

**Biology Department Assessment of Program Learning Outcomes**  
**MS in General Biology**  
**2016-2017**

**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):**

100% of students will score at “developed” or higher on rubric

**Longitudinal Data:**

Measure	% of students achieving “developed” or “highly developed”				
	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
MS exam questions (Non-thesis students)	100% (n=5)	100% (n=3)	100% (n=3)	100% (n=2)	100% (n=5)
MS thesis-written portion (Thesis students)	100% (n=2)	100% (n=1)	100% (n=3)	100% (n=2)	100% (n=2)

**Conclusions Drawn from Data:**

All graduating students are performing very well and meeting the criterion.

**Changes to be Made Based on Data:**

No changes to program. The intentional structure of the program to provide practice in building these skills coupled with close mentoring by faculty members during the thesis process and courses results in these outcomes.

**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 summer course major concepts (shaded rows)**

Summer course	Aspect of answer	Initial (fail)	Emerging (fail)	Developed (pass)	Highly Developed (pass)
#1	<b>Choice of topic</b>	Topic not addressed in course	Topic of minor importance in course	One of several main topics from course	Clearly a central topic from course
#1	<b>Topic description</b>	Inaccurately described	Accurately described, with minimal/no use of vocabulary from the course	Accurately described, with some use of vocabulary from the course	Accurately described using appropriate vocabulary from the course
#2	<b>Choice of topic</b>	Topic not addressed in course	Topic of minor importance in course	One of several main topics from course	Clearly a central topic from course
#2	<b>Topic description</b>	Inaccurately described	Accurately described, with minimal/no use of vocabulary from the course	Accurately described, with some use of vocabulary from the course	Accurately described using appropriate vocabulary from the course
#3	<b>Choice of topic</b>	Topic not addressed in course	Topic of minor importance in course	One of several main topics from course	Clearly a central topic from course
#3	<b>Topic description</b>	Inaccurately described	Accurately described, with minimal/no use of vocabulary from the course	Accurately described, with some use of vocabulary from the course	Accurately described using appropriate vocabulary from the course
#4	<b>Choice of topic</b>	Topic not addressed in course	Topic of minor importance in course	One of several main topics from course	Clearly a central topic from course
#4	<b>Topic description</b>	Inaccurately described	Accurately described, with minimal/no use of vocabulary from the course	Accurately described, with some use of vocabulary from the course	Accurately described using appropriate vocabulary from the course

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

<b>Component</b>	<b>Initial (70%)</b>	<b>Emerging (80%)</b>	<b>Developed (90%)</b>	<b>Highly Developed (100%)</b>
<b>Problem, question and/or hypothesis</b>	<ul style="list-style-type: none"> <li>• Fails to identify or summarize problem accurately</li> <li>• No indication of purpose of the research</li> </ul>	<ul style="list-style-type: none"> <li>• Summarizes the problem, though some aspects are incorrect or confusing</li> <li>• Some indication of purpose of the research</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly identifies the problem</li> <li>• Clearly articulates the purpose of the research</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly identifies the problem as well as nuanced aspects or key details</li> <li>• Clearly articulates the purpose of the research, beyond the narrow field</li> </ul>
<b>Choice of and use of relevant literature</b>	<ul style="list-style-type: none"> <li>• References not appropriately integrated into the paper</li> </ul>	<ul style="list-style-type: none"> <li>• Fewer than 35 references appropriately integrated into the paper</li> </ul>	<ul style="list-style-type: none"> <li>• 35-50 references appropriately integrated into the paper</li> </ul>	<ul style="list-style-type: none"> <li>• 50+ ref. appropriately integrated into paper</li> </ul>
<b>Knowledge of major biology theories</b>	<ul style="list-style-type: none"> <li>• Inadequate evidence of understanding of relevant biology concepts</li> </ul>	<ul style="list-style-type: none"> <li>• Basic evidence of understanding of relevant biology concepts</li> </ul>	<ul style="list-style-type: none"> <li>• Clear and adequate evidence of understanding of relevant biology concepts</li> </ul>	<ul style="list-style-type: none"> <li>• Clear and comprehensive evidence of understanding of relevant biology concepts</li> </ul>
<b>Methods (data collection/anal)</b>	<ul style="list-style-type: none"> <li>• No explanation or justification of research design</li> <li>• Methodology is unclear and incomplete</li> </ul>	<ul style="list-style-type: none"> <li>• Some explanation of research design, but no justification</li> <li>• Methodology is basic, but incomplete</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly explains research design, but no justification</li> <li>• Explains methodology</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly justifies and explains research design</li> <li>• Clearly explains methodology</li> </ul>
<b>Results</b>	<ul style="list-style-type: none"> <li>• Graphs and tables are poorly/inaccurately done</li> <li>• One or more pieces of data inaccurately interpreted in text with many opinion statements.</li> </ul>	<ul style="list-style-type: none"> <li>• Graphs and tables are inaccurate/missing labels with some errors</li> <li>• Usually accurately summarizes tables and graphs in text with obvious opinions</li> </ul>	<ul style="list-style-type: none"> <li>• Graphs and tables are adequate</li> <li>• Accurately summarizes the tables and graphs in text with some opinion</li> </ul>	<ul style="list-style-type: none"> <li>• Graphs and tables are professional</li> <li>• Accurately summarizes the tables and graphs in text w/o opinion</li> </ul>
<b>Conclusion(s)</b>	<ul style="list-style-type: none"> <li>• Fails to identify conclusions, or conclusion is a simplistic summary</li> <li>• Conclusion presented as "proof"</li> </ul>	<ul style="list-style-type: none"> <li>• Identifies conclusions and refers to some specific pieces of evidence</li> <li>• Does not relate conclusion to the broader field</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly links evidence with the conclusion</li> <li>• Minimal consideration of limitations</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly links evidence with the conclusion</li> <li>• Considers limitations of the study</li> </ul>

**Biology Department Assessment of Program Learning Outcomes  
MS in General Biology  
2016-2017**

**Learning Outcome:**

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

**Outcome Measures:**

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

MS written version of thesis (direct measure)

**Criteria for Success:**

100% of students will score at “developed” or higher on rubric

**Longitudinal Data:**

Measure	% of students achieving “developed” or “highly developed”				
	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
MS exam questions (Non-thesis option)	100% (n=5)	100% (n=3)	100% (n=3)	100% (n=2)	100% (n=5)
MS thesis-written portion (Thesis option)	100% (n=2)	100% (n=1)	100% (n=3)	100% (n=2)	100% (n=2)

**Conclusions Drawn from Data:**

All graduating students are performing very well and meeting the criterion.

**Changes to be Made Based on Data:**

No changes to program. The intentional structure of the program to provide practice in building these skills coupled with close mentoring by faculty members during the thesis process and courses results in these outcomes.

**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)**

<b>Paper</b>	<b>Aspect of answer</b>	<b>Initial (fail)</b>	<b>Emerging (fail)</b>	<b>Developed (pass)</b>	<b>Highly Developed (pass)</b>
#1	<b>Problem/question</b>	Missing	Unclear	Clear, but not accurate	Clear and accurate
#1	<b>2 major claims</b>	Identified claims that are inaccurate or not important	At least one identified claim is inaccurate	Accurately identified claims, but missed at least one main claim	Accurately identified the most important claims
#1	<b>Evidence</b>	Specific data is not identified or does not match the claim	Relevant tables, figures, etc. are mentioned but no specific areas are identified	Specific areas of relevant figures, tables, etc. are correctly identified for some claims	Specific areas of relevant figures, tables, etc. are correctly identified for each claim
#1	<b>Justification</b>	Justification missing for at least one claim	Attempt made to justify claims, but inaccurate	Justification given for why data supports the claim, but not clear	Clear justification as to why the data supports each claim
#1	<b>Methods</b>	Methods missing	Missing some major methods	Major methods identified, but unclear	Major methods clearly identified
#1	<b>Topic to teach at CC level</b>	Topic not identified, and no relationship between topic and teaching	Topic is too high or low level for CC course and unclear relationship between topic and teaching	Topic is somewhat appropriate for CC course and some relationship between topic and teaching	Topic is appropriate for CC course and clear relationship between topic and teaching

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

<b>Component</b>	<b>Initial (70%)</b>	<b>Emerging (80%)</b>	<b>Developed (90%)</b>	<b>Highly Developed (100%)</b>
<b>Problem, question and/or hypothesis</b>	<ul style="list-style-type: none"> <li>• Fails to identify or summarize problem accurately</li> <li>• No indication of purpose of the research</li> </ul>	<ul style="list-style-type: none"> <li>• Summarizes the problem, though some aspects are incorrect or confusing</li> <li>• Some indication of purpose of the research</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly identifies the problem</li> <li>• Clearly articulates the purpose of the research</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly identifies the problem as well as nuanced aspects or key details</li> <li>• Clearly articulates the purpose of the research, beyond the narrow field</li> </ul>
<b>Choice of and use of relevant literature</b>	<ul style="list-style-type: none"> <li>• References not appropriately integrated into the paper</li> </ul>	<ul style="list-style-type: none"> <li>• Fewer than 35 references appropriately integrated into the paper</li> </ul>	<ul style="list-style-type: none"> <li>• 35-50 references appropriately integrated into the paper</li> </ul>	<ul style="list-style-type: none"> <li>• 50+ ref. appropriately integrated into paper</li> </ul>
<b>Knowledge of major biology theories</b>	<ul style="list-style-type: none"> <li>• Inadequate evidence of understanding of relevant biology concepts</li> </ul>	<ul style="list-style-type: none"> <li>• Basic evidence of understanding of relevant biology concepts</li> </ul>	<ul style="list-style-type: none"> <li>• Clear and adequate evidence of understanding of relevant biology concepts</li> </ul>	<ul style="list-style-type: none"> <li>• Clear and comprehensive evidence of understanding of relevant biology concepts</li> </ul>
<b>Methods (data collection/anal)</b>	<ul style="list-style-type: none"> <li>• No explanation or justification of research design</li> <li>• Methodology is unclear and incomplete</li> </ul>	<ul style="list-style-type: none"> <li>• Some explanation of research design, but no justification</li> <li>• Methodology is basic, but incomplete</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly explains research design, but no justification</li> <li>• Explains methodology</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly justifies and explains research design</li> <li>• Clearly explains methodology</li> </ul>
<b>Results</b>	<ul style="list-style-type: none"> <li>• Graphs and tables are poorly/inaccurately done</li> <li>• One or more pieces of data inaccurately interpreted in text with many opinion statements.</li> </ul>	<ul style="list-style-type: none"> <li>• Graphs and tables are inaccurate/missing labels with some errors</li> <li>• Usually accurately summarizes tables and graphs in text with obvious opinions</li> </ul>	<ul style="list-style-type: none"> <li>• Graphs and tables are adequate</li> <li>• Accurately summarizes the tables and graphs in text with some opinion</li> </ul>	<ul style="list-style-type: none"> <li>• Graphs and tables are professional</li> <li>• Accurately summarizes the tables and graphs in text w/o opinion</li> </ul>
<b>Conclusion(s)</b>	<ul style="list-style-type: none"> <li>• Fails to identify conclusions, or conclusion is a simplistic summary</li> <li>• Conclusion presented as "proof"</li> </ul>	<ul style="list-style-type: none"> <li>• Identifies conclusions and refers to some specific pieces of evidence</li> <li>• Does not relate conclusion to the broader field</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly links evidence with the conclusion</li> <li>• Minimal consideration of limitations</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly links evidence with the conclusion</li> <li>• Considers limitations of the study</li> </ul>

**Biology Department Assessment of Program Learning Outcomes**  
**MS in General Biology**  
**2016-2017**

**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, as well as in science education.

**Outcome Measures:**

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

MS written version of thesis (direct measure)

**Criteria for Success:**

100% of students will score at “developed” or higher on rubric

**Longitudinal Data:**

Measure	% of students achieving “developed” or “highly developed”				
	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
MS exam questions (Non-thesis option)	100% (n=5)	100% (n=3)	100% (n=3)	100% (n=2)	100% (n=5)
MS thesis-written portion (Thesis option)	100% (n=2)	100% (n=1)	100% (n=3)	100% (n=2)	100% (n=2)

**Conclusions Drawn from Data:**

All graduating students, are performing very well and meeting the criterion.

**Changes to be Made Based on Data:**

No changes to program. The intentional structure of the program to provide practice in building these skills coupled with close mentoring by faculty members during the thesis process and the courses results in these outcomes.

**Rubric used:**

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

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

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

<b>Paper</b>	<b>Aspect of answer</b>	<b>Initial (fail)</b>	<b>Emerging (fail)</b>	<b>Developed (pass)</b>	<b>Highly Developed (pass)</b>
#1	<b>Problem/question</b>	Missing	Unclear	Clear, but not accurate	Clear and accurate
#1	<b>2 major claims</b>	Identified claims that are inaccurate or not important	At least one identified claim is inaccurate	Accurately identified claims, but missed at least one main claim	Accurately identified the most important claims
#1	<b>Evidence</b>	Specific data is not identified or does not match the claim	Relevant tables, figures, etc. are mentioned but no specific areas are identified	Specific areas of relevant figures, tables, etc. are correctly identified for some claims	Specific areas of relevant figures, tables, etc. are correctly identified for each claim
#1	<b>Justification</b>	Justification missing for at least one claim	Attempt made to justify claims, but inaccurate	Justification given for why data supports the claim, but not clear	Clear justification as to why the data supports each claim
#1	<b>Methods</b>	Methods missing	Missing some major methods	Major methods identified, but unclear	Major methods clearly identified
#1	<b>Topic to teach at CC level</b>	Topic not identified, and no relationship between topic and teaching	Topic is too high or low level for CC course and unclear relationship between topic and teaching	Topic is somewhat appropriate for CC course and some relationship between topic and teaching	Topic is appropriate for CC course and clear relationship between topic and teaching



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

<b>Component</b>	<b>Initial (70%)</b>	<b>Emerging (80%)</b>	<b>Developed (90%)</b>	<b>Highly Developed (100%)</b>
<b>Problem, question and/or hypothesis</b>	<ul style="list-style-type: none"> <li>• Fails to identify or summarize problem accurately</li> <li>• No indication of purpose of the research</li> </ul>	<ul style="list-style-type: none"> <li>• Summarizes the problem, though some aspects are incorrect or confusing</li> <li>• Some indication of purpose of the research</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly identifies the problem</li> <li>• Clearly articulates the purpose of the research</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly identifies the problem as well as nuanced aspects or key details</li> <li>• Clearly articulates the purpose of the research, beyond the narrow field</li> </ul>
<b>Choice of and use of relevant literature</b>	<ul style="list-style-type: none"> <li>• References not appropriately integrated into the paper</li> </ul>	<ul style="list-style-type: none"> <li>• Fewer than 35 references appropriately integrated into the paper</li> </ul>	<ul style="list-style-type: none"> <li>• 35-50 references appropriately integrated into the paper</li> </ul>	<ul style="list-style-type: none"> <li>• 50+ ref. appropriately integrated into paper</li> </ul>
<b>Knowledge of major biology theories</b>	<ul style="list-style-type: none"> <li>• Inadequate evidence of understanding of relevant biology concepts</li> </ul>	<ul style="list-style-type: none"> <li>• Basic evidence of understanding of relevant biology concepts</li> </ul>	<ul style="list-style-type: none"> <li>• Clear and adequate evidence of understanding of relevant biology concepts</li> </ul>	<ul style="list-style-type: none"> <li>• Clear and comprehensive evidence of understanding of relevant biology concepts</li> </ul>
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<b>Conclusion(s)</b>	<ul style="list-style-type: none"> <li>• Fails to identify conclusions, or conclusion is a simplistic summary</li> <li>• Conclusion presented as "proof"</li> </ul>	<ul style="list-style-type: none"> <li>• Identifies conclusions and refers to some specific pieces of evidence</li> <li>• Does not relate conclusion to the broader field</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly links evidence with the conclusion</li> <li>• Minimal consideration of limitations</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly links evidence with the conclusion</li> <li>• Considers limitations of the study</li> </ul>

**Biology Department Assessment of Program Learning Outcomes  
MS in General Biology  
2016-2017**

**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 633 (History & Philosophy of Science)

**Criteria for Success:**

Indirect assessment: At least 80% of students will “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: 80% of students will score at “developed” or higher for both rows on the rubric

**Longitudinal Data:**

Assessment	2014-2015	2015-2016	2016-2017
Alumni survey (Indirect)	35% strongly agreed with the statement 57% agreed with the statement	Data not collected this year*	Data not collected this year*
BIO 633 Signature assignment (Direct)  Explanation of the distinction between religious faith and science	Assignment did not exist	43% (n=14)	Data not collected this year**
BIO 633 Signature assignment (Direct)  Articulation of the possibility of a relationship and compatibility of the two domains	Assignment did not exist	86% (n=14)	Data not collected this year**

\*Since the Alumni survey is only conducted every 3 years, so no data was collected in 2016-2017.

\*\*BIO 633 is offered once every other year, so no data was collected in 2016-2017.

**Conclusions Drawn from Data:**

No data was collected this year.

**Changes to be Made Based on Data:**

Changes have been made to BIO 633 to provide more emphasis to discuss the distinction between science and faith by comparing the types of evidence required in science, and how this relates to faith. These changes will take place in Fall 2017 when the course is next offered.

**Rubric used:**

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

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

<b>Component</b>	<b>Initial (70%)</b>	<b>Emerging (80%)</b>	<b>Developed (90%)</b>	<b>Highly Developed (100%)</b>
<b>Explanation of the distinction between religious faith and science</b>	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
<b>Articulation of the possibility of a relationship and compatibility of the two domains</b>	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