## Annual Assessment Update

**Program/department name: Biology** **Academic year: 2011-2012**

This form is to be used by programs with previously completed assessment plans. Please address the following areas. You may answer on this form by expanding the space between the steps or on an attachment.

Note: You should fill in steps 1-4 ONLY if you have made changes to your assessment plan. You must fill in steps 5 and 6.

**Step 1: Mission**

Were any changes in your mission adopted during the past year?

**X No** Yes (Please describe the process used to approve these changes below or on an attachment and attach a copy of the new mission.)

**Step 2: Learning outcomes**

Were any changes in your learning outcomes adopted during the past year?

**X No** Yes (Please describe the process used to approve these changes below or on an attachment and attach a copy of the new learning outcomes.)

**Step 3: Program components**

Did you change the program components in which you carry out assessment in any way?

**X No** Yes (Please describe below or on an attachment.)

We did get approval from C&RC to change our introductory sequence of courses beginning in 2012-2013.

**Step 4: Data collection methods**

Did you change your data collection methods in any way?

No **X Yes** (Please describe below or on an attachment.)

In addition to having our senior majors and minors take the ETS Major Field Test in Biology, this year we administered the test to 21 first-year students who plan to be biology majors. These students took the exam in their first week of BIOL 195 in Fall 2011. We are able to compare the results of our seniors with first-year students. We anticipate that some of these same first-year students will end up as Biology majors or minors and retake the same version of the test as seniors. We then will have a comparison for some individual students over their time at Albion. (Because the version of the ETS MFT in Biology changes every five years, we do not have the opportunity to have comparison data for individual students between their first year and senior year for most classes.)

Our assessment liaison has suggested we give a set of questions that remain the same to our seniors each year. We will implement that suggestion in Spring 2013.

**Step 5: Summary and analysis of data collected during the past year**
Please describe and interpret the indirect and direct data you collected during this academic year.

I. We continued to collect information on our recent graduates. New info for May 2012:

1. **For our 55 majors who graduated in 2011** (either May or Dec), 38 (69%) responded to a recent Facebook and e-mail survey. The status of some other 2011 majors was determined by direct personal contact (1) and, less reliably, from a survey filled out in April 2010 (1).

Of these 40,

11 (27%) are in graduate school or will be entering graduate school this fall, including two in law school
10 (25%) are in medical school or will be entering medical school this fall
1 (3%) is in dental school
5 (13%) are in some type of other professional medically-related school, which includes nursing, physician assistant and physical therapy
9 (23%) are employed in some biology-related job
2 (5%) are employed in some non-biology-related job saving money for grad school
2 (5%) are unemployed.

Those employed in biology-related jobs include a high school science teacher, workers in research labs at major universities, and scientists in industry.

**2. Preliminary info for 56 majors who graduated/will graduate in 2012 (based on survey given during the last week of classes through finals)**:

6 (11%) will be entering various graduate programs, including those that will lead to degrees in marine biology, fisheries, and biomolecular sciences
5 (9%) will be entering medical school (MD or DO programs)
1 (2%) will be entering dental school
6 (11%) will be entering nursing, physical therapy, physician assistant, or veterinary medicine programs

7 (13%) will be employed in fields directly related to biology, including teaching or working in research labs, clinical labs, or in quality control where lab analysis skills are important
6 (11%) will be working in non-biology-related fields and/or taking courses in preparation for applying to professional schools
18 (32%) are unemployed; of this group, 13 are waiting to hear from graduate or professional schools or from employment or internship opportunities
15 (27%) from the group of students who will be employed or unemployed above plan to apply to graduate or professional school for Fall 2013 (take one year off)
4 (7%) will graduate in December 2012

II. We continued to give the ETS Major Field Test (MFT) in Biology to all majors and minors in their last Spring semester at Albion (if a student plans to graduate a semester early, he or she must take the exam the previous spring). In addition, in Fall 2011, we gave the MFT in Biology to 21 first-year students in their first week of BIOL 195. We present data for our majors from 2011 and 2012 and a subset of first-year students planning to major in biology (Table 1).

Table 1. ETS Major Field Test (Biology 4GMF) Scores for Albion Senior Biology Majors, 2011 and 2012, and a subset of first-year students planning to major in biology. Total scores and subscores are reported as scaled scores; scores for assessment indicators are reported as mean percent correct and are combined for senior majors and minors as all tests for seniors were graded together. **Percent below score** represents the percentage of students (or institutions) scoring below that score or subscore.

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| | Senior Biology majors | | First-year students |
|---|---|---|---|
| | S2011 | S2012 | F2011 |
| **Number of Albion students tested** | 57 | 54 | 21 |
| **Mean Score** (range 120-200) for Albion students | 152.6 | 152.9 | 137.4 |
| Mean Score all senior examinees in 2011 (n=7,681) | 153.2 | 153.2 | 153.2 |
| Mean Score for all institutions in 2011 (n=281) | 152.6 | 152.6 | 152.6 |
| Percent below score for Albion individual mean score | 46 | 47 | 11 |
| Percent below score for Albion institutional score | 43 | 44 | 4 |
| | | | |
| **Subscores** (range 20-100) for Albion students/**percent below score** | | | |
| Cell Biology | 51.7/**40** | 53.8/**50** | 37.9/**3** |
| Molecular Biology & Genetics | 52.6/**47** | 53.5/**52** | 38.3/**2** |
| Organismal Biology | 51.9/**40** | 50.5/**30** | 41.9/**9** |
| Pop. Biology/Ecology/Evolution | 53.5/**47** | 53.4/**47** | 40.6/**7** |
| | | | |
| **Assessment Indicators** shown as mean percent correct/**percent below score** | | | |
| 1 Biochemistry & Cell Energetics | 49/**57** | 50/**61** | 34/**6** |
| 2 Cell Structure, Organization, and Function | 52/**50** | 53/**54** | 29/**2** |
| 3 Molecular Biology & Molecular Genetics | 51/**61** | 49/**52** | 30/**2** |
| 4 Diversity of Organisms | 42/**38** | 42/**38** | 31/**8** |
| 5 Organismal – Animal Structure and Function | 41/**40** | 40/**35** | 32/**11** |
| 6 Organismal – Plant Structure and Function | 31/**35** | 32/**40** | 25/**10** |
| 7 Population Genetics & Evolution | 52/**45** | 53/**50** | 29/**2** |
| 8 Ecology: Population, Community, Ecosystem | 51/**38** | 50/**34** | 39/**8** |
| 9 Analytical Skills | 48/**47** | 48/**47** | **32/6** |
| | | | |
| # with scores > 175 (cutoff for 95 percent below score) | 1 | 1 | 0 |
| # with scores 171-175 (90-94%) | 6 | 2 | 0 |
| # with scores 166-170 (80-89%) | 1 | 4 | 0 |
| #with scores 161-165 (70-79%) | 7 | 5 | 1 |
| % of majors with scores of at least 161 | 26 | 22 | 5 |
| | | | |
| # with scores < 150 (cutoff for lowest 35%) | 24 | 23 | 15 |
| % with scores in lowest 35% | 42 | 43 | 71 |

The ETS MFT in Biology was changed in Fall 2010 (the exam version changes every 5 years; the most recent version is 4GMF), so we can compare the scores of our majors between 2011 and 2012 but we cannot compare their scores with classes that took earlier versions of the exam. Overall, the average score for our 2012 senior majors was about the same as in 2011 and around the national mean. The 2012 cohort scored higher than the 2011 group in two subscore areas (Cell Biology, Molecular Biology and Genetics) but lower in another subscore area (Organismal Biology).

In comparison to our seniors, a subset of 21 first-year students who intended to major in Biology scored considerably lower overall, on all Subscore areas, and on all Assessment Indicators. The first-year students scored very low in subscore areas of Cell Biology and Molecular Biology and Genetics. We anticipate that some of these first-year students will end up as Biology majors or minors and will retake the same version of the ETS MFT as seniors in Spring 2015. We will be able to compare scores of those individuals between their first and senior years at that time.

Although we have been intentionally working on having students do more interpretation of figures and tables in our classes, the Assessment Indicator for item 9, Analytical Skills, stayed the same for our seniors in 2011 and 2012 (assessment indicators are for our majors and minors combined). Our first-year students scored considerably lower than our seniors on this item.

Our minors, most of whom are Cell & Molecular Biology minors, performed better as a group than did our majors on overall average score and on three subscore areas in 2012 (Table 2). [The highest scores overall and in each subscore were made by majors.] The dramatic rise in the subscore in organismal biology in 2012 as compared with 2011 was due to two very high individual scores by minors.

Table 2. ETS Major Field Test (Biology 4GMF) Scores for Albion Senior Minors in Biology, 2011 and 2012. Total scores and subscores are reported as scaled scores; scores for assessment indicators are reported as mean percent correct and are combined for majors and minors as all tests for seniors were graded together. **Percent below score** represents the percentage of students (or institutions) scoring below that score or subscore.

| | 2011 | 2012 |
|---|---|---|
| **Number of Albion students tested (minors)** | 24 | 20 |
| **Mean Score** (range 120-200) for Albion BIOL Minors | 154.9 | 155.0 |
| Mean Score all senior examinees in 2011 (n=7,681) | 153.2 | 153.2 |
| Mean Score for all institutions in 2011 (n=281) | 152.6 | 152.6 |
| Percent below score for Albion BIOL Minors mean score | 52 | 52 |
| Percent below score for Albion BIOL Majors institutional score | 55 | 55 |
| | | |
| **Subscores** (range 20-100) for Albion BIOL Minors/**percent below score** | | |
| Cell Biology | 60.0/**82** | 58.3/**76** |
| Molecular Biology & Genetics | 59.5/**84** | 54.2/**54** |
| Organismal Biology | 51.5/**37** | 56.6/**63** |
| Pop. Biology/Ecology/Evolution | 48.3/**24** | 50.0/**30** |
| | | |
| # minors with scores > 175 (cutoff for 95 percent below) | 0 | 1 |
| # with scores 171-175 (90-94%) | 1 | 0 |
| # with scores 166-170 (80-89%) | 2 | 1 |
| #with scores 161-165 (70-79%) | 5 | 3 |
| % of minors with scores of at least 70% | 33 | 25 |
| | | |
| # minors with scores < 150 (cutoff for lowest 35%) | 5 | 5 |
| % of minors with scores in lowest 35% | 21 | 25 |

III. As described in our assessment document from Fall 2009, we have decided to focus on **Assessment Indicator 9, Analytical Skills,** from the ETS Major Field Test. This particular assessment indicator ties in with several of our learning goals for students, including:

Content Goal 3. Our students will acquire scientific investigation skills in laboratory and field courses necessary to apply the methods that biologists use to answer biological questions.
Process Goal 1. Our students will develop enhanced critical thinking skills.

To ensure a focus on analytical skills, all faculty members in the department were asked to work on interpretation of figures (graphs) or tables with students in at least one class and to include interpretation of a figure or table on an exam.

The results for each class are listed below. In future years, we plan to continue these types of exercises on figures and tables, including pre- and post-course examples.

Ecology, Evolution, and Biodiversity (BIOL 195) – Dan Skean
On the EEB final examination, students were asked to interpret the pattern of data in a figure that they had not seen previously that dealt with net assimilation of $CO_2$ by liverworts grown with and without arbuscular mychorrizae at two different levels of $CO_2$ (ambient and elevated). Of 34 students, 18 (53%) interpreted the figure correctly and comprehensively. Most other students (14, 41%) identified the major issue/topic that the figure dealt with, but they did not explain the pattern indicated by the data in the figure comprehensively. Two students (6%) failed to identify even the main topic of the figure.

Ecology, Evolution, and Biodiversity (BIOL 195) – Sheila Lyons-Sobaski
Students were given a figure from a paper from the primary literature that dealt with the assimilation of $CO_2$ in liverworts in the presence and absence of mycorrhizae (same example as in Skean's section). The plants were grown at two different $CO_2$ concentrations. Students needed to interpret the graph. Of 29 students, 8 (28%) students interpreted the graphs correctly (7 students) or were very close to interpreting them correctly (1). Most other students (16, 55%) understood the main idea but did not discuss all variables (they forgot to talk about either the effect of the mycorrizae or the different $CO_2$ levels.) Five students (17%) did not satisfactorily interpret the data, including one student who left the answer blank.

Cell and Molecular Biology (BIOL 210) – Ken Saville
Students were given a figure of a northern blot from a primary literature paper. The figure clearly showed the differential expression of two genes in different tissues, and there was one control gene that showed relatively equal expression in all tissues. The question regarding this figure was open-ended asking the students to describe the major conclusion of the figure. Answers were scored based on the conclusion that the genes were expressed at different levels in the different tissues. Answers were scored as wrong if students stated that the genes were present in some tissues but not others. The questions were scored with a 0, 1, or 2, with 0 having no mention of expression, 1 having some description that could be interpreted as expression, and 2 if expression or RNA levels in the different tissues were explicitly mentioned. Of 33 students, 15 (45%) scored 2, 5 (15%) scored 1, and 13 (39%) scored 0.

Invertebrate Zoology (BIOL 225) – Dean McCurdy
As part of a take-home assignment on my final exam in Biology 225 (Invertebrate Zoology), students were required to complete a short research proposal. The assignment required that they formulate a clear hypothesis with a prediction(s) using appropriate background literature (i.e., peer reviewed publications in scientific journals). Students were also required to include a proposed methods section that provided sufficient detail to repeat the project and mentioned an appropriate statistical treatment of data.

Using a very basic rubric, some key elements of the proposal as follows (numbers after each score indicate the number of students in each category):
(1) Development of background: appropriate citations to the literature were used and the format was correct:

Failure to incorporate literature at all (1)
Insufficient use of literature or citations entirely absent or incorrect types of literature used (yet still some evidence that sources of literature were used) (2)
Numerous minor errors with citation use (mission citation or incorrect format) or ocassional use of inappropriate sources such as unreviewed websites (7)
Correct use of citations and sources of literature throughout (6)

(2) Hypothesis / prediction(s)
Vague, unfocused hypothesis or no connection between background and hypothesis/prediction(s) (2)
Hypothesis and predictions clear, but not directly connected to the background material presented (4)
Clear prediction(s) based on the background material presented (10)

(3) Proposed methods
Many major problems: Methods not connected to proposed hypothesis/predictions / statistical treatment entirely absent / (2)
Some major problems or many minor problems: Methods were not explained clearly / proposed statistical treatment was inadequate / design was flawed and not a direct test of the prediction (s) (4)
Competent: All objectives met (this does not mean the student excelled in every area - only that she/he was able to give a logical and thoughtful explanation of methods that addressed all of the criteria). (10)

These results suggest that most students had a good understanding of how to formulate clear questions and that most can develop creative and valid tests of basic scientific questions. This is not surprising given that we focus on these areas extensively in our core curriculum. However, many students continue to have trouble assessing appropriate sources of literature and properly incorporating them into their work (although we also address this area in our curriculum). In Biology 225, we spend an entire lab early in the course working with scientific literature, but I suspect that many students are not yet grasping the need to continue with this practice beyond the initial classroom assignment. Before I teach Biology 225 this coming Fall, I plan to evaluate how I teach literature searches in this course. I am planning to modify the literature search assignment and may include more search components in other parts of the course.

Vertebrate Zoology (BIOL 227) – Dale Kennedy
Students were asked to interpret the pattern of data in a figure that they had been sent ahead of time (they had not discussed that particular figure) on relationship of genetic relatedness and helping at nests. Of 16 students, 14 (88%) interpreted the figure correctly. Most other students (2, 12%) identified the major issue/topic that the figure dealt with, but they did not explain the pattern indicated by the data in the figure.

Conservation Biology (BIOL 240) – Sheila Lyons-Sobaski
Students were given a figure from a paper from the primary literature that they read. The figure consisted of four graphs and students were asked to interpret the figure. Of 24 students, 16 (67%) students interpreted the graphs correctly (11 students) or were very close to interpreting them correctly (5), and the other eight students (33%) understood the main idea but made a misinterpretation when integrating all the figures.

Evolution (BIOL 310) – Dean McCurdy
Students were asked to construct a figure on the last in-class exam. Specifically, they were asked to include at least one figure/graph to explain competing hypotheses about recent human evolution. They were also asked to explain their figure(s) and the hypotheses that connected to them. Finally, they were asked how researchers might test these competing hypotheses (a 'higher order' question that required them to go beyond the material we discussed in class).
Thus, I had three objectives: Construction of a graph (properly labeled axes, logical construction, inclusion of material discussed in class); Basic explanation/interpretation of a graph; and Synthesis of new ideas.
Of the 18 students in the class the following results were obtained:
First objective met (basic explanation of the graph) = 16/18
Second objective met (interpretation of graph using the paper) = 15/18
Third objective met (synthesis of new ideas based on the results shown in the graph) = 13/18

Students who failed to complete more basic objectives also tended to fail to complete more advanced objectives. Thus, although 5 students did not meet the third objective, three of these students also failed to grasp the question and explain their graph (Objective 2), so it is not surprising that they were unable to address the third objective. Put another way, 13/15 students who understood the question, constructed an appropriate graph, and could recall the discussion from class (and/or the textbook) were able to successfully describe an appropriate approach to testing among several competing hypotheses to explain recent hominid evolution. It is also worth noting that 2/3 students who failed to meet the second objective were absent on the day we discussed hominid evolution in class! While I have not asked this question before, I was pleased that so many students were able to demonstrate "synthesis." The fact that most of these students in this class were seniors who had taken numerous biology courses, and the fact that we had discussed hominid evolution only days prior to the exam might also help explain their success with this question.

Medical Microanatomy (BIOL 321) – Ruth Schmitter
Students were told that a graph with two curves represented rates of solute movement with respect to solute concentration. They were asked to label the axes and indicate why the two curves differed. Of 14 students, 11 (78.5%) labeled the axes correctly. The same number of students (but not the same students) gave reasoned answers about why the curves differed. Only one student (7%) gave the definitive answer—facilitated diffusion vs. simple diffusion.

Developmental Biology (BIOL 324) – Roger Albertson
Students were asked to interpret the pattern of data in a figure that they had been sent prior to the exam. The figure data described the role of a morphogen during Xenopus embryonic development. During the exam students were asked to: 1) state the main conclusion supported by the data, 2) state a new hypothesis based on the figure data, 3) propose an experiment to test the hypothesis, and 4) describe a result that would support the hypothesis and a result that would argue against the hypothesis. Of 15 students, seven (47%) showed a complete understanding of the figure and answered all questions correctly. Four students (27%) identified the major conclusion, yet had minor errors in developing and testing a new hypothesis. Three students (20%) had a partial understanding of the figure with major errors for more than one question. One student (7%) lacked an understanding of the figure.

Microbiology (BIOL 332) – Ola Olapade
I used a figure that shows the antibody concentrations in blood titers of an infected individual collected over a period of 50 days during an illness and wanted the students to apply their knowledge of epidemiology to explain what was likely to have happened or the state of health of the individual during the time of the infection. Out of 33 students, 32 (97%) interpreted the figure correctly between days 0, 25 and 50; 28 (85%) were accurate in deducing whether the host's antibodies were in response to a common-source antigen/epidemic, a host-to-host antigen/epidemic, or to both types and also justified their answers with relevant examples as requested.

General Physiology (BIOL 341) - Brad Rabquer
Students were presented with a figure of an oxygen equilibrium plot with two lines. They were asked to describe what was happening in each line as the partial pressure of oxygen increased, which line had the lower pH, and whether line #2 was representative of a hyperventilative or hypoventilative state.
In Fall 2011, 29 of 31students (94%) got the question 100% correct, while the other 2 got partial credit for misinterpreting hypo versus hyperventilation.
In Spring 2012, 15 of 17 students (88%) got the question 100% correct, while the other 2 got partial credit.

Selected topics: Immunology (BIOL 389) - Brad Rabquer
In Spring 2012, 18/23 got the question 100% correct, while the other 5 got partial credit for misinterpreting the vaccinated vs. control group.

**Step 6: Use of the data**
Please describe how you used assessment data in this academic year, including any changes you have made or plan to make to your program as a result of assessment.

In Fall 2009, members of the Biology Department began discussing a return to a three-course introductory sequence, in part related to better meeting our student learning goals. We consider an understanding of genetics to be critical to all areas of biology, and we wanted to require all students in our majors and two of our minors to have a course in genetics as part of their curriculum. By adding a course in Genetics to our introductory sequence, we would be to modify Cell and Molecular Biology (BIOL 210) by taking out some genetics and putting in some material on specialized cells, notably muscle and nerve cells, and other topics, including plant hormones.

In Fall 2011, members of the department, with Roger Albertson taking the lead, drafted a document that outlined the proposed changes in our introductory course sequence. This information was shared with faculty members in Chemistry and Education, as well as with Marikay Dobbins in IPPHS. In Spring 2012, we submitted a final proposal to the C&RC for modifying our introductory course sequence for our majors (Biology; Major in Biology with Secondary Education Certification) and two of our minors (Cell and Molecular Biology; Minor in Biology with Secondary Education Certification). Our proposal was passed by the C&RC and our curricular changes were recorded in The Deanery.

Beginning in Fall 2012, students entering Albion interested in Biology will take a three-course introductory sequence: Ecology, Evolution, and Biodiversity (BIOL 195), Cell and Molecular Biology (BIOL 210), and Genetics (BIOL 300). The required course in Genetics will not have a laboratory, but students may take a new 0.5-unit, stand-alone laboratory course, Advanced Laboratory in Genetics (BIOL 312).

We anticipate that these changes to our introductory course sequence will help increase scores in several areas of the ETS MFT (and on other standardized tests such as MCAT and MTTC). With the addition of a required course in Genetics, we hope to see an increase in the Biology MFT subscore in Molecular Biology & Genetics as well as in the Assessment Indicator 3 (Molecular Biology and Molecular Genetics). We also anticipate that addition of material in BIOL 210 on specialized cells, plant hormones, and other items should improve our students' subscore in Organismal Biology as well as scores on Assessment Indicators 4, 5, and 6.