**BS in Environmental Science Assessment Plan**

1. **Learning Objective 1 – Breadth and depth of knowledge:**

**Statement**

Students will develop knowledge common to the liberal arts and sciences in the fields of arts, humanities, natural sciences, and social sciences. Students will also develop specialized knowledge and disciplinary expertise (CWEO 4.1.)

**ULO 2. Breadth and depth of knowledge** Develop knowledge common to the liberal arts and sciences in the fields of arts, humanities, natural sciences, and social sciences. Students will also develop specialized knowledge and disciplinary expertise

 **Learning Objectives (Outcomes)**

a) Understand the nature of science, biological molecules, cell structure and function, enzymes, metabolism, and classical and molecular genetics.

b) Understand the diversity of animal life; comparative aspects of development, physiology, morphology; life history, behavioral ecology, and evolutionary biology of animals.

c) Understand the diversity of plants; flowering plant anatomy, physiology, reproduction, and ecology; distribution of major plant communities with global climate patterns; biogeochemical cycles.

d) Understand hereditary mechanisms: linkage, gene interactions and regulation, molecular genetics, mutations, and development.

e) Understand interactions of organisms at the species, community, and ecosystem levels; evidences for modern evolutionary thought in the context of a Christian world view.

f) Understand theoretical structure and philosophical assumptions of environmental science.

g) Understand human impact on above systems and potential responses from a Christian Stewardship world view.

 **Courses/Programs Designed to Achieve Learning Objectives**

Planned, hierarchical first-two-year curriculum (BIOL 160, 161, 162, 260, 262)

followed by Junior and Senior year required courses (BIOL 271, 274, 315, CHEM 340, GIS 245) and electives chosen from Plant and Animal Taxonomy course groupings (BIOL321 or 332; BIOL 356 or 358) culminating in a Senior Capstone course (SUST 495/BIOL 495).

1. BIOL 160, 260
2. BIOL 161, 262
3. BIOL 162, 262
4. BIOL 260
5. BIOL 262
6. BIOL 274, SUST 495/BIOL 495
7. BIOL 271, 274, 315, SUST 495/BIOL 495

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| --- | --- | --- |
| **Assessment Strategies (Measures)** | **Results (Targets)** | **Timeline** |
| Internal exam taken in BIOL 260  | 75% achieving 70% or higher.  | Collect every year, analyze in even years. |
| ETS exam taken in SUST 495/BIOL 495 | 70% of majors will score at or above the national mean  |

**2. Learning Objective 2 - Specialized skills and scholarship**

**Statement**

Students will become proficient in the scholarship of their discipline and demonstrate specialized skills required for employment (CWEO 4.2.)

**ULO 4.2 Specialized scholarship.** Become proficient in the scholarship of their discipline and demonstrate specialized skills needed to pursue a career and/or graduate school

 **Learning Objectives (Outcomes)**

1. Participate in investigative-style laboratory experiences.
2. Learn to work as teams in conducting laboratory and field research.
3. Participate in intentional writing skills development within the major.
4. Application and extension of basic field and laboratory skills.
5. Present research results to an audience (e.g., in-class, on-campus, symposia, off-campus venues).

**Courses/Programs Designed to Achieve Learning Objectives**

Investigative laboratory experiences in selected courses throughout the major (BIOL 162, 260, 262). Intentional writing skills development within the major (BIOL 160, 262). Some students involved in faculty mentored student research program (BIOL 393, 422).

* 1. BIOL 260, 262, GIS 245
	2. BIOL 160, 260, 262, 271
	3. BIOL 160, 262, 271
	4. BIOL 271, Option 1: upper level lab courses; Option 2: BIOL 393, 422
1. Curricular and Co-curricular opportunities

|  |  |  |
| --- | --- | --- |
| **Assessment Strategies (Measures)** | **Results (Targets)** | **Timeline** |
| BIOL 162 ethnobotany oral presentation | 90% of majors will score a 75 or higher on the grading rubric | Collect every year, analyze in odd years. |

**Learning Objective 3 – Specialized skills and scholarship**

**Statement**

Students will become proficient in the scholarship of their discipline and demonstrate specialized skills required for employment (CWEO 4.3.)

**ULO 4.3 Specialized skills** Become proficient in the scholarship of their discipline and demonstrate specialized skills needed to pursue a career and/or graduate school

 **Learning Objectives (Outcomes)**

* 1. Proficient in basic field and laboratory techniques (e.g., microscopy, dissection, slide preparation, wetland delineation, plant and animal identification, radio telemetry, analysis of biological communities).
	2. Familiar with essential laboratory and field safety protocols.
	3. Able to search the biological literature and retrieve papers from journals.
	4. Able to compose technical lab reports in format similar to scientific journals and reports similar in format to government and consulting reports.
1. Skilled in use of software such as Excel, Word, PowerPoint, and ArcGIS in analysis and reporting of scientific data.

**Courses/Programs Designed to Achieve Learning Objectives**

Planned series of lab-based courses in the first-two-year curriculum (BIOL 160,

161, 162, 260, 262), followed by lab-based Junior and Senior year required courses (BIOL 271, 274, 315, CHEM 340, GIS 245) and electives chosen from Plant and Animal Taxonomy course groupings (BIOL321 or 332; BIOL 356 or 358) culminating in a Senior Capstone course (SUST 495/BIOL 495) with some students involved in faculty mentored student research program (BIOL 393, 422).

1. BIOL 160, 161, 162, 260, 262, 271, CHEM 340
2. All lab and field courses
3. BIOL 160, 262
4. BIOL 262, 271, 274
5. BIOL 160, 162, 262, 271, 274, GIS 245

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| --- | --- | --- |
| **Assessment Strategies (Measures)** | **Results (Targets)** | **Timeline** |
| Lab skills achieved by second year | For each skill, 75% of majors will demonstrate proficiency | Collect every year, analyze in odd years. |
| Lab skills in BIOL 271 (wetland delineation, basic navigation, radio telemetry) | For each skill, 90% of majors will demonstrate proficiency |
| GIS Skills | 75% of majors will score at least a 25 out of 30 in the Query/Interview section of the rubric |
| Excel assignment for graphing (BIOL 162) | 90% of majors will earn a score of 75% or higher on rubric |

**4. Learning Objective 4 - Intrapersonal awareness**

**Statement**

Students will gain self-awareness of identity, character, and vocational calling (CWEO 4.4.)

**ULO 5. Self-Awareness** Gain awareness of identity, character, and vocational calling

 **Learning Objectives (Outcomes)**

Be familiar with options for employment, voluntary service, and/or graduate education in environmental science.

**Courses/Programs Designed to Achieve Learning Objectives**

Informal: departmental advising, departmental seminars, associated student organizations (e.g., Earthkeepers, Grantham Community Garden, Pennsylvania Association of Environmental Professionals)

Formal: SUST 495/BIOL 495, faculty-mentored student research (BIOL 393, 422)

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| **Assessment Strategies (Measures)** | **Results (Targets)**  | **Timeline** |
| Vocation assignment response | 75% of majors will score 4.5 or above (out of 6) on the grading rubric  | Collect every year, analyze in even years. |

**5. Learning Objective 5 – Faith knowledge & application**

**Statement**

Students will develop informed and mature convictions about Christian faith and practice (CWEO 4.5.)

**ULO 3. Faith knowledge & application** Develop informed and mature convictions about Christian faith and practice

 **Learning Objectives (Outcomes)**

1. Understand the inter-relatedness of living organisms & humanity’s calling to creation stewardship.
2. Understand various models that relate science and Christian faith.
3. Appreciate historical, philosophical, and ethical aspects of Environmental Sciences.

**Courses/Programs Designed to Achieve Learning Objectives**

Introductory material on science/faith integration in first-two-year courses (BIOL

160, 161, 162, 262), extended in Environmental Ethics (BIOL315) culminating in capstone course (SUST 495/BIOL 495) in senior year.

* 1. BIOL 161,162, 262, 271, 274, 315
	2. BIOL 160, 161, 262, 274, SUST 495/BIOL 495
1. BIOL 262, 274, 315, SUST 495/BIOL 495

|  |  |  |
| --- | --- | --- |
| **Assessment Strategies (Measures)** | **Results (Targets)** | **Timeline** |
| BIOL 274 Green Bible Response paper | 90% of majors will score a 75% or higher on the grading rubric | Collect every year, analyze in even years |
| Capstone integration paper in BIOL 495 or SUST 495. | 70% of students will score “Satisfactory” (2 out of 4) or better in all categories. |

**BIOL 162 Ethnobotany presentation**

1. **Content coverage** (25pts)

|  |  |  |  |
| --- | --- | --- | --- |
|  Creative title **slide** (presenters names, date)  Reason(s) for choosing plant topic Herbaceous/Woody Perennial/biennial/annual  Deciduous or evergreenAverage size at maturity Vegetative characters Leaves (arrangement, complexity, margin)  Stems (unusual features?)  Roots (unusual features?) Floral characters Complete/incomplete Perfect/imperfect  Corolla symmetry Color of corolla  Number sepals, petals, stamens, pistils Fusion of parts  Manner of pollination Type of fruit Distribution Historic/current – **slide** with world map Old World/New World  Biome  | 111111111111 | Taxonomy Classification **slide** ((APG III clade name)  Nomenclature Formatting of binomial  Authority  Pronunciation and meaning of name Common name  Related species Ethnobotanical Significance Historic  Current  Name/structure molecules (if needed) Summary **slide**  References **slide** – minimum ten references References  One primary science research article  Electronic sources of recognized quality Recognized citation style  Citations on slides for photographs, quotes, primary research data/info  | 1111111111111 |

2. **Communication skills** (25pts)

 Was “excessive” reading of notes/slides avoided? 1 2 3 4 5

 Did the speakers make good eye contact? 1 2 3 4 5

 Did the speakers speak clearly with good volume? 1 2 3 4 5

 Were topics presented in an orderly manner? 1 2 3 4 5

 Did the speakers clearly answer questions? 1 2 3 4 5

3. **Effectiveness of visual material** (25pts)

 Appropriate font size & slide backgrounds 1 2 3 4 5

 Slides easy to read and understand 1 2 3 4 5

 Adequate number of illustrations/pictures 1 2 3 4 5

 Quality of pictures and diagrams, spelling 1 2 3 4 5

 Evidence of care and creativity in crafting talk 1 2 3 4 5

4. **Overall effectiveness of presentation** (25pts)

 Informative, engaging, well-researched? 1 2 3 4 5

 Equal participation/professional attire? 1 2 3 4 5

Finish within 16-18 minute window? Time\_\_\_\_\_\_ 1 2 3 4 5

 Meaningful use of primary research article? 1 2 3 4 5

 One half presentation time for Ethnobotany? 1 2 3 4 5

 Total score\_\_\_\_\_\_\_/100

**Learning Objective 3 – Technical Competency**

**Lab skills achieved by the second year**

Target: 75% of majors will demonstrate proficiency

BIOL 160 Microscopy – use oil immersion to locate and focus on a specified item

 Restriction analysis – use results from question on final exam

BIOL 161 Basic dissection skills

BIOL 162 Microscopy – prepare a slide (H2O mount of thin-sectioned plant tissue)

 Taxonomy – create a taxonomic key to identify tree species

BIOL 260 Pipetting

BIOL 160 Restriction analysis exam question

15. The DNA circle shown below (left) was cleaved at the locations indicated by the short lines. Which

pattern on the gel (right) best corresponds to the pattern of fragments generated by cleavage of the circle

at those locations?

A. 1

B. 2

C. 3

D. 4

E. M

  

**Lab skills in BIOL 271 and GIS 245**

**BIOL 162 Expressing Data in Graphic Format – Excel exercise**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |
| --- | --- | --- | --- |
|  | Relative Basal Area | Relative Density | Actual Density |
| 2-D Clustered Column Graph | 1 | 1 | 1 |
| All species abbreviations present and in vertical orientation to each bar | 1 | 1 | 1 |
| Net change, title box and horizontal lines removed | 1 | 1 | 1 |
| Outer border removed | 1 | 1 | 1 |
| Correct horizontal axis title and placement | 1 | 1 | 1 |
| Correct vertical axis title and placement  | 1 | 1 | 1 |
| Correct figure legend properly positioned below figure   | 1 | 1 | 1 |
| Each figure with legend on its own page in portrait orientation | 1 | 1 | 1 |
| Subtotals |  |  |  |
|  |  | Total |  |

**Assessment Rubric for Green Bible Essay Summary**

**Student:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Criterion  | **Poor**  | **Fair**  | **Good**  | **Excellent**  |
| **Content & Development 50%** **\_\_\_\_\_**  | No clear position taken; reasons undeveloped; no supporting facts used 0 10 20  | Position not clearly stated; development is brief; unrelated, unsupported general statements, reasons, and details; minimal facts used. Counter arguments not acknowledged. 25 30 35  | Clear position taken and defined; some reasons and some details present, but not fully developed. Counter arguments addressed. 40 45  | Takes a strong, well defined position; uses at least three appropriate reasons with at least two supporting details for each reason. Counter arguments effectively addressed, w/o undercutting position.48 50  |
| **Organization & Structure 20 %** **\_\_\_\_\_**  | Organization and structure detract from the message of the writer. Paragraphs are disjointed and lack transition of thoughts. 0  | Structure of the paper is not easy to follow. Paragraph transitions need improvement. Conclusion is missing, or if provided, does not flow from the body of the paper. 5 10  | Structure is mostly clear and easy to follow. Paragraph transitions are present. Conclusion is logical. 12 15  | Structure of paper is clear and easy to follow. Paragraph transitions are logical and maintain the flow of thought throughout the paper. Conclusion is logical and flows from the body of the paper. 20  |
| **Format 10 %** **\_\_\_\_\_**  | Paper lacks many elements of correct formatting. Paper is inadequate/ excessive in length. Paper is not double spaced. 0  | Paper follows most guidelines. Paper is over/ under word length. 2  | Paper follows designated guidelines. Paper is the appropriate length as described for the assignment.Format is good. 57  | Paper follows all designated guidelines. Paper is the appropriate length as described for the assignment. Format enhances readability of paper. 10  |
| **Grammar, Punctuation & Spelling 20 %** **\_\_\_\_\_**  | Paper contains grammatical, punctuation, and spelling errors. Language uses jargon or conversational tone. 0  | Paper contains few grammatical, punctuation and spelling errors. Language lacks clarity or includes the use of some jargon or conversational tone. 5 10  | Rules of grammar, usage, and punctuation are followed with minor errors. Few or no spelling errors. 12 15  | Rules of grammar, usage, and punctuation are followed; spelling is correct. Language is clear and precise; sentences display consistently strong, varied structure. 20  |

| **Vocational Essay**  |
| --- |
| **Criteria** | **Ratings** | **Pts** |
| Identifies 3 or more career opportunities in major [view longer description](https://messiah.instructure.com/courses/1393902/assignments/7477431)  |

|  |  |  |  |
| --- | --- | --- | --- |
| Good2 pts  | Fair1 pts  | Poor0.5 pts  | Not Done0 pts  |

 | 2 pts |
| Identifies 3 or more on/off campus opportunities to develop career skills during college. [view longer description](https://messiah.instructure.com/courses/1393902/assignments/7477431)  |

|  |  |  |  |
| --- | --- | --- | --- |
| Good2 pts  | Fair1 pts  | Poor0.5 pts  | Not Done0 pts  |

 | 2 pts |
| Identification of 3 or more Career Skills Gained in Major [view longer description](https://messiah.instructure.com/courses/1393902/assignments/7477431)  |

|  |  |  |  |
| --- | --- | --- | --- |
| Good2 pts  | Fair1 pts  | Poor0.5 pts  | Not Done0 pts  |

 | 2 pts |
| Total Points: 6 |