**BS in Molecular Biology Assessment Plan**

**Learning Objective 1 - Breadth and depth of knowledge:**

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)**

1. Understand the nature of science, and the scientific method
2. Develop understanding of cell structure and function; metabolic processes; biological macromolecules; gene structure, expression and manipulation; and principles of genetic inheritance
3. To develop understanding of Mendelian Genetics and basic concepts of Developmental Biology
4. To understand foundational principles of animal morphology, physiology, systematic zoology and taxonomic techniques for animals
5. Understand foundational concepts of plant structure, function and taxonomy
6. Understand foundational content, practices and philosophical assumptions of biological sciences
7. Develop integrative skills relating Biological concepts with chemistry, mathematics and writing

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

Planned, hierarchical first-two-year curriculum (BIOL 160, 161, 162, 260; CHEM 105, 106, 309, 310) followed by required (BIOL 413, 417, 412; CHEM 410, 412) and elective Junior and Senior year courses offered by the Biological Sciences and Chemistry and Biochemistry Departments, culminating in a Senior Capstone course (BIOL 495).

1. BIOL 160, 393,
2. BIOL 160, 260, 412, 413, 417; CHEM 410, 412
3. BIOL 260
4. BIOL 161
5. BIOL 162
6. BIOL 160, 495
7. BIOL 160, 412, 413, 417; CHEM 410, 412

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| --- | --- | --- |
| **Assessment Strategies (Measures)** | **Results (Targets)** | **Timeline** |
| a) Internal exam taken in BIOL 260.  | a) 75% of majors will achieve a grade of70% or higher.  | Collect every year, analyze in even years.  |
| b) ETS exam taken in BIOL 495. | b) 75% of majors will score at or above the national mean on relevant subsections  |

**Learning Objective 2 – Specialized skills and scholarship**

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. Work with primary literature in Molecular & Cellular Biology
2. Participate in scientific investigation
3. Understand ethical issues related to Molecular Biology
4. Learn to work as part of teams when conducting laboratory research
5. Present research results to students, faculty and scientists, in class or public settings
6. Think logically, analytically, creatively

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

Investigative laboratory experiences in selected courses throughout the major (BIOL 162, 260, 413, 417, CHEM 410, 412). Intentional writing skills development within the major (BIOL 160, 413, CHEM 412). Some students involved in faculty mentored student research program (BIOL 393, 422). Specifically:

1. BIOL 412, 413
2. BIOL 393, 422
3. BIOL 160, 260, 413, 495
4. BIOL 160, 260, 412, 413
5. BIOL 160, 413, 422
6. BIOL 422

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| --- | --- | --- |
| **Assessment Strategies (Measures)** | **Results (Targets)** | **Timeline** |
| a) BIOL 162 ethnobotany oral presentation  | a) 90% of majors will score a 75 or higher on the grading rubric  | Collect every year, analyze in odd years. |
| b) BIOL 413 primary literature presentation | b) 90% of majors will score a 75% or higher on the grading rubric |

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

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. Participate in lab-based opportunities that introduce and expand upon aspects of Mendelian Genetics, Cellular and Molecular Biology, and Biochemistry
2. Develop basic skills in microscopy, dissection, and pipetting
3. Search the biological literature and retrieve papers from journals
4. Develop skill in operating computer-interfaced image recorders
5. Manipulate & analyze plasmid DNA, or chromosome images
6. Gain confidence in advanced microscopy skills
7. Compose technical lab reports in format similar to scientific journals
8. Use common software applications like Word, Excel, PowerPoint
 to analyze and report scientific results
9. Understand fundamental techniques used to isolate, analyze and manipulate biological macromolecules (e.g. proteins or plasmids).

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

Planned series of lab-based courses in the first-two-year curriculum (BIOL 160,161, 162, 260), followed by lab-based Junior and Senior year requirements (BIOL 413, 417, CHEM 410, 412) and electives chosen from Biology and Chemistry course offerings with some students involved in faculty mentored student research program (BIOL 393, 422).

1. BIOL 160, 260, 412, 413, 417; CHEM 410, 412
2. BIOL 160, 161, 162
3. BIOL 160, 412, 413, 393
4. BIOL 412, 413
5. BIOL 160, 260, 413, 417
6. BIOL 161, 412
7. BIOL 160, 412, 413, 417
8. BIOL 160, 412, 413, 417, CHEM 410, 412
9. BIOL 413, CHEM 410, 412

|  |  |  |
| --- | --- | --- |
| **Assessment Strategies (Measures)** | **Results (Targets)** | **Timeline** |
| a) Lab skills achieved by second year (microscopy, restriction analysis, basic dissection, pipetting) | a) For each skill, 75% of majors will demonstrate proficiency | Collect every year, analyze in odd years. |
| b) Excel assignment for graphing (BIOL 162) | b) 90% of majors will score 75% or higher on rubric. |

**Learning Objective 4 - Intrapersonal awareness**

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 biology.

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

Informal: departmental advising, departmental seminars, health careers advisor, associated student organizations (e.g., Sigma Zeta, Earthkeepers, Med-Aware)

Formal: 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. |

**Learning Objective 5 - Faith knowledge & application**

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. To illustrate the splendor of God’s creation, inter-relatedness of living organisms & humanity’s calling to creation stewardship
2. Grasp philosophical & historical foundations of Biological Sciences
3. Understand responsibilities of Christians related to use of new technologies in Human Genetics
4. Think synthetically, logically and creatively about Biological Sciences and Christian faith
5. Bring Christian faith to bear on call as servant/leader

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

Introductory material on science/faith integration in first-two-year courses (BIOL 160, 161, 162) culminating in capstone course (BIOL 495) in senior year.

1. BIOL 161, 262
2. BIOL 161, 495
3. BIOL 260, 315, 317, 495
4. BIOL 495
5. BIOL 218, 495

|  |  |  |
| --- | --- | --- |
| **Assessment Strategies (Measures)** | **Results (Targets)** | **Timeline** |
| BIOL 495 integration paper. | 70% if students will score “Satisfactory” (2 out of 4) or better in all categories. | Collect every year, analyze in even years. |

**BIOL 162 Ethnobotany presentation rubric**

**Names of presenters \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Topic \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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

**BIOL 413 Primary Literature Assignment**

**Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_ No. \_\_\_\_\_\_\_\_\_\_ Name** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Quality of Student Oral PowerPoint Presentation of Primary Research (Journal) Article**

**(55 points total)**

**Written Outline of Oral Presentation** ( \_\_\_\_\_ / 5)

Neatly typed outline summary; *not* printed presentation slides.

Organized/balanced like presentation (easy to follow during presentation)

Submitted *before* presentation begins

Includes name of student presenter

Includes citation information: title, authors, journal, volume, pages of article

**Presentation** (My overall impression of your presentation) ( \_\_\_\_\_ / 5)

 Flow of presentation indicated appropriate preparation

 Segments of presentation were organized well

 Heavy use of appropriate visual aids and minimal use of “full text” slides

 General quality of oral delivery (Fluid vs. uncertain? Eye contact with audience?)

 ***Appropriate use of allotted time; balanced sections ( 15 minutes +/- 30 seconds)***

**Organization of Oral presentation**

**Introduction** (Do NOT just repeat/rehash the short intro presented by the authors!) ( \_\_\_\_\_ / 18)

 Adequately provided background needed to appreciate experimental question

 Liberal use of illustration slides (use of background info obtained from *additional* sources)

 Specifically/succinctly stated problem and summarize overall experimental approach(s)

**Results** (with Methods presented *only* as needed integrated with relevant experiments) ( \_\_\_\_\_ / 20)

 Presentation adequately explains key experiments; limit number presented to adequately explain

 Summarized methods required to obtain key results (without excessive detail)

 Present clear explanation of how/why results in given figure/graph/table support hypothesis

 Clearly state result(s)/implications of key experiments

 Demonstrated adequate understanding of experiments presented

**Conclusions** ( \_\_\_\_\_ / 3)

 Summarize main objectives of study and experimental results that support/refute

 Mentioned relevance, impact on field

 Mentioned future/further questions posed by results of the study

**Participation when part of audience:** Asked ***meaningful*** questions to other presenters ( \_\_\_\_\_ / 4)

 Circle as asked: 1 2 3 4

**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

  

**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 |  |

| **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 |