# COLLEGE OF NATURAL AND APPLIED SCIENCES
# BIOLOGY
# BACHELOR OF ARTS IN BIOLOGY
# MINOR IN BIOLOGY
# SEVEN FULL-TIME FACULTY MEMBERS

## BIOLOGY CURRICULAR MAPPINGS (CMs)

### BIOLOGY/NURSING SUPPORT PROGRAM SLOs

- **BI NU-1**: Disciplinary knowledge and skills: students will be able to demonstrate their foundational knowledge of the major fields of biology, through their focus on anatomy, physiology, and microbiology. They will be able to apply their knowledge as health care consumers or concerned citizens with regard to public health issues.
- **BI NU-2**: Laboratory skills: students will demonstrate competency in a range of biological laboratory skills, use of scientific instruments, and safety in the laboratory.
- **BI NU-3**: Quantitative and analytical skills: students will demonstrate their ability to test hypotheses, collect scientific data, analyze those data, and interpret results using critical thinking.
- **BI NU-4**: Communication skills: students will demonstrate their ability to communicate by writing in a clear and concise manner, through a combination of lab reports, lab review exercises, and written exams.

### BIOLOGY DEGREE PROGRAM SLOs

- **BI PR-1**: Disciplinary knowledge and skills: Graduates use their knowledge & understanding of essential concepts to solve problems in ecology, genetics, molecular biology, systematic, & evolution. They can apply their biology knowledge & skills to locally important issues such as island biogeography, conservation, & endangered species problems. They apply relevant concepts from chemistry & physics to biology problems.
- **BI PR-2**: Quantitative skills: Graduates apply numerical methods in research design, and use computers for analysis manipulating and modeling biological data.
- **BI PR-3**: Research/Laboratory skills: Graduates are competent in basic biology procedures & safety in the laboratory & the field; they formulate testable hypotheses & create effective experimental designs using their knowledge, understanding, & practical experience of scientific instruments.
- **BI PR-4**: Communication skills: Graduates use scientific literature & diagrams as a source of information, properly cite sources & avoid plagiarism, & create text & graphics to communicate results effectively through print & oral presentations. They collect & assess evidence & use it to create effective arguments in writing scientific reports & proposals.
- **BI PR-5**: Digital Literacy: Graduates use & process information in multiple formats via computer. Graduates are competent in the following computer skills as related to their science work: desktop competencies, work processing, presentation, and data retrieval and manipulation. Graduates effectively judge the usefulness and accuracy of external sources of information.
- **BI PR-6**: Professionalism: Graduates work effectively together in teams in a laboratory and field settings and follow ethical principles underlying scientific research and publication. Graduates understand and apply the values and limitations of scientific research in addressing public policy issues.

### GE SCIENCE SLOs

- **SC GE-1**: observe, describe, and interpret natural and experimental phenomena within the context of a scientific paradigm;
- **SC GE-2**: develop and employ skills of logical and critical thinking to collect and analyze data, interpret results, and write reports;
- **SC GE-3**: characterize scientific knowledge as theories and principles that result from experimentation that are subject to revision based on new observations and discoveries;
- **SC GE-4**: apply basic scientific principles and methods to explore the workings of the natural world, particularly in this region;
- **SC GE-5**: apply basic scientific principles and methods to solve real-world problems, and make appropriate use of science in their choices as citizens.
- **SC GE-6**: identify the capabilities and limitations of science, and distinguish science from pseudoscience;
- **SC GE-7**: identify how scientific ideas and values have been integrated into society and how other aspects of society affect science as a human activity.

### BIOLOGY/NURSING SUPPORT PROGRAM CM

| COURSE NO. | LINK TO BI/NU SLOs[1] | | | |
|---|---|---|---|---|
| | BI NU-1 | BI NU-2 | BI NU-3 | BI NU-4 |
| BI 124 | 1,2,3,4,5 | | 2,4,5 | 1,2,3,4,5 |
| BI 124L | 1,2,3,4 | 1,2,3,5,6 | 1,2 | 1,3,4 |
| BI 125 | 1,2,3,4,5,6 | | 2,3,4,5 | 1,2,3,4,5,6 |
| BI 125L | 1,2,3,4 | 1,2,5 | 1,2 | 1,3,4 |
| BI 225 | 1,2,3,4 | | | |
| BI 225L | 1,2,3,4 | 1,2,3,4 | | |

### BIOLOGY DEGREE PROGRAM CM

| COURSE NO. | LINK TO PROGRAM SLOs[1] | | | | | |
|---|---|---|---|---|---|---|
| | BI PR-1 | BI PR-2 | BI PR-3 | BI PR-4 | BI PR-5 | BI PR-6 |
| BI 120 | 2 | | | 1,2 | 3 | 2 |
| BI 157 | 1 | 2 | 2,3 | 1,2,3 | 3 | 1,2,3 |
| BI 157L | 1 | 2 | 2,3 | 1,2,3 | 3 | 1,2,3 |
| BI 158 | 1 | 1 | 2,3 | 3 | 1,2,3 | 1,2,3 |
| BI 158L | 1 | 1 | 2,3 | 3 | 1,2,3 | 1,2,3 |
| BI 302/BI 302L | 1,2,3,4 | | 3,5 | 3 | 5 | |
| BI 303 | 1,3 | | 2,3 | 1 | 1,2,3 | 1,2,3 |
| BI 303L | 1,3 | | 2,3 | 1 | 1,2,3 | 1,2,3 |
| BI 310 | 1,2,3,4,5 | 2,4,5 | 4,5 | 1,3 | 2,4,5 | 1 |
| BI 315 | 1,2,3,4,5 | 1,4,5 | 4,5 | 1,2,3 | 1,4 | 4,5 |
| BI 315L | 1,2,3,4,5 | 1,4,5 | 4,5 | 1,2,3 | 1,4 | 4,5 |
| BI 320 | 1 | | 1 | 1 | 1 | 2 |
| BI 321 | 1 | | | 1,2,3 | 2 | |
| BI 333 | 1,3 | | 2,3 | 1,3 | 1,2,3 | 1,2,3 |
| BI 333L | 1,3 | | 2,3 | 1,3 | 1,2,3 | 1,2,3 |
| BI 365 | 1,2 | 1 | 2,3,4 | 1,2 | 1,2,3,4 | 1,2,3,4 |
| BI 365L | 1,2 | 1 | 2,3,4 | 1,2 | 1,2,3,4 | 1,2,3,4 |
| BI 410 | 1 | 1,2,3 | 2,3 | 1,2,3 | 1,2,3 | 1,2,3 |
| BI 412/BI 412L | 1 | 2 | 2,3 | 1,2,3 | 3 | 1,2,3 |
| BI 416 | 7,9,10 | 7,4 | 8 | 8,9,10 | 9,10 | 10 |
| BI 416L | 2,3,4,9,12 | 2,9,10 | 10,11 | 14 | 10,11,14 | 10 |
| BI 419 | 3,4,6,10 | 4,6 | 4,10 | 3,10 | 3,4,10 | 10 |
| BI 419L | 1,2,3,4 | 1,2,3,4 | 4,5,6,7 | 4,5 | 1,2,4,5 | |
| BI 425 | 2,3,4,9 | 9,11 | 5,7,9 | 4,5,7 | 4,5,7 | 4,5,8 |
| BI 425L | 6,7,8,9 | 5 | 3,10 | 3,10 | 3,10 | 3,10 |

### BIOLOGY GE CM

| COURSE NO. | LINK TO GE SLOs[1] | | | | | | |
|---|---|---|---|---|---|---|---|
| | SC GE-1 | SC GE-2 | SC GE-3 | SC GE-4 | SC GE-5 | SC GE-6 | SC GE-7 |
| BI 100/BI 100L | 1 | 2,3 | 4 | 2 | 5 | 6 | |
| BI 157 | 1,2 | 1,2,3 | 1,2,3 | 1,2 | 1,2 | 1 | 1 |
| BI 157L | 1,2 | 1,2,3 | 1,2,3 | 1,2 | 1,2 | 1 | 1 |
| BI 158 | 1,2 | 1,2,3 | 1,2,3 | 1,2,3 | 1,2 | 1 | 1 |
| BI 158L | 1,2 | 1,2,3 | 1,2,3 | 1,2,3 | 1,2 | 1 | 1 |
| BI 212 | 1,2,3,4,5,6,7 | | | 1,2,3,4,5,6,7 | 1,2,3,4,5,6,7 | | |
| BI 212L | 1,2,3,4,5,6,7 | | | 1,2,3,4,5,6,7 | 1,2,3,4,5,6,7 | | |
| BI 225[1] | | | | | | | |
| BI 225L[1] | | | | | | | |
| BI 303 | 1,2 | 1,2 | 1,2 | 1 | | 1 | 1 |
| BI 303L | 1,2 | 1,2 | 1,2 | 1 | | 1 | 1 |
| BI 310 | 1,2,3,4,5 | 2,3,4,5 | 1,3 | 4,5 | 1,2,3,4,5 | 1,3 | 1,3 |
| BI 315 | 1,2,3,4,5 | 1,4,5 | 1,2,3 | 4,5 | 1,4,5 | 1 | 1,4,5 |
| BI 315L | 1,2,3,4,5 | 1,4,5 | 1,2,3 | 4,5 | 1,4,5 | 1 | 1,4,5 |
| BI 333 | 1,2 | 1,2 | 1,2 | 1 | | 1 | 1 |
| BI 333L | 1,2 | 1,2 | 1,2 | 1 | | 1 | 1 |
| BI 365 | 1,2 | 1,2 | 1,2 | 1,3,4 | 1,2 | 1 | 1,2,4 |
| BI 365L | 1,2 | 1,2 | 1,2 | 1,3,4 | 1,2 | 1 | 1,2,4 |
| BI 410 | 1,2 | 1,2 | 1,2 | 1,2,3 | 1,2,3 | 1 | 1,2 |
| BI 412/BI 412L | 1,2 | 1,2,3 | 1,2,3 | 1,2 | 1,2 | 1 | 1 |
| BI 474 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

[1]**The numbers are course SLO numbers that link the course to the program SLO (See UOG/CNAS/CNAS Assessment Website for detailed descriptions of these course SLOs by visiting: http://www.uog.edu/dynamicdata/CNASAssessment.aspx?siteid=2&p=20);**

## BIOLOGY PROGRAM ASSESSMENTS

| ASSESSMENT ACTIVITY | ASSESSMENT RESULTS AND RECOMMENDATIONS FOR PROGRAM IMPROVEMENTS |
|---|---|
| 1. **Bio majors'** statistical ability -- Because of student difficulties in the required BI 412 Biometrics, Math faculty conducted pre-test of students at start of course to assess preparedness. | Results showed that a statistics course tailored to biology would better prepare students for BI412 than the present requirement of MA61a – College Algebra. Results were used to support a successful grant application; course development is largely complete and a new textbook for the course by Prof. Han Tower Chen is in draft form; course MA 394 (Biostatistics) is being piloted in Spring 2009. |
| 2. **Bio majors'** communication ability -- BI310 (Evolution) - Students do a critical review of a research articles with the application of knowledge from the course and with the application of a scoring rubric. | Assessment data used to focus instruction and exams on problem-solving and hypothesis testing. |
| 3. **Bio majors'** communication ability -- Various measures and anecdotal reports from science faculty revealed student need for increased skills in reading and writing science. Among the measures was a Cloze test used internationally to assess student reading difficulties; this test was also given to pre-nursing and gen-ed students (see example of Program Assessment on page 2). | Results of tests were used to justify funding from ED-MSEIP to include development of three one-credit science communication courses: BI 120 (Scientific Prose), 320 (Biodiversity Photomicroscopy), 321 (Scientific Arguments) – (also called SciComm 1, 2, and 3). These courses are now required in the BA Biology program. Based on assessment and new learning by faculty, structured critical thinking and responsible conduct of scientific research are being integrated under a UOG NIH *RISE* grant. |
| 4. **General Education Science** – Various measures were used to assess student reading and writing skills, especially with regard to an exercise in writing a lab report, introduced to the course to meet Gen Ed goals. | Results of the lab report test showed that there was little correlation between the student's writing ability in the lab report, judged by a rubric that eliminated content, and their overall performance in the course. Results of the Cloze test showed that students in BI 100 had similar difficulties to pre-nursing and science majors. |
| 5. **Pre-nursing** service courses -- BI124/125 (Anatomy & Physiology)- Evaluation of multiple-section lecture and lab classes in BI 124 and BI 124L - structure, content, and student evaluation / grading. | Uniformity in structure, content, and evaluation, was needed across all sections. Staffing was inadequate to the demand for the class. Changes—an adjunct instructor and 2 graduate students were hired to run the 6 lab sections. A single instructor teaches the lectures and coordinates all the lab sections. Enrollment issues (class overrides, etc.) were solved by a single instructor, to ensure that all labs and lectures are approximately equal in size to ensure student-to-instructor ratios. A common syllabus, timetable, and SLOs were prepared, and given to the students. Weekly lab meetings among all instructors ensure consistency among sections. A single instructor writes all the quizzes, tests, and exams, with multiple versions within and between sections. Common lab exams (4-5) are administered in a single day, to all students in the lab. Staffing continues to be inadequate to the demand for the class, as well as the projected future enrollments. |
| 6. **Pre-nursing** service courses -- BI124/125 (A&P) Pre- and post-test assessments were conducted for 91 students in BI 124 in Fall 2007 and 147 in BI124 in Fall 2008; Pre- and post-test assessments were conducted for 86 students in BI 125 in Spring 2008, and 110 pre-test assessments were conducted in BI125 spring 2009. | Data input and analysis is not complete. Projected outcomes and changes—It may be necessary to change the amount of time spent on particular sections that the students find especially difficult. Students appear to have difficulty making the transition from memorization to critically thinking about the subject matter. It may be necessary to build in a critical thinking module. |

# BIOLOGY ASSESSMENT OF ONE PROGRAM SLO USING ONE DIRECT MEASURE OF ASSESSMENT WITH RECOMMENDATION FOR PROGRAM IMPROVEMENT

## Cloze test of science student difficulties with reading science texts

Conducted and analyzed by Dr. Mitch O'Toole (University of Newcastle, Australia) and Dr. María Schefter (U. Guam)

Dr. O'Toole and Dr. Schefter used a test devised by O'Toole for which there exists a large database for students of various linguo-cultural backgrounds and school levels. The test utilized a Cloze procedure designed by Dr. O'Toole in which students read a passage from a scientific textbook and replaced deleted words. Students were evaluated on the terms they supplied and whether the terms were exact (i.e., the "strict" regime) or conceptually adequate (i.e., the "conceptual" regime). The deleted items were classified in both traditional and modern grammar categories. Student volunteers included Biology majors, and students taking G.E. Biology and service courses in Biology. For UOG students N = 290; the larger data set of students from elsewhere was N = 673. O'Toole & Schefter analyzed findings for Guam students in various ethnic groups in general (O'Toole & Schefter 2008) and in various biology classes (O'Toole & Schefter unpublished). All students had significant difficulties with text. For example, Table 1 (O'Toole & Schefter unpublished) shows that students who spoke Micronesian or Filipino language at home had more difficulty than English speakers, but even for the latter nouns and cohesive devices caused significant problems. The text passage below the table illustrates the impact of such difficulties on the comprehensibility of the passage from Solomon, Berg and Martin (2005, p. 104) (the current introductory biology textbook) by replacing language features indicated by Table 1 with words from a Gaelic folksong. The impact of the difficulties increases as they accumulate. This passage has a lower Flesch-Kincaid reading level (11.2) than the base text (12.2) on which the cloze test used in this investigation was based. This randomly chosen passage is also noteworthy in that its purpose is clearly language-related: the passage explains the meaning of a number of technical terms.

Table 1. Difficulty levels with features of Scientific English for undergraduate science classes at the University of Guam.

| BI Class | Language Group | No. | Noun %* wrong | At'cle % wrong | Verb % wrong | Prp'n % wrong | Tchlty % wrong | Word Stacks % wrong | Pas've Voice % wrong | Cohsv Device % wrong | Overall D'fclty % wrong |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **100** | **English** | 23 | 34 | 17 | 22 | 25 | 20 | 9 | 21 | 35 | 28 |
| | **Micronesian** | 20 | 37 | 33 | 30 | 46 | 22 | 22 | 33 | 43 | 36 |
| | **Filipino** | 25 | 43 | 26 | 31 | 38 | 29 | 19 | 32 | 41 | 38 |
| | ***Total*** | *68* | *38* | *25* | *28* | *36* | *24* | *16* | *28* | *39* | *34* |
| **124** | **English** | 39 | 35 | 25 | 25 | 32 | 23 | 15 | 26 | 38 | 32 |
| | **Micronesian** | 125 | 56 | 65 | 55 | 52 | 46 | 35 | 64 | 63 | 58 |
| | **Filipino** | 2 | 37 | 25 | 28 | 34 | 25 | 12 | 31 | 40 | 34 |
| | ***Total*** | *108* | *39* | *29* | *30* | *35* | *26* | *16* | *32* | *42* | *36* |
| **157** | **English** | 20 | 28 | 20 | 20 | 30 | 18 | 12 | 17 | 31 | 24 |
| | **Micronesian** | 5 | 32 | 28 | 38 | 24 | 18 | 13 | 27 | 37 | 32 |
| | **Filipino** | 12 | 29 | 20 | 22 | 28 | 16 | 8 | 17 | 32 | 26 |
| | ***Total*** | *38* | *29* | *21* | *24* | *28* | *17* | *11* | *20* | *33* | *26* |
| **225** | **English** | 13 | 42 | 31 | 34 | 32 | 32 | 12 | 41 | 42 | 38 |
| | **Micronesian** | | | | | | | | | | |
| | **Filipino** | 21 | 36 | 40 | 26 | 39 | 26 | 13 | 30 | 46 | 36 |
| | ***Total*** | *38* | *39* | *35* | *29* | *36* | *28* | *13* | *34* | *43* | *36* |
| **315** | **English** | 5 | 20 | 12 | 8 | 8 | 8 | 3 | 0 | 19 | 12 |
| | **Micronesian** | 1 | 33 | 20 | 17 | 20 | 30 | 3 | 0 | 40 | 28 |
| | **Filipino** | 4 | 46 | 5 | 8 | 15 | 8 | 0 | 0 | 13 | 10 |
| | ***Total*** | *10* | *20* | *10* | *9* | *12* | *10* | *5* | *0* | *19* | *12* |
| **410** | **English** | 6 | 20 | 27 | 11 | 23 | 7 | 14 | 11 | 23 | 18 |
| | **Micronesian** | 4 | 18 | 45 | 23 | 10 | 7.5 | 8 | 17 | 40 | 22 |
| | **Filipino** | 4 | 26 | 25 | 15 | 20 | 10 | 13 | 17 | 32 | 22 |
| | ***Total*** | *14* | *21* | *31* | *15* | *19* | *8* | *12* | *14* | *30* | *20* |
| **416** | **English** | 5 | 26 | 16 | 15 | 24 | 14 | 7 | 20 | 23 | 20 |
| | **Micronesian** | | | | | | | | | | |
| | **Filipino** | 4 | 35 | 20 | 25 | 35 | 23 | 12.5 | 25 | 31.7 | 32 |
| | ***Total*** | *9* | *30* | *18* | *19* | *29* | *18* | *9* | *22* | *27* | *24* |

**NOTES:**

- Student data was recoded so that a clear error = 1 and acceptable replacement or defeat was = 0.
- Cloze test deletions were classified by language category.
- Two SPSS routines were written ('dictionary categories' + 'modern grammar categories'). These did the following:
  1. count number of items representing a particular language category (eg. nouns) a pupil got wrong
  2. divide that number by the number of items representing that category (eg. nouns) deleted (in this case, 18) to give the individual pupil category (in this case, noun) difficulty
  3. add individual category difficulties and divide by number of pupils completing the sub-test to give the mean pupil difficulty with that category
  4. multiply that mean by 100 to yield a percentage.

@ **Comparative Sample Difficulty**: Difference between the difficulty a particular group (e.g., pupils specifying Filipino as the language spoken in their homes) experienced with a specific feature of the language of science (e.g., nouns: 36%) compared to the mean level of difficulty with this feature experienced by undergraduate Guam sample as a whole (e.g., 35%, yielding a comparative difference of +1 for Filipino difficulties with nouns).

**Original passage: "Two solutions may be isotonic or one may be hypertonic and the other hypotonic**

If the surrounding fluid has a concentration of dissolved substances greater than the concentration within the cell, it has a higher osmotic pressure than the cell and is said to be **hypertonic** to the cell. Because a hypertonic solution has a lower effective water concentration, a cell placed in such a solution shrinks as it loses water by osmosis. Human red blood cells placed in a solution of 1.3% sodium chloride shrivel and die (Fig. 5-12b). If the surrounding fluid contains a lower concentration of dissolved minerals than does the cell, it has a lower osmotic pressure and is said to be **hypotonic** to the cell; water then enters the cell and causes it to swell. Red blood cells placed in a solution of 0.6% sodium chloride gain water, swell (Fig. 5-12c), and may eventually burst. Many cells that live in hypotonic environments have adaptations to prevent excessive water accumulation. For example, certain protists such as *Paramecium* have contractile vacuoles that expel excess water (see Fig. 24-7)." (Solomon, Berg, & Martin, 2005, p. 104)

**Substituted passage: Two 'bhaile may be isotonic or one may be hypertonic and the other hypotonic**

If the surrounding fluid has an anois of 'bhailo substances greater than the anois within the cell, it has a higher tsamhraidh pressure than the cell and is said to be **hypertonic** to the cell. Because a hypertonic 'bhaile has a lower effective water anois, a cell placed in such a 'bhaile shrinks as it loses water by tsamhraidh. Human red blood cells placed in a 'bhaile of 1.3% sodium chloride shrivel and die (Fig. 5-12b). If the surrounding fluid contains a lower anois of 'bhailo minerals than does the cell, it has a lower tsamhraidh pressure and is said to be **hypotonic** to the cell; water then enters the cell and causes it to swell. Red blood cells placed in a 'bhaile of 0.6% sodium chloride gain water, swell (Fig. 5-12c), and may eventually burst. Many cells that live in hypotonic environments have adaptations to seilbh excessive water accumulation. For example, certain protists such as *Mhaol* have contractile vacuoles that theacht excess water (see Fig. 24-7).

**Closing the Loop:** Particular instruction in these language elements have been incorporated into Science Communication courses to improve skills in this area. No outcomes results are available yet.

References

O'Toole, J.M. & Schefter, M. (2008). Patterns of student difficulty with science text in undergraduate biology courses. *The International Journal of Learning* 15(1): 133-148.

Solomon, E., L. Berg, & D. Martin. (2005). *Biology*, 7th ed. Belmont, CA: Brooks/Cole-Thomson Learning.