

**Biology Department Assessment of Program Learning Outcomes
MS in General Biology
2022/2023**

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” | | | | | | | | |
|--|---|--------|--------|--------|--------------------------|--------|--------|--------|--------|
| | '15-16 | '16-17 | '17-18 | '18-19 | | '19-20 | '20-21 | '21-22 | '22-23 |
| MS exam | N=2 | N=5 | N=10 | N=6 | | N=10 | N=8 | N=13 | N=11 |
| | 100% | 100% | 100% | 100% | No revisions | 70% | 100% | 62% | 64% |
| | | | | | Revisions to 1-2 answers | 30% | - | 38% | 36% |
| | | | | | Revisions to 3-4 answers | - | - | - | - |
| | | | | | Revisions to 5+ answers | - | - | - | - |
| MS thesis- Written portion (Thesis students) | N=2 | N=2 | N=0 | N=1 | | N=1 | N=0 | N=2 | N=1 |
| | 100% | 100% | - | 100% | | 100% | - | 100% | 100% |

Conclusions Drawn from Data:

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

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 summer course major concepts (shaded rows)

| Summer 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 | One of several main topics from course | Clearly a central topic from course |
| #1 | Topic description | 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 | Choice of topic | 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 | Topic description | 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 | Choice of topic | 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 | Topic description | 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 | Choice of topic | 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 | Topic description | 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

| Component | Initial (70%) | Emerging (80%) | Developed (90%) | Highly Developed (100%) |
|---|---|---|---|--|
| Problem, question and/or hypothesis | <ul style="list-style-type: none"> • Fails to identify or summarize problem accurately • No indication of purpose of the research | <ul style="list-style-type: none"> • Summarizes the problem, though some aspects are incorrect or confusing • Some indication of purpose of the research | <ul style="list-style-type: none"> • Clearly identifies the problem • Clearly articulates the purpose of the research | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • References not appropriately integrated into the paper | <ul style="list-style-type: none"> • Fewer than 35 references appropriately integrated into the paper | <ul style="list-style-type: none"> • 35-50 references appropriately integrated into the paper | <ul style="list-style-type: none"> • 50+ ref. appropriately integrated into paper |
| Knowledge of major biology theories | <ul style="list-style-type: none"> • Inadequate evidence of understanding of relevant biology concepts | <ul style="list-style-type: none"> • Basic evidence of understanding of relevant biology concepts | <ul style="list-style-type: none"> • Clear and adequate evidence of understanding of relevant biology concepts | <ul style="list-style-type: none"> • Clear and comprehensive evidence of understanding of relevant biology concepts |
| Methods (data collection/anal) | <ul style="list-style-type: none"> • No explanation or justification of research design • Methodology is unclear and incomplete | <ul style="list-style-type: none"> • Some explanation of research design, but no justification • Methodology is basic, but incomplete | <ul style="list-style-type: none"> • Clearly explains research design, but no justification • Explains methodology | <ul style="list-style-type: none"> • Clearly justifies and explains research design • Clearly explains methodology |
| Results | <ul style="list-style-type: none"> • Graphs and tables are poorly/inaccurately done • One or more pieces of data inaccurately interpreted in text with many opinion statements. | <ul style="list-style-type: none"> • Graphs and tables are inaccurate/missing labels with some errors • Usually accurately summarizes tables and graphs in text with obvious opinions | <ul style="list-style-type: none"> • Graphs and tables are adequate • Accurately summarizes the tables and graphs in text with some opinion | <ul style="list-style-type: none"> • Graphs and tables are professional • Accurately summarizes the tables and graphs in text w/o opinion |
| Conclusion(s) | <ul style="list-style-type: none"> • Fails to identify conclusions, or conclusion is a simplistic summary • Conclusion presented as “proof” | <ul style="list-style-type: none"> • Identifies conclusions and refers to some specific pieces of evidence • Does not relate conclusion to the broader field | <ul style="list-style-type: none"> • Clearly links evidence with the conclusion • Minimal consideration of limitations | <ul style="list-style-type: none"> • 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 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” | | | | | | | | |
|---|---|--------|--------|--------|--------------------------|--------|--------|--------|--------|
| | '15-16 | '16-17 | '17-18 | '18-19 | | '19-20 | '20-21 | '21-22 | '22-23 |
| MS exam questions (Non-thesis option) | N=2 | N=5 | N=10 | N=6 | | N=10 | N=8 | N=13 | N=11 |
| | 100% | 100% | 100% | 100% | No revisions | 40% | 62.5% | 69% | 63% |
| | | | | | Revisions to 1-2 answers | 30% | 25% | 31% | 18% |
| | | | | | Revisions to 3-4 answers | 30% | 12.5% | - | 9% |
| | | | | | Revisions to 5+ answers | - | - | - | 9% |
| MS thesis-Written portion (Thesis option) | N=2 | N=2 | N=0 | N=1 | | N=1 | N=0 | N=2 | N=1 |
| | 100% | 100% | - | 100% | | 100% | - | 100% | 100% |

Conclusions Drawn from Data:

Students are performing consistently on this PLO, but certainly could be doing better.

Changes to be Made Based on Data:

All students will be continued to be encouraged to take at least one of our 1-unit elective readings courses to prepare for this portion of the exam, and all professors will be reminded to require students to understand and summarize methodology at least once in every course so that the students get plenty of practice in analyzing articles.

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 |
| 1 st 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 the one of 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 | Specific areas of relevant figures, tables, etc. are correctly identified | Specific areas of relevant figures, tables, etc. are correctly identified |
| 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 AND not in own words | Missing some major methods OR not in own words | Major methods identified in own words, but unclear | Major methods clearly identified in own words |

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

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

Longitudinal Data:

| Measure | % of students achieving “developed” or “highly developed” | | | | | | | | |
|---|---|--------|--------|-------------------------|--------------------------|--------|--------|--------|--------|
| | '15-16 | '16-17 | '17-18 | '18-19 | | '19-20 | '20-21 | '21-22 | '22-23 |
| MS exam – non-thesis option | N=2 | N=5 | N=10 | N=6 | | N=10 | N=8 | N=13 | N=11 |
| | 100% | 100% | 100% | 100% | No revisions | 40% | 62.5% | 69% | 36% |
| | | | | | Revisions to 1-2 answers | 30% | 25% | 15% | 27% |
| | | | | | Revisions to 3-4 answers | 10% | - | 15% | 18% |
| | | | | Revisions to 5+ answers | 20% | 12.5% | - | 18% | |
| MS thesis-written portion (Thesis option) | N=2 | N=2 | N=0 | N=1 | N=0 | N=1 | N=0 | N=2 | N=1 |
| | 100% | 100% | - | 100% | - | 100% | - | 100% | 100% |

Conclusions Drawn from Data:

Data from this year clearly show a decline in performance on this PLO.

Changes to be Made Based on Data:

All students will be continued to be encouraged to take at least one of our 1-unit elective readings courses to prepare for this portion of the exam, and all professors will be reminded to require students to understand and summarize the claim, the evidence for the claim, and rationale for the evidence supporting the claim at least once in every course so that the students get plenty of practice in analyzing articles.

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)

| 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 |
| 1 st 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 the one of 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 | Specific areas of relevant figures, tables, etc. are correctly identified | Specific areas of relevant figures, tables, etc. are correctly identified |
| 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 AND not in own words | Missing some major methods OR not in own words | Major methods identified in own words, but unclear | Major methods clearly identified in own words |

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 | <ul style="list-style-type: none"> • Fails to identify or summarize problem accurately • No indication of purpose of the research | <ul style="list-style-type: none"> • Summarizes the problem, though some aspects are incorrect or confusing • Some indication of purpose of the research | <ul style="list-style-type: none"> • Clearly identifies the problem • Clearly articulates the purpose of the research | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • References not appropriately integrated into the paper | <ul style="list-style-type: none"> • Fewer than 35 references appropriately integrated into the paper | <ul style="list-style-type: none"> • 35-50 references appropriately integrated into the paper | <ul style="list-style-type: none"> • 50+ ref. appropriately integrated into paper |
| Knowledge of major biology theories | <ul style="list-style-type: none"> • Inadequate evidence of understanding of relevant biology concepts | <ul style="list-style-type: none"> • Basic evidence of understanding of relevant biology concepts | <ul style="list-style-type: none"> • Clear and adequate evidence of understanding of relevant biology concepts | <ul style="list-style-type: none"> • Clear and comprehensive evidence of understanding of relevant biology concepts |
| Methods (data collection/anal) | <ul style="list-style-type: none"> • No explanation or justification of research design • Methodology is unclear and incomplete | <ul style="list-style-type: none"> • Some explanation of research design, but no justification • Methodology is basic, but incomplete | <ul style="list-style-type: none"> • Clearly explains research design, but no justification • Explains methodology | <ul style="list-style-type: none"> • Clearly justifies and explains research design • Clearly explains methodology |
| Results | <ul style="list-style-type: none"> • Graphs and tables are poorly/inaccurately done • One or more pieces of data inaccurately interpreted in text with many opinion statements. | <ul style="list-style-type: none"> • Graphs and tables are inaccurate/missing labels with some errors • Usually accurately summarizes tables and graphs in text with obvious opinions | <ul style="list-style-type: none"> • Graphs and tables are adequate • Accurately summarizes the tables and graphs in text with some opinion | <ul style="list-style-type: none"> • Graphs and tables are professional • Accurately summarizes the tables and graphs in text w/o opinion |
| Conclusion(s) | <ul style="list-style-type: none"> • Fails to identify conclusions, or conclusion is a simplistic summary • Conclusion presented as "proof" | <ul style="list-style-type: none"> • Identifies conclusions and refers to some specific pieces of evidence • Does not relate conclusion to the broader field | <ul style="list-style-type: none"> • Clearly links evidence with the conclusion • Minimal consideration of limitations | <ul style="list-style-type: none"> • 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 | 2017-2018 | 2018-2019 | 2019-2020 | 2020-2021 | 2021-2022 | 2022-2023 |
|---|---|--------------------------------|-------------------------------|---|-------------------------------|-------------------------------|
| Alumni survey (Indirect) | 50% strongly agreed with the statement, 16.7% agreed with the statement | Data not collected this year* | Data not collected this year* | Switched to two distinct questions (below) | Data not collected this year* | Data not collected this year* |
| Alumni survey (Indirect): <i>Did the program coursework help you to distinguish between the types of questions science faith can answer?</i> | | | | 40% strongly agreed with the statement, 27% agreed with the statement | | |
| Alumni survey (Indirect): <i>Did the program coursework (assignments, discussions) include the potential compatibility of science and faith?</i> | | | | 53% strongly agreed with the statement, 13% agreed with the statement | | |
| BIO 6033 Signature assignment (Direct): <i>Explanation of the distinction between religious faith and science</i> | N=15 | | N=16 | N=14 | N=12 | N = 7 |
| | 60% | Data not collected this year** | 62% | 54% | 60% | 71% |
| BIO 6033 Signature assignment (Direct): <i>Articulation of the possibility of a relationship and compatibility of the two domains</i> | 100% | Data not collected this year** | 94% | 93% | 100% | 71% |

*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:

In BIO 6033, fewer students see the possibility of compatibility of science and faith compared to previous years, but a significant percentage are clearly distinguishing between science and faith.

Changes to be Made Based on Data:

While instruction in BIO 6033 has been adjusted to address more clearly the distinctions between faith and science, more emphasis should be added on the possibility of the compatibility between them.

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 |