment	'19-'20	'20-'21	'21-'22	'22-'23	'23-'24	'24-'25
Alumni survey (Indirect)	No data this year*	n=15	No data this year*	No data this year*	n=18	No data this year*
Alumni survey (Indirect): *Did the program coursework help you to distinguish between the types of questions science faith can answer?*		67% strongly agreed or agreed with the statement			94% strongly agreed or agreed with the statement	
Alumni survey (Indirect): *Did the program coursework (assignments, discussions) include the potential compatibility of science and faith?*		66% strongly agreed or agreed with the statement			83% strongly agreed or agreed with the statement	
BIO 6033 Signature assignment (Direct): *Explanation of the distinction between religious faith and science*	n = 16	n = 14	n = 12	n = 7	n = 7	N = 6
	62%	54%	60%	71%	100%	83%
BIO 6033 Signature assignment (Direct): *Articulation of the possibility of a relationship and compatibility of the two domains*	94%	93%	100%	71%	100%	100%

*Alumni survey is only conducted every 3 years.
**BIO 6033 has been offered once every other year, but starting in 2019, it is offered every year.

Conclusions Drawn from Data:
Criteria was met or exceeded in 2024/2025 on the direct assessment.

Changes to be Made Based on Data:
No changes will be made.

Questions used on Alumni Survey (indirect assessment)

a. Did the program coursework (assignments, discussions) help you to distinguish between the types of questions science can answer and the types of questions faith can answer?
b. Did the program coursework (assignments, discussions) include the potential compatibility of the two domains (science and faith)?

Rubric used:

BIO 633 Signature Assignment and Rubric for PLNU Graduate Biology program PLO#4

Signature assignment:

a. In a 200-300 word essay, distinguish between science and faith.
b. In a 200-300 word essay, discuss the potential compatibility of the two domains within the context of explanations for the diversity of life on earth.

Component	Initial (70%)	Emerging (80%)	Developed (90%)	Highly Developed (100%)
Explanation of the distinction between religious faith and science	Minimal or inaccurate description of both science and religious faith	Basic description of both science and religious faith	Good description of both science and religious faith	Excellent and thorough description of both science and religious faith
Articulation of the possibility of a relationship and compatibility of the two domains	Denies the possibility of a relationship/ intersection between religious faith and science	States ambivalence about the possibility of a relationship/ intersection between religious faith and science	Acknowledges the possibility of a relationship/ intersection between religious faith and science.	Fully embraces possibility of a relationship/ intersection between religious faith and science, and provides personal evidence of such a relationship